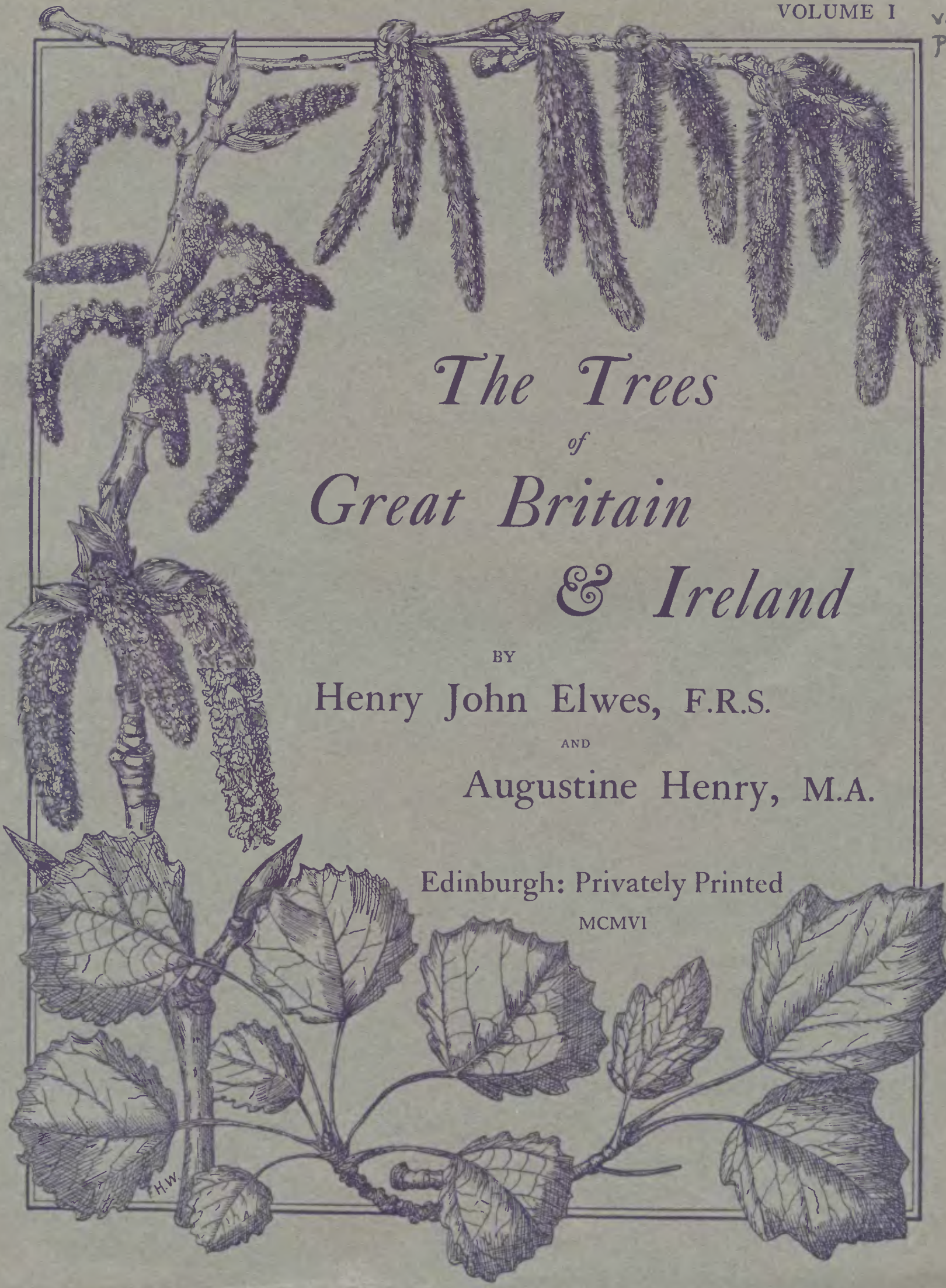


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VOLUME I



The Trees
of
Great Britain
& Ireland

BY
Henry John Elwes, F.R.S.
AND
Augustine Henry, M.A.

Edinburgh: Privately Printed
MCMVI

THE TREES OF GREAT BRITAIN AND IRELAND





QUEEN BEECH AT ASHRIDGE

From a Drawing lent by the Earl Brownlow.

A detailed botanical illustration of tree branches. The top half shows several catkins, some with bright red flowers and others with green, fuzzy catkins. The bottom half shows a branch with large, green, serrated leaves and a small, reddish-brown bud. The entire illustration is enclosed in a thin black rectangular border.

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F.H.W.

DEDICATED
BY SPECIAL PERMISSION
TO
His Majesty King Edward VII
BY
HIS OBEDIENT HUMBLE SERVANTS
THE AUTHORS



PREFACE

THE United Kingdom offers a hospitality to exotic vegetation which finds no parallel in the Northern Temperate region of the globe. Never parched by the heat of a continental summer, the rigour of winter is no less tempered by its insular position. The possession of land still ensures the residence on their properties of a large number of persons of at least moderate affluence. The most modest country house possesses a garden, and not rarely some sort of pleasure ground; and this usually reaches the dimensions of a park in the case of the larger mansions. While forests for the commercial production of timber such as are found in foreign countries hardly exist, and the methods of their scientific management are little recognised, arboriculture of some sort may be almost said to be a national passion. In all but purely agricultural districts the free and unrestrained growth of trees enhances, if it does not create, the natural beauty of the landscape. The Roman occupation brought to our shores our fruit-trees and others whose names of Latin derivation bear witness to their foreign origin. One of these, the so-called "English Elm," dominates the landscape of Southern England. Yet, while it perfects its seed on the Continent, it rarely does so in this country, and it holds its own by root suckers, the tenacity of which is all but ineradicable.

Down to the reign of Henry the Eighth the native forests supplied the timber necessary for construction. It was not till their area became restricted that planting was commenced to maintain the supply. And if this has never developed into a scientific system as it has done abroad, the reason may be found in the abandonment of wood as fuel for coal, and the facilities for external supply of over-sea water-carriage which attach to a maritime country.

From an early time with the growth of continental intercourse, the contents of foreign gardens had gradually been transferred to those of the wealthy at home. The taste, however, for cultivating foreign trees and shrubs simply for their interest, and apart from any useful purpose they might serve, is not more recent than the seventeenth century. The pioneer in this branch of English arboriculture was Henry Compton, Bishop of London, who planted in the garden of Fulham Palace "a greater variety of curious exotic plants and trees than had at that time been collected in any garden in England." Hitherto the European continent had

been the only hunting ground. To this was now added in striking contrast the resources of the North American forests.

In the eighteenth century the practice of planting foreign trees became in some degree a fashion amongst wealthy landowners, though still mainly for ornament. This was due in large measure to the example of Archibald, third Duke of Argyll, who formed a large collection at Whitton. After his death in 1762 all that were removable were transferred to Kew, where an Arboretum had been commenced by the Princess Dowager of Wales.

An intelligent taste for arboriculture was at any rate for a time firmly established. Those who care to trace its further history more in detail will find abundant information in Loudon's *Arboretum et Fruticetum Britannicum*, a work which, though published more than half a century ago, must always remain indispensable to any student of the subject. Parks and pleasure grounds throughout the country were stocked with specimens of new and interesting trees. And though often neglected and even forgotten, we now possess a wealth of examples which have attained adult development. Loudon catalogued with indefatigable industry every tree or shrub known to be tolerant of the climate of the British Isles. It might have been thought that this laborious undertaking would have excited a new interest in planting. But it began to languish with the beginning of the last century, and Loudon's labours from their very completeness, perhaps, deterred many from engaging in an occupation where more than moderate success would seem costly and laborious, and anything beyond almost unattainable. In 1845 a National Arboretum was projected at Kew, and commenced the following year on a plan prepared by W. A. Nesfield.

The latter half of the last century saw a remarkable development of open-air horticulture. In so far as this included woody plants, it was limited to shrubs. Broad-leaved trees were little cared for. The rarer kinds were little in request, and those that were planted were too often drawn from the ill-named stock of some convenient nursery. The neglect was increased when conifers became a fashion. This led, no doubt, to many fine Pinetums being planted, the interest and importance of which will increase with age. But it led also to much unconsidered and scattered planting of trees which, attractive enough in a juvenile state, are often less sightly as they grow older, and can never blend with their broad-leaved neighbours into stately umbrageous masses.

If the planting of broad-leaved trees as distinguished from conifers has for the moment fallen into neglect, we still inherit the results of the labours of our predecessors. The British Isles for the last two centuries have, in fact, been the seat of an experiment in arboriculture without parallel elsewhere. And the very neglect into which tree-planting has fallen, paradoxical as it may seem, adds to the interest and value of the experiment. For the trees that have come down to us from the

past have been subjected to the least favourable conditions, and have had in effect to survive a somewhat rigorous process of natural selection.

In taking stock of the results, the task which my friend Mr. Elwes has set himself differs, if I understand his intention rightly, somewhat widely from that which Loudon accomplished. That amounted to little more than a descriptive catalogue of every woody plant the cultivation of which had been attempted in this country. The present work aims at ascertaining the practical results. What are the most favourable conditions for the growth of each species? What in turn are the most suited for different circumstances? And what, if any, profit can be derived from their cultivation on a large scale?

And to accomplish or even attempt such a task appears to me no small public service. The depreciation of the value of agricultural land has turned the thoughts of many landowners to the possibility of growing timber as a crop for profit. So far little attempt has been made to depart from tradition. Yet it cannot be doubted that there must be many trees suited to our climate whose commercial possibilities are still unascertained. Apart from the larger uses of timber its employment for minor industries is still little regarded among us. If but a single tree can be added to the list of those which can be profitably cultivated the labour spent on the quest will not be unrequited.

W. T. THISELTON-DYER.

KEW, November 1905.

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INTRODUCTION

THE object of this work is to give a complete account of all the trees which grow naturally or are cultivated in Great Britain, and which have attained, or seem likely to attain, a size which justifies their being looked on as timber trees; but does not include those which are naturally of shrubby or bushy habit.

Although sixty years have passed since Loudon's great work was published, no book has been written which describes in full the species which in his time were unknown, or so recently introduced that their cultural requirements and economic or ornamental value had not been tested.

Many deciduous trees, which were commonly planted before his time, have gone out of popular favour, and are almost forgotten; whilst the rage for conifers which sprang up about seventy years ago has led to the introduction of almost every species which can be grown in this country; and many of these have now reached an age at which their value can be accurately judged of.

Special books dealing with conifers have appeared which may satisfy the wants of a horticulturist, but none exists that at all meets the requirements of land-owners, foresters, and arboriculturists, and will enable them to distinguish the species with certainty, or guide them in selecting the species the best suited for economic culture in different parts of England.

Forestry is at last making headway as a science in this country, but too many of the books recently published on the subject have been based on continental experience, which is not directly applicable to the very different conditions of climate, soil, labour, and market existing here. In the cultural part of the work we base our conclusions on home experience and practice; and in this connection it may be stated that for almost every exotic species there are older specimens of individual trees and of plantations in these islands than on the Continent. After having seen the trees of every country in Europe, of nearly all the States of North America, of Canada, Japan, China, West Siberia, and Chile, we confidently assert that these islands contain a greater number of fine trees from the temperate regions of the world than any other country. Descriptions of the best examples of all of these and of interesting woods and plantations will be a prominent feature of the book.

We have the special qualification that we have seen with our own eyes and studied on the spot, both at home and abroad, most of the trees which will be included in the book.

Knowing how difficult it is for the general public to understand the descriptions of nearly allied species, usually made by compilers who are unacquainted with the crucial points of distinction, we hope to supply this information in concise, clear, and simple language. What we understand by scientific knowledge is accuracy, expressed in plain words; and in order to ensure this we have copied nothing from other authors that we could verify for ourselves.

In order to give a history of the finest trees in this country, we have visited during the past five years nearly every important place in England, Scotland, Wales, and Ireland where large and rare trees are found; and have received from land-owners, estate agents, foresters, and gardeners an amount of information and assistance which justifies us in believing that our work will be generally appreciated. Though the historic trees of some places in England and of more in Scotland have been described in scattered publications, those of Ireland have been almost totally neglected; and Dr. Henry has paid special attention to the many interesting properties in that country.

A prominent feature of the work will be the illustrations. Modern photography enables the authors to give accurate pictures of the trees as they grow. Almost all the photographs of trees and of forest scenes have been taken by skilful photographers specially engaged for the purpose. In dealing with about 300 species of trees, many of which will require several illustrations to show the best specimens both as park and forest trees, the authors have accumulated a large number of photographs, which are being reproduced by the Autotype Company of London, who guarantee their permanency.

With regard to these illustrations we desire to say, that though in some cases they may not be perfect from the point of view of the photographic artist, yet the amount of time, skill, and money that has been spent on them is very far beyond what would be imagined by any one who has not had experience of the difficulty of securing good negatives of trees scattered over so large an area, under all conditions of light and weather, and in situations often extremely difficult to the photographer.

In some cases two or three special journeys have been made to obtain a photograph of one tree only, as the object has been to show the finest individual trees known to the authors rather than to make pretty pictures of scenery.

Besides these reproductions of photographs there will be lithographed drawings of seedlings, buds, leaves, flowers, and fruit, so far as is necessary to distinguish the trees in winter and in summer. These original drawings have all been done under the personal supervision of Dr. Henry, who has carefully studied the material, living and dead, that exists in the unrivalled establishment at Kew.

All measurements have been taken by the authors themselves with Stanley's Apomecometer, or by practical foresters on whose accuracy they could rely, and though in many cases errors to the extent of a few feet may have been made, owing to the shape or position of the tree measured, we believe them to be as accurate as possible under the conditions.

FAGUS

THE NORTHERN BEECHES

Fagus, Linnæus, *Syst. ed. 1. V. Monœcia* (1735); Bentham et Hooker, *Gen. Plant.* iii. 410 (1880).

THE genus, as understood by Bentham and Hooker, included all the beeches, those of the southern as well as of the northern hemisphere. Blume¹ separated the southern beeches as a distinct genus, *Nothofagus*; and his arrangement, on account of its convenience, will be followed by us. *Fagus* belongs to the family *Quercineæ*, which includes the oaks, chestnuts, castanopsis, and beeches. The genus, limited to include only the northern beeches, consists of large trees with smooth bark and spindle-shaped buds arranged alternately on the twigs in two rows. Leaves: deciduous, simple, pinnately-nerved, folded in the bud along the primary nerves. Flowers monœcious: the staminate flowers numerous in pendulous globose heads, the pistillate flowers in pairs in involucre. The male flower has a 4 to 8 lobed calyx with 8 to 16 stamens. The female flower has a 6 lobed calyx, adnate to a 3 celled ovary, with 2 ovules in each cell; styles 3, filiform. On ripening, the involucre is enlarged, woody, and covered with bristly deltoid or foliaceous processes; it dehisces by 4 valves, allowing the 2 fruits enclosed to escape. Each fruit is 3 angled and contains 1 seed, which has no albumen.

Seven distinct species of *Fagus* have been described, of which three, the European beech, the American beech, and the peculiar *Fagus japonica* are recognised by all botanists as good species. The Caucasian beech, the two Chinese beeches, and the common beech of Japan are considered by some authorities to be mere varieties of *Fagus sylvatica*; but these can all readily be distinguished, and in the following account will be treated as independent species.

KEY TO THE SPECIES OF FAGUS.

I. *Nuts projecting out of the top of the involucre.*1. *Fagus japonica*. Japan.

Involucre very small, covered externally with small deltoid processes, and borne on a very long slender stalk. Leaves with 10-14 pairs of nerves, which bend round before quite reaching the slightly undulating margin.

¹ Blume, in *Mus. Lugd. Bat.* i. 306.

2 The Trees of Great Britain and Ireland

II. Nuts enclosed in the involucre.

A. Involucres with linear, awl-shaped, bristly appendages. Species 2, 3, and 4.

2. *Fagus sylvatica*. Europe.

Fruit-stalks short and pubescent throughout.

Leaves: under surface glabrous except on the nerves and midrib; lateral nerves 5-9 pairs; margin not regularly serrate.

3. *Fagus ferruginea*. North America.

Fruit-stalks short and pubescent throughout.

Leaves: under surface glabrous except on the nerves and midrib; lateral nerves 10-12 pairs, ending in the teeth; margin serrate.

4. *Fagus sinensis*. Central China.

Fruit-stalks short, pubescent only close to the involucre.

Leaves: minutely pubescent over their whole under surface; lateral nerves 9-10 pairs ending in the teeth; margin serrate.

B. Involucres with their lower appendages dilated and foliaceous. Species 5, 6, 7.

5. *Fagus orientalis*. Caucasus, Asia Minor, N. Persia.

Fruit-stalks long (twice the length of the involucre or more) and very pubescent throughout.

Leaves: broadest above the middle; lateral nerves about 10 pairs, bending round before quite reaching the undulate margin; under surface glabrous except on the midrib and nerves.

6. *Fagus Sieboldi*. Japan.

Fruit-stalks short (as long as the involucres) and pubescent throughout.

Leaves: broadest below the middle; lateral nerves 7-10 pairs, bending round before quite reaching the margin, which is crenate; under surface glabrous beneath except on the nerves and midrib.

7. *Fagus Engleriana*. Central China.

Fruit-stalks very long (five times the length of the involucre) and quite glabrous.

Leaves glabrous and glaucescent underneath; lateral nerves 13 pairs, bending round before quite reaching the undulate margin.

FAGUS FERRUGINEA. American Beech.

Fagus ferruginea, Dryander, in *Ait. Hort. Kew.* iii. 362 (1789); Loudon, *Arb. et Frut.* iii. 1980 (1838); Mayr, *Wald. von Nordamerika*, 176 (1890).

Fagus sylvatica atropunicea, Marsh. *Arb. Am.* 46 (1785).

Fagus silvestris, Mich. fil. *Hist. Arb. Am.* ii. 170, t. 8 (1812).

Fagus atropunicea, Sudworth, *Bull. Torrey Bot. Club*, xx. 42 (1893).

Fagus americana, Sweet, *Hort. Brit.* 370 (1826); Sargent, *Silva of N. Am.* ix. 27 (1896).

The American beech ranges, according to Sudworth, from Nova Scotia to north shore of Lake Huron and Northern Wisconsin; south, to western Florida; and west, to south-eastern Missouri and Texas (Trinity River). Mayr¹ says it is at

¹ Mayr, *l.c.*

Fagus

its best in the northern deciduous forest, where it is a stately tree, *e.g.* at Lake Superior. The finest individual trees occur on the small hills of the Mississippi valley, but the timber is not so good as that of trees farther north. Pure woods of American beech rarely if ever occur.¹ Elwes saw the American beech principally near Boston and in Canada, and remarked one peculiarity which may not be found in all places. This was its tendency to throw up suckers from the roots, a feature which is very marked in Professor Sargent's park at Brookline, and in the beautiful grounds of the Arnold Arboretum. There is a group of beech here by the side of a drive, of which the largest was 65 feet by 7 feet 8 inches, surrounded by a dense thicket of suckers. Beech seedlings, however, seem to be much less common here than in Europe, and on moist ground are often suppressed by maple and other trees. The rate of growth of young trees in the Arboretum was about equal to that of the European beech at twenty years, and the bark of the latter was darker in colour. Near Ottawa Elwes gathered ripe fruit of the American beech²—which here is not a large or tall tree—in the end of September; the mast was smaller and less abundant than in the European beech, and the tree—as near Boston—did not seem to have the same tendency to outgrow and suppress other hardwoods which it shows in Europe. The roots, judging from seedlings sent from Meehan's nurseries at Philadelphia, are larger, deeper, and less fibrous than those of the European beech, though this may be caused by a deep soil. A good illustration of the American beech in the open is given in *Garden and Forest*, viii. 125, taken from a tree at South Hingham, Massachusetts.

The American beech is rare in collections in England. We have only seen specimens at Kew Gardens, Beauport, Tortworth, and Eastnor Castle. In no case do these attain more than 15 feet in height. As the tree, no doubt, was often planted even a century ago, and no large trees are known to exist in this country, it is very probable that, like many other species from the Eastern States, it will never reach timber size in this climate. The specimen from Eastnor Castle has very dull green leaves, somewhat cordate at the base, and probably belongs to the following variety.

Var. *caroliniana*, Loudon, *ex Lodd. Cat.* (1836).—In cultivation in Europe, distinguished from the common form by the leaves being more rounded at the base, said to be more dwarf in height, and to come out in leaf fifteen days before ordinary *Fagus ferruginea*.³

FAGUS ORIENTALIS. Caucasian Beech.

Fagus orientalis, Lipski, *Acta. Hort. Petrop.* xiv. 300 (1897).

Fagus sylvatica, Linnæus, β *macrophylla*, DC., and γ *asiatica*, DC. (*ex parte*), *Prod.* xvi. 2, 119 (1864).

Lipski says that the beech which occurs in the Caucasus, Asia Minor, and

¹ But Sargent says that it attains its largest size in the rich land of the Lower Ohio valley, and in the Southern Alleghanies, and that it often forms pure forests. He quotes an old author (Morton) as follows:—"Beech there is of two sortes, red and white, very excellent for trenchers or chaires, also for oars," and says that these different coloured woods, recognised by lumbermen, are produced by individual trees, which are otherwise apparently identical, and for which Michaux and Pursh tried to find botanical characters which he cannot allow to be specific.

² Sargent says that the sweet nuts are sold in Canada, and in some of the middle and western states.

³ Jouin, "Les Hêtres" in *Le Jardin* (1899), p. 42.

North Persia, is a peculiar species. Radde,¹ while not admitting it to be a distinct species, considers that it is a form which approaches the Japanese *Fagus Sieboldi*, Endl., rather than the typical European beech, which occurs in the Crimea. Specimens in the Kew herbarium from the Caucasus, Paphlagonia, Phrygia, and Ghilan (a province of North Persia), differ markedly in fruit from the common beech. This tree occurs throughout the whole of the Caucasus, both on the north and south sides, often ascending to the timber line, but descending in Talysch to the sea-level. On the north side of the Caucasus the beech reaches to 5900 feet altitude; while in the Schin valley, on the south side of the range, it attains 7920 feet. It occurs mixed with other trees, or forms pure woods of considerable extent. It sometimes occurs in the forests in the form of gigantic bushes (springing from one root), of which the individual stems measure 6 feet in girth, and are free from branches to 30 or 40 feet. The largest trees recorded by Radde were:—one 380 years old, 7 feet in girth, and 123 feet high; and another 250 years old, 8 feet 4 inches in girth, and 120 feet high, which contained 370 cubic feet of timber.

This species has been introduced into cultivation on the Continent, and is said² to have a crown of foliage more slender and more pyramidal than the common beech.

FAGUS JAPONICA. Small Beech of Japan. (Native name, *Inubuna*.)

Fagus japonica, Maximowicz, *Mél. Biol.* xii. 542 (1886).

Shirasawa, *Iconographie des Essences Forestières du Japon*, vol. i. t. 35, figs. 1-13 (1900).

This species is much rarer in Japan than *Fagus Sieboldi*, and was not seen by Elwes or Sargent, who says that it had not been collected since a collector in Maximowicz's employ found it on the Hakone mountains, and in the province of Nambu. Very little is known about it, and it has not been introduced into Europe. Shirasawa, however, says it has the same distribution as *Fagus Sieboldi*, and grows almost always in mixture with it, but beginning at a lower level; and that it often occurs in a bushy form, and does not attain the dimensions of the other species.

FAGUS SIEBOLDI. Common Beech of Japan. (Native name, *Buna*.)

Fagus Sieboldi, Endlicher, *Gen. Suppl.* iv. 2, 29 (1847).

Fagus sylvatica, L., γ *asiatica*, DC. *Prod.* xvi. 2, 119 (1864).

Fagus sylvatica, L., δ *Sieboldi*, Maximowicz, *Mél. Biol.* xii. 543 (1886).

Shirasawa, *l.c.* t. 35, figs. 14-26.

This is the common beech which occurs in Japan, and it is considered by Japanese botanists³ to be only a variety of the European beech. Shirasawa⁴ has given some details concerning its distribution, in connection with a figure which illustrates well the botanical characters of the species. Sargent⁵ was doubtful if the common beech in Japan was not quite identical in all respects with the European beech.

Elwes saw it in many places in Central Japan, but not in Hokkaido. Near Nikko it grows to a large size at 2000-4000 feet, but not in pure woods, being, so

¹ Radde, *Pflanzenverbreitung in den Kaukasusländern*, 182 (1899).

² Schneider, *Laubholzkunde*, 152.

³ Matsumura, *Shokubutsu-me-i*, 123.

⁴ Shirasawa, *l.c.* 86.

⁵ Sargent, *Forest Flora of Japan*, 70.

far as he saw, always mixed with other trees, though Goto says¹ that it occurs in Honshu and in the southern half of Hokkaido in almost unmixed woods, and that in Aomori, Iwate, Echigo, and Yamagata, pure woods of vast dimensions are seen in the mountains above 1000 feet elevation. It is one of the most important trees for firewood and charcoal, but little valued for building. It grows well in shade, and continues to grow to a great age, sometimes attaining enormous size. The Ainos in old Japan are said to have used the tree for dug-out canoes. The largest trees measured by Elwes were in the Government forest of Atera, in the district of Kisogawa, where there were tall straight trees in mixed deciduous forests of beech, magnolia, oak, birch, and maple, about 100 feet high and 9-10 feet in girth. Here the wood was not of sufficient value to pay the expense of carriage.

FAGUS SINENSIS.

Fagus sinensis, Oliver, in Hook. *Icon. Plant.* t. 1936 (1891); Diels, *Flora von Central China*, 284 (1901).

Fagus sylvatica, L., var. *longipes*, Oliver, in sched. ad Hook. *Icon. Plant.* t. 1936 (1891); Franchet, *Jour. de Bot.* 1899, p. 90.

Fagus longipetiolata, v. Seemen, in Engler, *Bot. Jahrb.* xxiii. *Beibl.* 57, p. 56 (1897).

This tree was discovered by Henry in the mountains south of the Yangtse, near Ichang, in Central China. It occurs scattered in deciduous forests at 3000-4000 feet altitude, and sometimes attains a considerable size, one tree being noted as 15 feet in girth. Von Rosthorn subsequently found the same species in the mountains south of Chungking, in Szechuan.

FAGUS ENGLERIANA.

Fagus Engleriana, v. Seemen, in Diels, *Flora von Central China*, 285, cum figurâ (1901).

Fagus sylvatica, L., var. *longipes*, Oliver, "var. *bracteolis involucri exterioribus spatulatim dilatatis*," Oliver, in sched. ad Hook. *Icon. Plant.* t. 1936 (1891).

Fagus sylvatica, L., var. *chinensis*, Franchet, *Jour. de Bot.* 1899, p. 201.

This species was also discovered by Henry, but in the mountains north of the Yangtse from Ichang in Central China. Subsequently specimens were sent to Europe by Père Farges from North-East Szechuan, and by von Rosthorn from Southern Szechuan. It is a smaller tree than *F. sinensis*, and was seen by Henry on wooded cliffs.

Neither of the Chinese beeches form pure woods. A beech of considerable size was seen by Henry in Yunnan, in a mountain wood near Mengtse, at about 5000 feet elevation, and is possibly a distinct species. This rare tree is remarkable in that it extends the southern limit of the northern beeches to as low as 23° N.

¹ *Forestry of Japan* (1904), p. 22.

FAGUS SYLVATICA, COMMON BEECH

Fagus sylvatica, Linnæus, *Sp. Pl.* 998 (1753). Loudon, *Arb. et Frut. Brit.* iii. 1950 (1838).

A large tree, commonly 100 feet high (attaining 130 to 140 feet under very favourable conditions), with a girth of 20 feet or more. Bark¹ usually grey and smooth, but often in old trees becoming fissured and scaly, especially near the base. Branchlets of two kinds; the short shoots ringed and bearing only a terminal bud in winter and one, two, or three leaves in summer; the long shoots slender, glabrous, with many leaves in two lateral rows (in winter the buds are seen arising from the upper side of the twig, the leaf-scars being on the lower side).

Leaves: deciduous, alternate, two-ranked, varying in size with altitude and vigour, those of trees at high elevations being much smaller; generally oval, somewhat acuminate at the apex, slightly unequal at the base, undulate or toothed in margin, with 6-10 pairs of lateral nerves, which with the midrib are raised on the under surface of the leaf, and are more or less pubescent.

Flowers: arising in the axils of the leaves of the young shoots; the male heads by long pendulous stalks, the female involucre by short erect stalks above the male flowers on the same branchlet or on separate branchlets. The true fruits are usually two together enclosed in a woody involucre, which is beset by prickles. Each fruit contains a seed, triangular in shape like the fruit containing it. The seed hangs from the top of the cell and has no albumen.

Seedling: the seedling of the beech² has a long primary root and a stout radicle, 1-2 inches long, bearing 2 large sessile oval cotyledons, which are dark green above and whitish beneath. The first true leaves of the beech are opposite, ovate, obtuse, and crenate, borne on the stem an inch or so above the cotyledons. Above this pair other leaves are borne alternately, and the first season's growth terminates in a long pointed bud with brown imbricated scales.

The common beech is distinguishable at all seasons by its bark, which is only simulated by the hornbeam; but in the latter tree the stem is usually more or less fluted. In winter the pointed buds, arranged distichously on the long shoots and composed of many imbricated scales, are characteristic; while in length they exceed

¹ There is much difference in the colour and roughness of the bark, which varies with age, soil, situation, and exposure. On the dry, sandy soil of Kew Gardens this bark of the beech is so different from that seen on calcareous soils that it might almost be mistaken for a hornbeam, and Elwes has observed the same in the Botanic Gardens at Edinburgh, where the trees are exposed to the salt east wind. These variations are not, however, entirely caused by local conditions, but are sometimes found in trees standing close together. Professor Balfour pointed out to Elwes two beeches in the Edinburgh garden of which one has the bark rough and scaly, and regularly comes into leaf fifteen to twenty days before another tree similar in size which grows next to it, whose bark is smooth and silvery. Whether these variations are correlated with any differences in the wood does not seem to have been proved in England; but it is evident that for cold and exposed situations it would be advantageous to sow only the seed of the late leafing and flowering trees.

² The beech seedling has its cotyledons green and above ground; those of the oak and chestnut remain in the soil. In the hornbeam, hazel, and alder, the cotyledons are aerial, but the first pair of true leaves above them are alternate.

those of any tree ordinarily cultivated in England, being about $\frac{3}{4}$ inch long. The buds of the European beech are wider at the middle than at either end; while in the American beech they are as narrow in the middle as they are at the base.

VARIETIES

A great number of varieties of the common beech occur, some of which have originated wild in the forests, whilst others have been obtained in cultivation.

Var. *purpurea*, Aiton, Purple Beech. A complete account of the origin of this variety appeared in *Garden and Forest*,¹ 1894, p. 2. From this it would appear that a purple beech² discovered in the eighteenth century in the Hanleiter forest near Sondershausen in Thuringia, is the mother tree of those which now adorn the pleasure grounds of Europe and America. This is the only authenticated source from which horticulturists have derived their stock. The purple beech was, however, long known before the Thuringian tree was discovered. In Wagner's *Historia naturalis Helvetiæ curiosa* (Zurich, 1680) mention is made of a beech wood at Buch, on the Irchel mountain in Zurichgau (commonly called the Stammberg), which contains three beech trees with red leaves, which are nowhere else to be found. These three beeches are again referred to in Scheuzer's *Natural History of Switzerland*, published in 1706; and the legend is stated that according to popular belief five brothers murdered one another on the spot where the trees sprang up. Offspring of these trees were carried into a garden, where they still retained their purple colour. The purple beech has also been observed in a wild state in the forest of Darney in the Vosges.

The purple beech has delicate light red-coloured foliage, which is of a pale claret tint in the spring, becoming a deep purple in summer. In early autumn the leaves almost entirely lose their purple colour, and change to a dark dusky green. The buds, young shoots, and fruits are also purple in colour. The involucre are deep purple brown in autumn, becoming browner with the advance of the season. The purple beech often fails to fruit regularly; still many individuals of this variety do produce fruit, and this has been sown, and in some cases produced plants almost all with purple leaves, not 5 per cent reverting to green.³ The colour in the leaves, etc., is due to a colouring matter in the cells of the epidermis. The variety submits well to pruning or even to clipping with the shears; and may therefore, if necessary, be confined within narrow limits or grown as a pyramid in the centre of a group of trees.

A fine purple beech⁴ grows in Miss Sullivan's garden, Broom House, Fulham, which is 82 feet high and 12 feet 2 inches in girth.

¹ See also *Gartenflora*, 1893, p. 150.

² This tree is still living. See Lutze, *Mitth. des Thüringer Bot. Vereines*, 1892, ii. 28.

³ Elwes saw at the Flottbeck Nurseries near Hamburg, formerly occupied by the celebrated nurseryman John Booth, a fine hedge of purple beech, which Herr Ansorge told him was raised from a cross between the purple and the fern-leaved beeches. Of the produce of this cross 20 to 30 per cent came purple, but none were fern-leaved. This coincides exactly with his own experience in raising from seed. But in *Mittheilungen Deutschen Dendrologischen Gesellschaft*, 1904, p. 198, Graf von Schwerin describes as *F. sylvatica ansorgei* a hybrid from these two varieties which seems to combine the characters of both.

⁴ Figured in *Gard. Chron.* 1898, xxiv. 305. See also *ibid.* 1903, xxxiii. 397, for notes on sub-varieties of the purple beech.

Another occurs at Hardwick, Bury St. Edmunds, the seat of G. M. Gibson Cullum, Esq., which in 1904 was 11 feet 9 inches in girth, and about 80 to 90 feet in height. Bunbury¹ considered this to be the finest purple beech in England, and says it produces abundance of fruit, from which young trees have been raised.

Var. *cuprea*, Loddiges, Copper Beech.—This is only a sub-variety of the purple beech, distinguished by its young shoots and leaves being of a paler colour. The largest purple or copper beech which Elwes has seen is in the park at Dunkeld, Perthshire, not far from the Cathedral. This measures 86 feet high, with a girth of 15 feet 3 inches, and does not show any evidence of having been grafted. There is a very fine one at Corsham Court, the seat of General Lord Methuen, 85 to 90 feet high, by 14 in girth, forking at about 10 feet. At Scampston Hall, Yorkshire, Mr. Meade-Waldo tells us of two large spreading trees on their own roots, 11 feet 6 inches and 10 feet 6 inches in girth respectively. At Beauport, Sussex, the seat of Sir Archibald Lamb, Bart., a copper beech measured 12½ feet in girth in 1904. At Syston Park, Lincolnshire, the seat of Sir John Thorold, Bart., there is one nearly as large (12 feet 2 inches girth). A copper beech at Bell Hall, York, which was planted in 1800, measured in 1894, 9 feet in girth, the diameter of the spread of the branches being 74 feet. At Castle MacGarrett, Claremorris, Ireland, the seat of Lord Oranmore, there is a beautiful copper beech, which in 1904 was 70 feet high and 9 feet 10 inches in girth. In Over Wallop Rectory grounds, in Hampshire, a copper beech measured 9 feet 4 inches in 1880.

Two fine trees occur at Clonbrock, in Co. Galway, the seat of Lord Clonbrock. One measured in 1904 a length of 76 feet and a girth of 12 feet 9 inches. The other was 7 feet 6 inches girth in 1871, and in 1880 it had increased to 8 feet 5 inches.

The copper beech² is rarely used as a hedge, but there is one in the gardens of Ashwellthorpe Hall, Norwich, which is 138 yards long, 8 feet high, and about 5 feet through. It was planted about seventy years ago from seedlings by the Hon. and Rev. R. Wilson. The colouring in spring is very beautiful.

There is a sub-variety³ of the copper beech in which the leaf is edged with pink whilst young, but later in summer it becomes nearly like the type. This variety has been called *Fagus purpurea roseo-marginata*, and it has been recommended as a hedge-plant, to be clipped two or three times during summer so as to obtain several crops of young shoots.

Var. *atropurpurea*.—The leaves in this are of a darker colour than in the ordinary purple beech.

Var. *atropurpurea Rohani* is quite different from the last, as the form of the leaves is similar to that of the fern-leaved beech, but their colour is like that of the copper beech.

Var. *purpurea pendula*.—This is a weeping form of the purple beech. It is of slow growth.

¹ *Arboretum Notes*, p. 117.

² *Garden*, July 30, 1904, Answers to Correspondents.

³ *Gard. Chron.* June 23, 1888, p. 779.

Var. *Zlatia*, Späth,¹ Golden Beech.—This was found wild in the mountains of Servia by Professor Dragashevitch. It is known in Servia as *Zladna bukwa* (golden beech).

Var. *striata*, Bose.¹—This was discovered many years ago in a forest in Hesse. Soon after opening, the leaves show a regular golden striation parallel with the nerves, and this appearance lasts till the leaves fall off in autumn. It was introduced in 1892 by Dippel.

Various other coloured varieties have been obtained by horticulturists. In var. *variegata* the leaves are particoloured with white and yellow, interspersed with some streaks of red and purple. In var. *tricolor* the leaves are dark purplish green, spotted with bright pink and shaded with white. There are also gold-striped (var. *aureo-variegata*) and silver-striped (var. *argenteo-variegata*) varieties.

Var. *heterophylla*, Loudon, Fern-leaved Beech.—The leaves are variously cut, either in narrow shreds like some ferns, or in broader divisions like the leaves of a willow. This variety has received a great number of names, as *laciniata*, *comptoniaefolia*, *incisa*, *salicifolia*, *asplenifolia*, etc. The tree occasionally bears normal and cut leaves on the same twig, or normal and cut leaves on different twigs. It bears fruit occasionally, which, according to Bunbury,² is smaller than that of the common beech, the cupule being shorter in proportion to the nuts. The leaf-buds are considerably smaller than those of the common form; and the twigs are often very pubescent. The origin of this variety is unknown.

There is a good specimen of this tree at Devonhurst House, Chiswick, which measured in 1903 55 feet in height, and 8 feet 2 inches in girth at 3 feet, just under a great horizontal branch.

At Barton, Bury St. Edmunds, a fern-leaved beech in 1904 was 53 feet high, with a girth of 5 feet 1 inch. This tree² was planted in 1831, but grew slowly, in 1869 being only 15 feet high, with a trunk 3 feet round. In 1868 the tree bore some twigs with ordinary leaves; and it first fruited in 1869, the crop being a very small one.

There are large and well-shaped trees of this form at Strathfieldsaye measuring 50 feet by 7 feet 5 inches; at Fawley Court of the same size exactly, and weeping to the ground; and at Stowe near Buckingham.

Var. *quercooides*, Pers., Oak-leaved Beech.—The leaves in this variety are long-stalked, with an acute base and acuminate apex; margins pinnately and deeply cut, the individual segments being acute.

Var. *cristata*, Lodd. (also known as var. *crispa*).—Small and nearly sessile leaves, crowded into dense tufts, which occur at intervals on the branches. This form rarely attains a large size.

Var. *macrophylla* (also known as *latifolia*).—The leaves in this form are very large. In a specimen at Kew, from the garden of the Horticultural School at Vilvorde, they attain 7 inches in length and 5 inches in width. A large specimen of this tree, some fifty years old, occurs at Enys in Cornwall. The buds, as might

¹ *Gard. Chron.* 1892, xii. 669. This is an account of Späth's novelties by Dr. Edmund Göze of the Greifswald Botanic Gardens.

² *Arboretum Notes*, p. 118.

be expected, in this variety are considerably larger than those of the ordinary form.

Var. *rotundifolia*, Round-leaved Beech.¹—The leaves are very small, round, and bright green, and are set close on the twigs. This variety has an upright habit of growth, and was introduced in 1894 by Jackman of Woking.

Var. *grandidentata*.—A form with conspicuously toothed leaves.

Var. *pendula*, Loddiges, Weeping Beech.—Several forms of this variety occur, but in all the smaller branches hang down. The main branches are irregularly disposed, so that the tree often has a very rugged outline. This variety should be grafted at a good height, as otherwise many of the pendulous branches will lie upon the ground; and the main branches, if they show a tendency to droop too much, should be supported. Weeping beeches may be tall and slender, or low and broad, or quite irregular, depending upon the direction of the larger branches, which may grow outwards or upwards, or in almost any direction; the smaller branches only are uniformly pendulous.

The weeping beech has been observed wild in the forest of Brotonne, in Seine-Inférieure, France.

A good example of a tall, slender, weeping beech may be seen near Wimbledon Common, on the estate lately owned by Sir W. Peek. A fine specimen occurs at Barton, which in 1904 was 77 feet high and 5 feet 2 inches in girth. Elwes has noted a very picturesque and well-shaped one at Endsleigh, near Tavistock, the Devonshire seat of the Duke of Bedford. Several have been figured in the *Gardeners' Chronicle*, e.g. a group of three trees² at Ashwick Hall, Gloucestershire, which were planted about 1860. In the Knap Hill Nursery³ at Woking, and in the nursery⁴ of R. Smith and Co. at Worcester, there are fine specimens. Another good specimen,⁵ occurring in Dickson's nursery at Chester, is figured in the *Garden*.

Many forms of weeping beech have been described as sub-varieties, as *purpurea pendula*, mentioned above; var. *miltonensis*, with branches less pendulous, found wild in Milton Park, Northamptonshire; var. *borneyensis*, found wild in the forest of Borney, near Metz, and described as having an erect stem and distinctly pendulous branches; var. *pagnyensis*, discovered in the forest of Pagny in the department of Meurthe-et-Moselle in France; var. *remillyensis*, found in the forest of Remilly, near Metz.

Var. *tortuosa*, Parasol Beech.⁶—In this curious form, the branches, both large and small, and the branchlets are all directed towards the ground. It is not to be confounded with the preceding variety, in which only the slender branches are pendulous; and is analogous rather to the weeping ash. Beeches of this form have, even in old age, a very short and twisted stem, with a hemispherical crown, which sometimes touches the ground; and it scarcely ever grows higher than 10 feet. This variety has been found wild in France, in the forest of Verzy, near Rheims, and also

¹ *Card. Mag.* 1894, p. 339, with figure.

² *Card. Chron.* June 20, 1903, fig. 155.

³ *Ibid.* Dec. 24, 1870, p. 70.

⁴ *Ibid.* Dec. 29, 1900, suppl.

⁵ *Garden*, Dec. 5, 1903, p. 167.

⁶ For a complete account of the occurrence of this curious form in the forests of the east of France, see Godron, *Les Hêtres tortillardés des environs de Nancy*, Mém. de l'Acad. de Stanislas, Nancy, 1869. Godron says that their growth is infinitely slower than that of normal beech. See also *Rev. Hort.*, 1861, p. 84, and 1864, p. 127.

in the neighbourhood of Nancy. Fruits of this form have been sown in the garden of the Forest School of Nancy, and have reproduced the twisted form in about the proportion of three-fifths; the other two-fifths of the fruit produced form like the common beech and intermediate varieties.¹

Many other varieties have been described; and other forms possibly occur wild which have not been noticed. Major M'Nair sent to Kew in 1872 from Brookwood, Knaphill, Surrey, a specimen from a tree growing there, and reported to be in vigorous health, in which the leaves are remarkably small and have only four pairs of lateral nerves.

(A. H.)

DISTRIBUTION

The beech is indigenous to England. Remains of it have been found in neolithic deposits at Southampton docks, Crossness in Essex, in Fenland, in pre-glacial deposits in the Cromer forest bed, and at Happisburgh, Norfolk.² Names of places of Saxon origin, in which the word beech occurs are very common, as Buckingham, Buxton, Boxstead, Boxford, Bickleigh, Boking, etc. The existence of the beech in Britain in ancient times has been questioned on account of the statement by Julius Cæsar³ that *Fagus* did not occur in England. H. J. Long⁴ has discussed what tree the Romans meant by *Fagus*, and the evidence is conflicting. Pliny⁵ described as *Fagus* a tree which is plainly the common beech. However, Virgil's⁶ statement that *Castanea* by grafting would produce *fagos* indicates rather that *Fagus* was a name used for the sweet chestnut; and this view is confirmed by the fact that out of the wood of *Fagus* the Romans made vine-props and wine-casks. The Latin word *Fagus* is derived immediately from the Greek *φηγός*; and the *φηγός* of Theophrastus is certainly the chestnut, probably the wild tree which is indigenous to the mountains of Greece. Cæsar's statement probably implies that in his day the sweet chestnut did not occur in Britain.

The beech is not believed to be indigenous in Scotland and Ireland,⁷ and no evidence is forthcoming of its occurrence in prehistoric deposits in those countries. An able writer in *Woods and Forests* (1884, June 11, p. 404) contests this view, and speaks of the existence of two beech woods in the north of Scotland, not 10 miles from the most easterly point of Britain, where the trees were larger than any other timber tree, not excepting the Scotch fir, and where it produced fertile seed, while that of the oak was abortive. These woods were high and exposed, but the soil was good. In view of the way in which the beech ascends in the Vosges and the Jura to cold, bleak situations, finally becoming at 4000 feet a dwarf shrub, which

¹ The parasol beech, or a form closely like it, has been found in Ireland, according to a correspondent of *Woods and Forests*, Jan. 1885, who writes as follows:—"Near to Parkanour, in Tyrone, the residence of Mr. J. Burgess, stand two beeches, which at a short distance resemble heaps of leaves more than trees. They were found in the woods sixty years since, and are from 6 feet to 8 feet in height and 15 feet diameter, and of dense drooping habit. Upon creeping inside, I found them to branch off at 2 feet or 3 feet from the ground, where one was nearly 5 feet in circumference. The arms and branches are not unlike corkscrews. The inferior branches and matted rubbish, if cleared out, would greatly improve their appearance, as the singular growth would then be visible. They might, if sent out, become a valuable adjunct to the upright yew, which flourishes in Ireland, the finest of which I have yet seen being 24 feet high and 12 feet through, and well filled in the centre.—C. I."

² C. Reid, *Origin of British Flora*, 28, 69, 146.

³ *B. G.* v. 12.

⁴ Loudon, *Card. Mag.* 1839, p. 9.

⁵ *N. H.* xvi. 7.

⁶ *Georg.* ii. 71.

⁷ The name in Irish is *crann sleamhain*, the "slippery tree," so-called from the smoothness of the bark.

forms the timber line, it would be remarkable if the beech had not in early days gained a footing in Scotland and Ireland. The mere negative evidence is of little value, as scarcely any scientific work has yet been done in the way of exploration of the peat-mosses and other recent deposits; and the woods, from which are made the handles of numerous prehistoric implements preserved in our museums, have rarely been examined.¹

The beech occurs in a wild state throughout the greater part of Northern, Central, and Western Europe, usually growing gregariously in forests which, when undisturbed by man, have a tendency to spread and take the place of oak, which, owing to its inability to support such dense shade, is often suppressed by the beech.

In Norway, according to Schubeler,² it is called bok, and is wild only near Laurvik, where he believes it to be truly indigenous, and is a small tree, the largest he measured being 7 feet 4 inches in girth. At Hosanger, however, a planted beech had in 1864 attained 75 feet at 81 years old, with a diameter of 27 inches. It ripens seed as far north as Trondhjem in good years, and exists in Nordland as far north as lat. 67°.56.

In Sweden its most northerly wild habitat is Elfkalven, lat. 60°.35, though it has been planted as far north as lat. 64°.

In Russia the beech extends only a little way,—its eastern limit in Europe passing the Prussian coast of the Baltic between Elbing and Königsberg, about 54° 30' N. lat., and running south from Königsberg, where the last spontaneous beeches occur on the Brandenburg estate, continuing through Lithuania, eastern Poland, Volhynia, where beech woods still occur between lat. 52° and 50°, and Podolia to Bessarabia. It is absent from the governments of Kief and Kherson, but reappears in the Crimea, where, however, it is only met with in the mountains of the south-east coast. In the Caucasus, Persia, and Asia Minor it is replaced by the closely allied species, *Fagus orientalis*.

In Finland and at St. Petersburg it exists as a bush only, but is not wild. On the southern shores of the Baltic it forms large forests, and in Denmark is one of the most abundant and valuable timber trees, growing to as large a size and forming as clean trunks as it does farther south. Lyell speaks of it as follows:³—"In the time of the Romans the Danish isles were covered as now with magnificent beech forests. Nowhere in the world does this tree flourish more luxuriantly than in Denmark, and eighteen centuries seem to have done little or nothing towards modifying the character of the forest vegetation. Yet in the antecedent bronze period there were no beech trees, or at most but a few stragglers, the country being then covered with oak."

At page 415 he says further—"In Denmark great changes were taking place in the vegetation. The pine, or Scotch fir, buried in the oldest peat, gave place at length to the oak; and the oak, after flourishing for ages, yielded in its turn to the

¹ In a paper by H. B. Watt on the "Scottish Forests in Early Historic Times," printed in *Annals of the Andersonian Nat. Soc.* ii. 91, Glasg., 1900, which contains many interesting particulars of the oak and other trees, no mention is made of the Beech. In the Highland Society's *Gaelic Dictionary* (1828), *faidhbhile* is given as the word for beech; here *faidh* is cognate with *fagus*, *bhile* being one of the Gaelic terms for *tree*. This name is also known in Ulster.

² Schubeler, *Viridarium Norvegicum*, vol. i. 521.

³ Lyell, *Antiquity of Man*, 2nd. ed. 1873, pp. 17, 415.

beech; the periods when these three forest trees predominated in succession tallying pretty nearly with the ages of stone, bronze, and iron in Denmark."

All over Germany, except in the sandy plains of the north, it is one of the principal forest trees; but, so far as we have seen, does not—or is rarely allowed to attain—such a great size as in England. In Central and Southern Germany and in Eastern and Southern France it seems to be indigenous only in hilly districts and mountains.

In the north of France it attains perfection, and forms very large forests, usually mixed with oak, which sometimes contain trees of immense height, but is not planted as an ornament to parks as much as in England.

According to Huffel's *Economie Forestière*, 362 (1904), the finest beech forest in France is that of Retz, also called Villers Cotterets, which contains 37,000 acres, on a soil composed of deep sand, mixed with a slight proportion of clay. The trees consist almost entirely of beeches, there being only a small number of oaks and hornbeams. In the best plot of this forest, the canton of Dayancourt, which is 30 acres in extent, there were, in 1895, 1998 beech trees, 20 oaks, and 16 hornbeams. The beeches contain 329,433 cubic feet of timber, and reach a height of nearly 150 feet with clean stems of 80 to 90 feet. Their age in 1895 was 183 years, and they were considered to have reached their maximum development and to be on the point of going back.

In an account of the beech, Mr. Robinson has stated in *Flora and Sylva* that in the forest of Lyons-la-Forêt, near Rouen, beeches of 160 feet in height are found; but on asking my friend M. Leon Pardé, inspector of forests at Beauvais (Oise), near Paris, whether this statement could be confirmed, he was good enough to send me a letter from the forest officer there, who says that the tallest beech known in France is the one which I saw in the Forêt de Retz, when the English Arboricultural Society visited France in 1903,¹ the height of which was given as 45 metres, about 147 feet. This tree measured 13 feet 2 inches in girth, and was straight and clear of branches to 91 feet. It was estimated by the English measurement to contain 560 cubic feet to the first branch, or 700 feet in all. This letter goes on to say that the tallest trees at Lyons-le-Forêt do not, in his opinion, exceed a total height of 35 metres, though one has doubtfully been stated to attain 37½ metres.

Two of the finest and tallest beeches in France are the one called "La Bourdigalle" in the Forêt de Lyons at La Haye (Seine Inf.), which is 35.80 metres high by 5.55 metres at 1 metre, and is supposed to be from 375 to 575 years old.²

Another called "Le Trois Hêtres," in the forest of Brotonne at Guerbaville (Seine Inf.), has three straight clean stems rising from a single base to a height of nearly 35 metres, with a girth at 1 metre of about 18 feet. This very remarkable tree is figured on plate xi. of the work cited below.²

In Switzerland pure beech forest is found as high as 4500 feet, and at 5000 assumes a shrubby habit.

In the Austrian Alps and Carpathians it is also a common tree, forming vast forests, which are sometimes pure, sometimes mixed with other trees.

¹ *Trans. Eng. Arb. Soc.* v. pt. ii. p. 209.

² Gadeau de Kerville, *Les Vieux Arbres de la Normandie*, 143 (1893).

In Italy it is found only in the mountains; in the Apennines it is one of the dominant trees at from 3000 to 5000 feet. In the Sila mountains of Calabria, Elwes found it covering the mountains above the limit of chestnut, at from 3000 to 5000 feet and upwards. It is usually coppiced for charcoal and firewood; but it attains a considerable size, the largest measured being about 90 feet by 10-12 in girth. Here it is often mixed with the Calabrian pine. In Sicily it finds its southern limit on Mount Etna, where it ascends to 7200 feet.

In Spain the beech occurs in the Pyrenees and in the northern provinces only, its most southerly known habitat being in lat 40° 10' east of Cuença. In Portugal it has not, so far as we know, been recorded to exist.

The finest natural beech forests seen by us in Europe are on the northern slopes of the Balkans, where it grows as pure forest from near the foot of the mountains up to about 4000 feet. The trees are very straight and clean, but are being rapidly felled in those places where they are most accessible. Boissier¹ says that the beech occurs in northern Greece on Mounts Pindus and Pelion. Elwes found it in Macedonia, on the north side of Mount Olympus.²

(A. H. and H. J. E.)

CULTIVATION

Seed is without doubt the best means of reproducing the tree, and I am inclined to think that the best and cleanest trunks are produced by seedlings which have never been transplanted, but opinions differ on this question. Seed is only produced in quantity at intervals of several years, and in some years a large proportion of the seeds, even in districts where the beech grows well, are mere empty husks.

The season of 1890 was probably the best for beech-mast in England which had occurred for many years, and I took particular pains, by enclosing certain spots where I found a number of germinating seeds in the following April, to protect them. But a severe frost, which occurred in the middle of May, destroyed all or nearly all the seedlings in the open, and those whose germination had been delayed by dense shade, or a thick covering of leaves, mostly withered away in the dry summer which ensued, before their rootlets had become established in the ground. Notwithstanding this, in most woods where rabbits, pheasants, and wood-pigeons are not so abundant as to devour all the seedlings and seeds, a good number of seedling beech of the year 1901 may still be found, and in the New Forest and elsewhere the ground in suitable spots is covered with seedlings.

Whether the seed should be sown when ripe or kept until the following spring is a question which must be decided by local conditions and experience, but where the danger of late spring frosts is great, I should prefer keeping it in an airy, dry loft spread thinly on a floor until April, or even the first week in May, as if February and March are mild, it will germinate in March and run great risk of being frozen in April or May. On March 11, 1901, I found a quantity of

¹ *Flora Orientalis*, iv. 1175.

² Halácsy, *Cousp. Flor. Græcæ*, iii. 124 (1904), says that the beech forms in Greece large woods in the mountains, and gives its distribution as follows:—Thessaly—Mountains of Pindus, Chassia, Olympus, Ossa, and Pelion; Acarnania—Mount Kravara; Ætolia—Mount Oxyes.

beech-mast on the lawn at Heythrop Park which had already germinated and had the radicle protruding as much as $\frac{1}{2}$ inch. I gathered a basketful and sowed it two days later, covering the drills with beech-leaf mould. Most of this was above ground in April, and where not protected by branches over the beds, was destroyed by frost. Stored seed sown at the same time was almost all devoured by mice and rooks, which seemed to follow the drills with great care, whilst seed sown broadcast on a freshly ploughed surface and covered by one turn of a harrow, produced a certain number, but still a very small proportion of plants. These were, in June 1904, still very small and stunted, not more than 3-5 inches high, whilst seedlings of the same age raised on good rich sandy soil in an Edinburgh nursery were from $1\frac{1}{2}$ to 2 feet high.

In the autumn of 1902 I found it impossible to procure any beech-mast in Great Britain, and after many inquiries procured some German seed early in April. Part of this was dibbled in a field of wheat, but so few plants could be found when the wheat was cut that the experiment was a practical failure. I sowed a part of this seed early in May in the garden, which germinated in June, and thus escaping spring frosts it grew without a check, and the seedlings were 4 to 6 inches high in the autumn.

Judging from these results it appears to me that, except in woods or where there is shelter, it is not economically desirable to raise beech from seed where it is to grow, and that spring sowing is preferable to autumn.

Seedlings are easy to transplant if their roots are not allowed to become dry, and the percentage of loss in 20,000 sent to me from Edinburgh in the winter 1902-3 was not more than 5 to 10 per cent. But if the trees are older and the roots are bad or have been heated in transit, or exposed too long to the air, the loss will be very great; and in most cases I should not plant out on a large scale trees of over two years old two years transplanted, though for specimen or lawn trees they may be safely moved when 6 to 10 feet high, or even more, if properly transplanted every two years.

SOIL AND SITUATION

Though the beech will grow on almost any soil except pure peat and heavy wet clay, it comes to its greatest size and perfection on calcareous soil or on deep sandy loam, and usually in pure woods unmixed with other trees.

The finest beech woods in England are, or rather were, in the Chiltern Hills, Bucks, in the neighbouring counties of Oxford and Herts; in the valleys of the Cotswold Hills; and in Sussex.

Sir John Dorington, M.P., tells me that he cut 2 acres 1 rood 13 poles of beech on a steep bank opposite his house at Lypiatt Park, Stroud, in 1897, growing on thin oolite limestone brash, which at 1s. 2d. per foot produced £562, equal to about 9634 feet. And off 4 acres of the same wood in 1875 he sold beech to the value of £1100, being at the rate of £275 per acre. This was supposed to be about 150 years old, and is the best actual return of value from timber on such land which I know of. He also bought a beech wood of 26 acres growing on similar soil in 1898, on which the timber, supposed to be about seventy years old, was valued at £2200, equal to £85 per acre. He cut £600 worth of thinnings out of it the year

following; and as the trees are growing fast, considers that it might now be valued at the same price per acre. Sir John considers, from experience in his own plantations, that planted beech will do as well as when naturally seeded. His old woodman, now dead, was for long of a contrary opinion, but changed his mind latterly from his own experience.

It is necessary to say something about the actual conditions and returns from the Buckinghamshire beech woods, which have been held up by some writers as an example of what may be done by following the system known as *jardinage* in France, which consists in thinning out the saleable trees every ten or twelve years and allowing natural seedlings to come up in their places.

During a visit of the Scottish Arboricultural Society on July 30, 1903, to this district, in which I took part, it was stated by one of the principal land agents in the district that £2 per acre was a common return over an average of years on woods managed on this system, which seems to have grown up during the last sixty years, partly through the legal disability of the owners to make clear fellings, and partly owing to the regular demand for clean beechwood of moderate size for chair-making. But what I saw myself led me to believe that though such a return may have been obtained for a short period on the best class of beech woods, it is not likely to continue, and that if an owner had a free hand and was not liable for waste, clear felling of the mature timber about once in 60-100 years would probably in the long-run be a better system. And this opinion was confirmed by Mr. George James, agent for the Hampden estate, who thinks that 15s. per acre, which is about the average rateable value of these woods, is as much as they are actually worth, and that when you get fine timber clean and well grown, as on Mr. Drake's estate at Amersham, many natural seedlings do not occur, but that on Earl Howe's estate at Dunn where, forty years ago, all or nearly all of the timber was cut, there is a good growth of young seedlings.

Professor Fisher of Cooper's Hill has written a very instructive article¹ on the Chiltern Hill beech woods, in which he states that these are probably the northern and western British limit of the indigenous beech forest, which was probably eradicated during the glacial period in the north of England; though remains found in the submarine forest-bed at Cromer, in Norfolk, prove that it existed before this period farther east. He quotes measurements taken by Mr. A. S. Hobart Hampden, now director of the Forest School at Dehra Dun, India, which show that on the average it takes ninety years in this district for beech to attain 3 feet in girth at breast height, and that a full crop of seed cannot be expected from trees much younger than eighty years when grown in dense order. He agrees with me that in many of the woods, including those which belong to Eton College, over-thinning has been prevalent, and states that rabbits and brambles have in many cases prevented the natural regeneration from being as complete as it must be to keep such woods in profitable condition under the decennial selection system.² And as

¹ *Land Agent's Record*, April 9 and 16, 1904.

² A paper by Mr. L. S. Wood, in the *Trans. Eng. Arbor. Soc.* v. 285 (1903), gives many particulars of the beech woods in this district.

the furniture factories of High Wycombe are now largely supplied with American birch and other foreign timber, which can be imported at a cheaper rate than beech is locally worth, I am inclined to think that where these woods have become too thin to be profitable, they would pay better if the seeding of ash—which grows well on this land though not to the largest size—was encouraged, and the vacant spaces filled up with larch, which, when mixed with beech, usually keeps healthy and grows to a larger size than it does alone.

It is probable, however, that as our coal supplies diminish, the value of firewood in England will increase, and as beech is one of the best firewoods we have, and one of the most economical to convert into suitable sizes, I should advise its being more largely planted in districts where coal is distant and costly.

As a nurse to other forest trees, especially larch and oak, it has a value greater than any deciduous tree, because, if not allowed to overtop its neighbours, its shade and the decay of its leaves preserve the soil in a cool, moist, and fertile condition. On poor calcareous and chalk soil it is specially valuable, and should be planted in mixture with most kinds of other trees, provided rabbits can be permanently excluded; but on account of its thin bark it is never safe in a deep snow or in hard winters from rabbits, which will bark the roots of trees 100 years old as readily as young trees.

The distance apart at which beech should be left in plantations, must depend on the goodness of the soil and on the size at which the trees can be most profitably cut. The better the land the thicker it may stand, but on really poor soil it grows so slowly if crowded, that as soon as it has attained a sufficient height and cleaned itself from branches up to 30-50 feet, it should be thinned to about 150 trees or even less to the acre. And I have often observed that on soils which are not naturally favourable for beech, it will not under any circumstances grow so straight and clean as in woods where natural regeneration is easy.

Notwithstanding what Loudon and some German foresters say about the beech being unfit for coppice-wood, I can show beech stools of considerable age which have been regularly cut over at intervals of about eighteen years for at least a century; whilst the growth of shoots from the stool on the dry rocky bank in Chatcombe Wood, near Seven Springs, on the Cotswold Hills, is faster than that of ash similarly treated. In the mountains of Calabria also, I have seen hillsides covered with beech scrub which appeared to have been coppiced for firewood for a very long period. Therefore, in cases where the beech has been planted merely as a nurse to oak or other trees, and there is no deciduous tree better adapted to this purpose, I should not hesitate to cut over the trees if they seemed likely to smother their neighbours, with the expectation of getting a quantity of excellent firewood or small poles fit for turning, fifteen to twenty years later.

As a clipped hedge the beech is useful, but does not grow so fast at first as the hornbeam. An excellent example of this fact may be seen near the entrance to Dr. Watney's place at Buckholt, near Pangbourne, where the two are growing in the same hedge; the beech treated in this way keeps its leaves all the winter and makes good shelter.¹

¹ Cf. Loudon, *loc. cit.* p. 1965.

BEECH AVENUES

Sir Hugh Beevor has sent me a photograph of a remarkable avenue of beech trees called Finch's Avenue, near Watford, which is composed of straight, clean, closely planted trees up to 120 feet high (Plate 2).

As an avenue tree the beech is one of the most stately and imposing that we have; but probably because of the difficulty of getting tall, straight standards from nurseries, and their tendency to branch too near the ground when planted thinly, they are not so much in vogue as they were two centuries ago. One of the finest examples I know of in England is the grand avenue in Savernake Forest, the property of the Marquess of Ailesbury. This was planted in 1723, and extends for nearly 5 miles from Savernake House to the hill above Marlborough. It is described and figured in the *Transactions of the English Arboricultural Society*, v. p. 405, and though the trees are not individually of quite such fine growth as those at Ashridge, yet, forming a continuous green aisle meeting overhead, for such an immense distance, it is even more beautiful than the elm avenue at Windsor, or the lime avenue at Burghley, and surpasses both of them in length. The Savernake avenue, however, is not like those above mentioned, planted at regular distances, but seems to have been cut out of a belt.

The beech avenue at Cornbury Park, the property of Vernon Watney, Esq., to whom I am indebted for the following particulars, is, on account of the great size of the trees, one of the most imposing in England. It was probably planted or designed by John Evelyn, whose diary, 17th October, 1664, says: "I went with Lord Visct. Cornbury to Cornbury in Oxfordshire, to assist him in the planting of the park, and beare him company, dined at Uxbridge, lay at Wicckam (Wycombe)." They reached Cornbury the following day, and among the entries for that day is the following: "We designed an handsom chapell that was yet wanting as Mr. May had the stables, which indeed are very faire having set out the walkes in the park and gardens." This Lord Cornbury who, after his father's death, became Lord Clarendon, records in his diary, "1689, September 25. Wednesday.—The elms in the park were begun to be pruned." This avenue is 800 yards long, and runs from the valley where the great beech grew, up the hill to the house. Many of the trees seem to have been pollarded when young at about 15 feet high, but have shot up immense straight limbs to a height of 100 to 110 feet, some even taller.

The Ten Rides in Cirencester Park affords a good illustration of the value of the beech for bordering the broad rides through a great mass of woodland; but the trees here, as at Cornbury and in so many of our old parks, have seen their best days, and when blanks are made by wind or decay, it is beyond the power of man to restore the regular appearance of such a vista.

Whatever pains may be taken to replant the gaps, the trees never seem to run up as they do when all planted together, and the art of planting avenues does not seem to be so well understood or so much practised now, as it was in the seventeenth and eighteenth centuries.

REMARKABLE TREES

As an instance of the rapid growth of the beech, I will quote from a letter of Robert Marsham of Stratton Strawless, near Norwich, to Gilbert White, dated 24th July 1790, in which he says: "I wish I had begun planting with beeches (my favourite trees as well as yours), and I might have seen large trees of my own raising. But I did not begin beeches till 1741, and then by seed; and my largest is now at 5 feet, 6' 3" round, and spreads a circle of + 20 yards diamr. But this has been digged round and washed, etc." In Gilbert White's reply to this letter, dated Selborne, 13th August 1790, he says: "I speak from long observation when I assert, that beechen groves to a warm aspect grow one-third faster than those that face to the N. and N.E., and the bark is much more clean and smooth."

Marsham, replying to White on 31st August (it seems to have been at least fifteen days' post in those days from Norfolk to Hants), says: "Mr. Drake has a charming grove of beech in Buckinghamshire, where the handsomest tree (as I am informed by a friend to be depended on) runs 75 feet clear, and then about 35 feet more in the head. I went on purpose to see it. It is only 6 F. 6 I. round, but straight as possible. Some beeches in my late worthy friend Mr. Naylor's park at Hurstmonceux in Sussex ran taller and much larger, but none so handsome." In a later letter he speaks of one being felled here in 1750 which "ran 81 feet before it headed."

Sir Hugh Beevor informs me that he found it impossible to identify with certainty the trees measured at Stratton Strawless by Marsham, which we shall have occasion to allude to later.¹

It would be impossible to mention more than a few of the finest beech trees in this country, but the photographs which have been reproduced represent a few of those which I have seen myself.

In Hants there are many fine beeches in the New Forest, of which the wood called Mark Ash contains some of the most picturesque, and is to my eyes one of the most beautiful woods from a naturalist's point of view in England, or even in Europe, though it is, like so many of the fine old woods in the New Forest, deteriorating from causes which are described elsewhere. One of the finest trees here is over 100 feet high and 24 feet in girth, dividing at about 10 feet into six immense erect limbs, and entirely surrounded, as are many of the trees in this wood, by a dense thicket of holly.

There is another beech in Woodfidley in the New Forest which Mr. Lascelles considers the finest beech in the forest, and of which the measurement as given by him is 120 feet high, 14 feet 6 inches in girth at 5 feet, carrying its girth well up, with an estimated cubic content of 650 feet.

In Old Burley enclosure is another magnificent beech, rather shut in by other trees, and therefore difficult to measure for height. I estimated it at 110 feet high. The girth was 18 feet, dividing at about 25 feet into two main trunks, which carried a

¹ Cf. *Trans. of the Norfolk and Norwich Nat. Soc.* ii. 133-195.

girth of perhaps 8 feet up to a great height. I have no doubt this tree contains 700 to 800 feet of timber.

At Knole Park, near Sevenoaks, there are some splendid trees of the park type, with very wide-spreading limbs, two of which are known as the King and Queen Beeches. The King Beech is surrounded by a fence, and many of its branches are supported by chains. Strutt, who figures it, gives its height as 105 feet by 24 in girth at 13 feet. When I measured it in 1905 it was about 100 feet by 30 in girth at 5 feet, with a bole 10 feet high. It has the largest girth of any beech I know of now standing in England (Plate 12). The Queen Beech is 90 to 100 feet high and 28 feet in girth. I am not sure whether this or the last is the one recorded by Loudon, iii. 1977, as having a diameter of 8 feet 4 inches, a height of 85 feet, and a spread of branches of 352 feet diameter.

There are many fine tall beeches in the park of Earl Bathurst at Cirencester, of which Plate 1 gives a good idea, and shows the reproduction from seed in this part of the park to be very good, though a considerable number of other trees, such as ash and sycamore, are growing as well or better than the young beeches under the shade of the tall ones, which in this view are not so remarkable for their size as for their clean cylindrical trunks.

At Ashridge Park, Bucks, the property of Earl Brownlow, are perhaps the most beautiful and best grown beeches in all England, not in small numbers, but in thousands. Though the soil is neither deep nor rich, being a sort of flinty clay overlying limestone, it evidently suits the beech to perfection, and in some parts of the park there is hardly a tree which is not straight, clean, and branchless for 40 to 60 feet, whilst in other parts, where the soil is heavier and wetter, and where oaks grow among the bracken to a great size, the beeches are of a more branching and less erect type.

The largest and finest beech, from a timber point of view, at Ashridge, known as the King Beech, was blown down about 1891, and was purchased for £36 by Messrs. East of Berkhamstead. Loudon says that this tree in 1844 was 114 feet high, with a clear trunk of 75 feet, which was 5 feet 6 inches in girth at that height. Evidently this was less than its real height. Mr. Josiah East tells me that as it stood it had about 90 feet of clean trunk, of which the lower 15 feet was partly rotten and not measured. The sound part was cut into three lengths as follows:—

17 feet × 29 inches, $\frac{1}{4}$ girth	.	.	.	.	.	= 99 cubic feet.
28 " × 25 " "	.	.	.	.	.	= 136 " "
30 " × 23 " "	.	.	.	.	.	= 110 " "
butt, say, 15 " × 36 " "	.	.	.	.	.	= 135 " "
<hr/>						<hr/>
90						480

The branches were partly rotten and much broken in falling, so that they were only fit for firewood. But the celebrated Queen Beech remains, and though in one or two places it shows slight signs of decay, it may, I hope, live for a century or more, as it is in a fairly sheltered place, and has no large spreading limbs to be torn off by the wind. This extremely perfect and beautiful tree was photographed with great

care from three positions by Mr. Wallis (Plate 3), and as carefully measured by Sir Hugh Beevor and myself in Sept. 1903. We made it as nearly as possible to be 135 feet high (certainly over 130), and this is the greatest height I know any deciduous tree, except the elm, to have attained in Great Britain. Its girth was 12 feet 3 inches, and its bole straight and branchless for about 80 feet, so that its contents must be about 400 feet to the first limb.¹ Other extraordinary beeches at Ashridge are figured. Plate 4 is an illustration of natural inarching of a very peculiar type: the larger tree is 17 feet 6 inches in girth, the smaller, 4 feet 9 inches, and the connecting branch 12 feet long. It passes into the other tree without any signs to indicate how the inarching took place, and might almost have been a root carried up by the younger tree from the ground, as it has no buds or twigs on it. There are several beeches at Ashridge with very large and curious bosses on the trunk; one of these (Plate 5) at the base measured 21 feet over the boss, another had a large burr growing out of the side of a straight, clean, healthy tree at 40 feet from the ground. Such burrs are formed on the trunks of healthy as well as of diseased beeches, but I am not sure whether they ever have their origin in injuries produced by insects, birds, or other extraneous causes. Sometimes they have a horny or almost coral-like growth. Such burrs when cut through have an ornamental grain, which might be used for veneers when sufficiently compact and solid, but are left to rot on the ground by timber merchants, who as a rule place no value on such products.

In some parts of this park the beeches show a remarkably wide-spreading network of snake-like roots on the surface, which, though not uncommon in this tree when growing on shallow soil, are here unusually well developed. There is a remarkable beech clump to the east of the house containing 26 trees in a circle of 197 paces (11 of them grow in a circle of 78 paces), of which every tree is large, clean, and straight. The largest of them is about 125, perhaps 130, feet high, and 13 feet 10 inches in girth, and the average contents of the trees probably over 200 feet. I do not think I have ever seen in England such a large quantity of timber on so small an area.

But though it is doubtful whether any place in England can boast so many perfect beech trees as Ashridge, this park contains also some of the finest limes, the largest horse-chestnuts, and the most thriving and bulky chestnuts; and in a wood not far off is an ash which is much the best-grown tree of its species, if not the largest, that I have seen in England. All things considered, I doubt whether there is a more interesting and beautiful type of an English park than Ashridge, for though it contains few exotic trees, and no conifers except some Scotch pines, it has a magnificent herd of red, of Japanese, and of fallow deer, as well as flocks of St. Kilda sheep and of white Angora goats.

At Rotherfield Park, Hants, there is an immense pollard beech, of which I have a photograph kindly sent me by the owner, Mr. A. E. Scott, who gives its girth as 28 feet 3 inches at the narrowest point, 3 feet from the ground.

¹ According to Loudon, iii. 1977, this tree was in 1844 110 feet high, 10 feet in girth at 2 feet, and 74 feet to the first branch.

At Slindon Wood, near Petworth, Sussex, between the South Downs and the sea, which is seven miles distant, on the property of Major Leslie, there was in 1903 one of the finest beech woods in England, growing on chalk soil, of which I have particulars from Mr. C. H. Greenwood, and of which I give an illustration from a photograph sent me by him (Plate 6). Mr. Greenwood states that 634 trees were recently cut and sold in this wood, many of them being 70 and several 80 to 90 feet long to the first limb, and quarter girthing 20 inches in the middle. One tree now standing measures, without the top, $70' \times 26'' = 320$ feet, and on one acre at the east side of the wood are standing 60 which would average 150 feet each, making 9000 cubic feet to the acre. The tallest tree is 90 feet to the first bough, with 21 inches $\frac{1}{4}$ girth = 275 feet. This is perhaps the largest yield of beech per acre of which I have any record in England.

In Windsor Park there are some fine old beeches, of which three are figured by Menzies.¹ His plate 4 shows a remarkable old pollard at Ascot Gate 30 feet in girth, which he supposed to be 800 years old, and another, his plate 6, on Smith's lawn, of similar age and 31 feet 9 inches in girth. The third, Queen Adelaide's Beech, is a tree of no great size or beauty. It measured in 1864 8 feet 6 inches in girth, when supposed by Menzies to be 140 years old. In 1904 it had only increased 10 inches in girth. The finest beech now growing at Windsor—Mr. Simmonds, the deputy-surveyor of the Park, who was good enough to show it to me, agrees in this—is a tree near Cranbourne Tower, which in March 1904 measured 125 feet by 15, with a fine clean bole, but not equal to that of the Queen Beech at Ashridge.

The two largest beech trees, of whose measurement I have exact particulars, were both blown down in the heavy gale of September 1903, I believe on the same night. One of these was at Cowdray Park in Sussex, the property of the Earl of Egmont, and grew on sandy soil near the top of the great chestnut avenue at a considerable elevation, perhaps 400 feet. I saw it lying on the ground not long after, and obtained from Mr. Barber, steward on the estate, the following careful measurements:—

Butt 22 feet by 72 inches $\frac{1}{4}$ girth = 792 feet. Limbs measured down to 9 inches $\frac{1}{4}$ girth only, 43 in number, contained 924 feet 6 inches. Total 1716 feet 6 inches. Measured on the ground 21st September 1903.

The other was the great beech at Cornbury Park, of which I give a photograph taken after its fall (Plate 7), that gives an idea of its immense size. I saw the stump of this tree two years afterwards, and counted about 230 rings in it, which justify the belief that it may have been planted by Evelyn. Mr. C. A. Fellowes, agent for the property, had the tree carefully measured after its fall, and gives its height as 120 feet, girth 21 feet 4 inches. Cubic contents 1796 feet (nothing under 6 inches quarter girth being measured).

A magnificent beech growing in Studley Park, the seat of the Marquis of Ripon, was figured by Loudon, iii. 1955, and is there stated to have been 114 feet high.

¹ *History of Windsor Great Park and Windsor Forest, 1864.*

Mr. O. H. Wade, agent for the estate, tells me that this tree cannot now be identified.

Another celebrated tree, mentioned by Loudon as Pontey's Beech, was measured for him in 1837 by the direction of the Duke of Bedford in the Park at Woburn Abbey. It was then 100 feet high, with a clean bole of 50 feet, and was 12 feet 6 inches in girth at 4 feet. When visited in July 1903 it was about the same height and 14 feet 6 inches in girth, and was estimated to contain nearly 600 cubic feet.

A tree known as the Corton Beech at Boyton, Wilts, once the home of Mr. Lambert, author of the *Genus Pinus*, and mentioned by Loudon as one of the largest in England, was blown down a few years ago, and I have not been able to get its dimensions.

There were some very fine beeches at Castle Howard, Yorkshire, the seat of the Earl of Carlisle, one of which Loudon gives as 110 feet by 14 feet 2 inches, with a clean bole of 70 feet, and the other as containing 940 feet of timber, but when I visited this fine place in 1905 I could not identify either of these trees as still standing, though I saw many in Raywood of great size, with clean boles of 50 to 60 feet. A tree standing outside the garden wall was remarkable for the very rugged bark on its trunk, which up to 8 to 10 feet from the ground was more like that of an elm than a beech.

In Scotland, though the beech does not attain quite the same height and size as in some parts of England, it is a fine and commonly planted tree.

The self-layered beech at Newbattle Abbey near Dalkeith, the property of the Marquess of Lothian, eight miles from Edinburgh, must be looked on as the most remarkable, if not the largest, of all the beeches of the park or spreading type now standing in Britain; and though difficult to represent such a tree by photography in a manner to show its great size, every pains has been taken by Mr. Wallace of Dalkeith to do it justice (Plates 8 and 9). This splendid tree is growing in light alluvial soil in front of the house, and not far from the banks of the North Esk river, and may be 300 years old or more. It was in Loudon's time 88 feet high, and the trunk 9 feet in diameter (probably at the base), with a spread of branches of 100 feet. When I visited it in February 1904 under the guidance of Mr. Ramsay, who has known the tree for many years, I made it about 105 feet high, with a girth at about 5 feet—which is near the narrowest part of the bole—of 21 feet 6 inches. The trunk, as will be seen from the figure, is unusual in shape, and shows no sign of decay except where one large limb has been blown off, and this has been carefully covered with lead. But the numerous branches which have drooped to the ground, taken root, and formed a circle of subsidiary stems round the main trunk, are its most peculiar feature, and may remain as large trees for centuries after the central stem decays. The first of these has produced 7 stems of various sizes growing into fresh trees, at a distance of 8 to 12 yards from the trunk. The second has 2 large and 3 smaller stems. The third has 3 large stems about 30 to 40 feet high and 3 to 4 feet in girth. The fourth has 3 large and 6 smaller ones. The fifth is not yet firmly rooted, but is fastened down in several places to prevent the wind from moving it. The total circumference of

these branches is about 400 feet. Detailed measurements by Mr. Ramsay are given below.¹

A similar instance of self-layering, perfectly natural, was to be seen in the Kew Gardens, where a very fine beech, though by no means such a giant as the Newbattle tree, was surrounded by a fence in order to protect it. This tree, however, having become seriously decayed, had its main stem cut down in 1904.

Among the best specimens I have seen in Scotland are those at Hopetoun House, near Edinburgh, the seat of the Marquess of Linlithgow, where I measured a tree 110 feet high, with a clean bole of about 50 feet, and a girth of 12 feet. At Blair Drummond, near Perth, the seat of H. S. Home Drummond, Esq., Henry measured one of 117 feet high by 16 feet 6 inches in girth, and at Methven Castle, the seat of Colonel Smythe, another which is 120 feet high by 17 feet 2 inches in girth. This tree divides into three stems at about 20 feet, and is the tallest of which we have any certain record in Scotland. At Gordon Castle is a very fine beech with spreading roots (Plate 10) measuring 95 feet by 15 feet 8 inches. At Castle Menzies, Perthshire, the property of Sir Neil Menzies, is a very fine beech, which is described by Hunter² as a vegetable "Siamese Twins." Whether originally two trees or one is difficult to say, but it seemed to me to be from a single root which had forked a little above the ground and then grown together again, leaving an opening through which Hunter says an ordinary sized person might pass, but which in 1904 was smaller. At Inverary Castle is another example of an inoculated beech, known as the Marriage Tree, which, from a photograph published by Valentine, does not seem to be so striking as the one at Castle Menzies.

¹ Newbattle Abbey, Midlothian, N.B. Measurement of the great beech tree, August 25, 1903, by Mr. John Ramsay. Girth in feet, inches, etc., of trunk—

At the ground	43 feet 8 inches.
About 1 foot up	37 "
" 2½ feet "	27 " 8 "
" 3 " "	25 " 9½ "
" 4 " "	23 " 1½ "
" 4½ " "	21 " 11½ "
" 5 " "	20 " 3½ "
" 6 " "	19 " 7½ "

The ground measurement was taken by allowing the tape to lie on the roots as near to the uprising of the buttresses as possible, and is necessarily vague. The measurement at 6 feet up is the most correct, being taken on a line marked at intervals all round with white paint for future comparison.

Circumference of foliage fully 400 feet; diameter of foliage averages 130 to 140 feet; height, 112 feet.

The following are a few of the branches with the girth of them, and the girth of the branches springing up from the main branches rooted in the ground:—

No. 1.—Branch girth, 1 foot 10 inches, with two branches growing up from it; girth of both these new branches, 4 feet 5 inches each.

No. 2.—Branch girth, 1 foot 8 inches, having three branches springing up from it, one 5 feet 5 inches, one 5 feet 1 inch, one 23 inches by 1 foot 11 inches in girth.

No. 3.—Branch girth, 12½ inches, having three branches springing up from it, one 4 feet 7½ inches, one 24½ inches, one 4 feet 4 inches in girth.

No. 4.—Branch girth, 12 inches, with two branches springing up from it, one 2 feet 8½ inches, one 12 inches in girth.

No. 5.—Branch girth, 1 foot 7 inches, with three branches springing up from it, one 2 feet 4½ inches, one 12 inches, one 18 inches in girth.

No. 6.—Branch girth, 2 feet 4 inches, with five branches springing up from it, one 4 feet 4 inches, one 3 feet 8 inches, one 4 feet, one 3 feet 4 inches, one 1 foot 11 inches in girth.

² Hunter, *Woods, Forests, and Estates of Perthshire*, 1883, p. 397.

There are two beeches standing on a mound near the road to Lochfynehead in the Park at Inverary, which are known as the Doom trees, because in former times they were said to have been used as a gibbet for criminals; the largest of them measures 75 feet by 16 feet 5 inches. The Duke of Argyll, however, doubts this tradition.

There is another very fine beech, the largest I know of in the West Highlands, at Ardkinglas, at the head of Lochfyne, under which Prince Charles's men are said to have camped in 1745. Though of no great height it has a girth of 18 feet 8 inches, and spread of branches 30 yards in diameter.

In Ayrshire the largest beech is at Stair House. According to Renwick,¹ in 1903 it was 100 feet high, and 18 feet 9 inches at 4 feet 3 inches above the ground. At Kilkerran, in the same county, Renwick records a beech 21 feet 3½ inches at 3 feet from the ground, which, however, had a bole of only 4 feet. Other large beeches in Scotland occur at Eccles in Dumfriesshire and at Belton in East Lothian. The Eccles Beech, according to Sir R. Christison, was little inferior to the Newbattle Beech; according to Hutchinson, in 1869 it was 20 feet in girth at 4 feet up. I learn from Dr. Sharp that it has been dead for some years. The Belton Beech in 1880 was 20 feet 4 inches girth at 5 feet, with a 13-foot bole and a height of 63 feet.

One of the most striking effects produced by the beech in Scotland is the celebrated beech hedge of Meikleour, in Perthshire, on the Marquess of Lansdowne's property. An account of this hedge is given in the *Gardeners' Chronicle*, Dec. 15, 1900. This hedge forms the boundary between the grounds and the highway, and has to be cut in periodically, which is done by men working on a long ladder, from which they are able to reach with shears to about 60 feet. Local history says that this hedge was planted in 1745, and that the men who were planting it left their work to fight at the battle of Culloden, hiding their tools under the hedge, and never returning to claim them.² It is 580 yards long, and composed of tall, straight stems planted about 18 inches apart, and nearly touching at the base. The average height of the trees, as I am informed by Mr. Donald Matheson, is 95 feet, and their average girth at 3 feet is 18 to 36 inches. He adds that "close to the ground they are as fresh and green as a young hedge." An illustration of this hedge, taken specially for our work by Mr. D. Milne of Blairgowrie, gives a good idea of its appearance in October 1903 (Plate 11).

I am informed by Sir Herbert Maxwell, M.P., that a remarkably similar occurrence is on record at Achnacarry, on the property of Cameron of Lochiel; here the trees were laid in ready to plant in 1715, and the men were also called off to take part in the rebellion of that year. The trees were never planted, and have grown up in a slanting position close together just as they were left.

In a paper on the "Old and Remarkable Trees of Scotland," published in 1867 by the Highland and Agricultural Society of Scotland, many other remark-

¹ Renwick in *British Association Handbook*, p. 140 (1901). We are much indebted to Mr. John Renwick for measurements and descriptions of large and interesting trees in the south-west of Scotland.

² Hunter, *loc. cit.* 379.

able beeches are mentioned, of which one at Edenbarnet in the parish of Old Kilpatrick, Dumbartonshire, is said to be 140 feet high; but the measurements of many of the trees in this compilation are so unreliable that I cannot believe them without confirmation.

J. Kay, in *Scottish Arb. Soc. Transactions*, ix. p. 75, mentions a tree in the Beech Walk at Mount Stuart in Bute, which in 1881 was 120 feet by 11 feet 9 inches, with a clean bole 60 feet high, and contained 450 feet of timber.

In Ireland the beech is probably not a native tree. According to Hayes¹ it was first introduced at Shelton, near Arklow, where, in 1794, there were beech trees as much as 15 feet in girth, and many carrying a girth of 10 feet for more than 40 feet high. Another growing at Tiny Park was 16 feet 3 inches in girth, and continued nearly of that girth for 36 feet. Hayes also mentions, as an instance of the rapid growth of the beech in Ireland, "several at Avondale, which were transplanted within thirty years on a swelling ground at that time much exposed to storm, are now (1793) from 7 feet 6 inches to 6 feet 6 inches at a foot from the ground, and continue nearly of that size from 8 to 20 feet in height. Of two which were planted in a richer soil near the river, and are now (1793) just fifty-four years from the mast, one measures 9 feet round, the other 9 feet 6 inches."

The finest beeches in Ireland, probably, are those occurring at Woodstock (Co. Kilkenny), the seat of E. K. B. Tighe, Esq.—a property which is remarkable all round for magnificent trees of many kinds, and which is in the possession of a family that for generations has been deeply interested in forestry and arboriculture. The measurements of many trees have been taken periodically for nearly a century. The best beeches on this beautiful property occur in the meadow land by the River Nore, close to the village of Inistioge. The following table gives an interesting series of measurements of these beeches:—

No.	GIRTH.						HEIGHT.	
	1825.	1830.	1834.	1846.	1901.	1904.	1901.	1904.
A ₃	ft. in. 10 9	ft. in. 11 1	ft. in. 11 6	ft. in. 12 6	ft. in. 20 6	ft. in. 20 7	81	86
C ₇	...	...	...	12 7	17 3	17 9	97	99
B ₃	...	...	...	12 5	14 0	...	91	...
B ₅	12 1	12 10	14 4	15 4	18 9	18 10	113	117
B ₆	11 10	12 3	13 8	14 10	17 9	...	108	...
B ₂	11 4	11 11	12 10	13 8	15 8	16 4	112	109
B ₁	11 0	11 6	12 7	13 8	16 6	...	106	...
B ₉	11 9	...	12 9	14 0	16 7	...	120	...
B ₈	...	...	9 5	10 1	12 3	...	100	...

The measurements up to 1901 are from the foresters' records; those of 1904 were taken by Henry. The beech A₃ has a great bole, dividing into three limbs at 18 feet up, and is a very wide-spreading tree. C₇ is pressed on each side by two lime trees, and is narrow in shape. The most remarkable of all is B₆, which is probably the tallest beech in Ireland.

¹ Hayes, *A Practical Treatise on Planting* (1794), pp. 109, 118.

As showing the rate of growth of the beech in Co. Galway, a beech measured by Lord Clonbrock at Clonbrock was 11 feet 3 inches in girth in 1871, and 15 feet in 1903. A beech hedge at Kilruddery, Co. Wicklow, the seat of Lord Meath, said to be 300 years old, was measured by Henry in 1904, when it was 18 feet through and 29 feet high. It is clipped regularly, and forms a dense, impenetrable mass.

BEECH COCCUS

We are indebted to Mr. R. Newstead of the Grosvenor Museum, Chester, for particulars of the coccus which in some seasons, and in certain parts of England, has been of late years very injurious to the beech. A fuller account of this insect has been written by him in *Journ. R. Hort. Soc.* 1900, vol. xxiii. p. 249, and in a leaflet recently published by the Board of Agriculture. From this we take the following precis:—

The trunks and, less frequently, the main branches of good-sized beech trees are often covered, to a greater or less extent, with irregular spots of a white cottony substance. The latter is really the covering of white felted wax fibres secreted by the felted beech coccus (*Cryptococcus fagi*, Bärensprung), a minute, hemispherical, lemon-yellow insect, about one twenty-fifth of an inch long, without legs, but furnished on the underside with a well-developed beak, which it buries in the bark for the purpose of sucking up the juices of the tree. When once a tree is attacked the number of individuals of the pest becomes in time so great that it is doubtful whether a badly-infected tree ever recovers unless active measures be taken against the insect. The waxy covering of the latter is sufficient to protect it against the effects of any of the insecticides usually applied by spraying, and its habit of preferring the deepest part of the fissures in the bark makes it difficult to remove with certainty. The only remedy at all likely to succeed is that of thoroughly scrubbing the bark with a stiff brush and soap and water, the latter mixed in the proportion of half a pound of soft soap to each gallon of water; and the success of this treatment depends for the most part on the amount of care taken to dislodge the insects by means of the brush.

TIMBER

The timber of the beech is not valued so highly in England as abroad, where it is considered as the best fuel in general use, and is little used in carpentry or building, as it is hard, brittle, and liable to be attacked by beetles. It weighs when green about 65 lbs. to the cube foot, when dry about 50. Its durability is said to be increased by seasoning it in water, and it is more durable when entirely under water than most timbers, being highly recommended by Matthews and Laslett for planking the sides and bottoms of ships. In France it is used, when creosoted, for railway sleepers, but requires more than twice as much creosote to preserve it as oak does, and is not used in England, so far as I know, for this purpose. It is also used for tool handles, rollers, butchers' blocks, brush heads, planes, and general turnery, but decays rapidly when exposed to the weather.

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The principal centres for beechwood furniture in England are at High Wycombe, and Newport Pagnell in Bucks, and the price of clean trunks in these districts is from 1s. to 1s. 6d. per cube foot standing, according to the situation. Beechwood is also used largely for making saddle-trees, and in consequence of the great demand for these during the South African war, went up to a very high price in 1901, when I was offered 1s. 4d. a foot standing for beech trees which in ordinary times would not be worth more than 8d. or 9d. a foot. Being easy to split it is, where there is a demand for firewood, easier to dispose of the branches and rough parts of the tree for this purpose, but the amount of waste is much greater in the beech than in some other trees, unless grown in thick woods. For more minute particulars of the characters and uses of this timber, Stone's *Timbers of Commerce*, p. 231, and Loudon, pp. 1959-64, may be consulted with advantage. (H. J. E.)

AILANTHUS

Ailanthus, Desfontaines, *Mém. Acad. Paris*, 1786 (1789), 263, t. 8; Bentham et Hooker, *Gen. Pl.* i. 309 (1862); Prain, *Indian Forester*, xxviii. 131, Plates i. ii. iii. (1902).

LOFTY trees with very large alternate imparipinnate leaves. Flowers small, polygamous, bracteolate, in panicles. Calyx 5-toothed, imbricate. Petals 5, valvate, disk 10-lobed. Stamens 10 in the staminate flowers, 2-3 in the hermaphrodite flowers, and absent in the pistillate flowers. Ovary present in pistillate and hermaphrodite flowers, rudimentary in staminate flowers, deeply 2-5 cleft with connate styles: ovules 1 in each cell. Fruit of 1-5 samaras, with large membranous wings, each samara containing 1 seed.

Ailanthus belongs to the Natural order Simarubaceæ, and consists of about eleven species occurring in India, Indo-China, China, Java, Moluccas, and Queensland. Most of the species are tropical trees, *Ailanthus glandulosa* being until lately the only species which was known to occur in temperate regions; but *Ailanthus Vilmoriana*, Dode,¹ must be here mentioned. This is a tree remarkable for its prickly branchlets, of which only one specimen is known, namely, a young, healthy, vigorous tree grown in M. de Vilmorin's garden at Les Barres.² It was raised from seed sent by Père Farges in 1897 from the mountains of Szechuan in Central China;³ and is certainly a very distinct species. I saw it in the summer of 1904, and in general aspect there is little to distinguish it from the common species. It is now about 20 feet in height. The leaflets in this species are less abruptly acuminate, not falcate, much duller above and paler beneath, with larger glands than in *Ailanthus glandulosa*. All the parts of the tree are much more pubescent than in that species.

Ailanthus grandis,⁴ Prain, a new species from Sikkim and Assam, which attains 120 feet high, may be here mentioned, as it is possible that it might be grown in Cornwall or in Kerry. It has not yet been introduced.

¹ *Revue Horticole*, 1904, p. 445, fig. 184.

² Figured in *Fruticetum Vilmorinianum*, 1904, p. 31; where it is called *Ailanthus glandulosa*, var. *spinosa*.

³ Mr. E. H. Wilson informs us that it is very common in the valleys of the Min, Tung, and Fou rivers, between 2000 and 4500 feet. He says that it is much more spiny in the young than in the adult state, and that it has much larger foliage than the common species. A plant is now growing at Kew, and is referred to by Mr. Bean in *Gardeners' Chronicle*, xxxviii. 276 (1905).

⁴ *Indian Forester*, xxviii. 131, Plate i. (1902).

AILANTHUS GLANDULOSA, AILANTHUS TREE

Ailanthus glandulosa, Desfontaines, *Mém. Acad. Paris.* 1786 (1789), 263, t. 8; Loudon, *Arb. et Frut. Brit.* i. 490 (1838); Britton and Brown, *Illustrated Flora of the Northern United States and Canada*, ii. 355, Fig. 2272 (1897).

A tree attaining 100 feet in height and 13 feet in girth; branches massive and forming an oval crown, which becomes flattened at the top in old trees. Bark smooth, grey, or dark brown, and marked by longitudinal, narrow, pale-coloured fissures, which are very characteristic.

Leaves deciduous, compound, 1-3 feet long, imparipinnate, with 7-9 (sometimes even 20) pairs of leaflets, which are either opposite or nearly so, shining above, pale and glabrous (occasionally slightly pubescent) beneath, and unequally divided by the midrib. Each leaflet is stalked, ovate, or ovate-lanceolate, acute or acuminate at the apex, cordate or truncate at the base, entire in margin, except that near the base there are 1-4 pairs of glandular teeth. Stipules absent. The leaves appear late in spring, and exhale when rubbed a disagreeable odour which renders them distasteful to animals. They fall off late in autumn, absciss layers being formed at the base of the leaflets as well as of the main stalk; the former usually drop first.

Flowers appearing in July and August in large panicles at the summit of the branchlets, either unisexual or hermaphrodite; but as a rule the trees are practically dioecious, and those bearing staminate flowers give off an objectionable odour.

Fruit, 1-5 keys, resembling those of the ash, linear or oblong, membranous veined, with a small indentation above the middle on one side, close to where the seed is located; and the wings on both sides of the seed are slightly twisted, so that the fruit in sailing through the air moves like a screw. The keys are bright red or purplish brown in colour, and are very conspicuous amidst the green foliage.

Seedling: the cotyledons appear above the soil on a caulicle about an inch long and are foliaceous, coriaceous in texture, oboval, obtuse, shortly stalked, entire in margin, and pinnate in venation. The stem above them is pubescent, and at a short distance (about $\frac{1}{2}$ inch) up bears two leaves, which are trifoliolate and long-stalked, the terminal leaflet being lanceolate, acuminate, and entire, the two lateral shorter and toothed.¹ Higher up ordinary pinnate leaves are borne. Plate 15 A shows a seedling raised by Elwes from seed ripened on a tree overhanging Dr. Charles Hooker's garden at Cirencester in 1900;² sown November 26, germinated under glass in May 1901, and photographed on August 28 of the same year, when it measured about a foot high; the roots, which were very succulent and brittle, were 13 inches long. The seedlings were planted out in May 1902, and grew very rapidly, attaining 5 feet in height, but did not ripen their wood, which was killed back in some cases nearly to the ground. They are now (January 1905) 4-6 feet high.

¹ See Plate 14, fig. B.

² As I know of no other tree in the neighbourhood this case seems to confirm Bunbury's observation that the tree in some cases is capable of self-fertilisation.—(H. J. E.)

IDENTIFICATION

In summer the Ailanthus is readily distinguished from all other trees cultivated in England by its large pinnate leaves, which have *at the base of the leaflets on each side one or two glandular teeth*. The black walnut, butternut, and *Cedrela sinensis* have somewhat similar foliage; but in these the glandular teeth are wanting. The bark of Ailanthus is quite peculiar, and when once seen cannot be confounded with that of any other tree.

In winter Ailanthus is easily recognised by its bark in trees of a certain size; but in all stages of growth it is well marked by the characters of the buds and branchlets.

The buds are alternate, uniform in size, small and hemispherical, and show externally 2 or 3 brown tomentose scales.¹ The buds are set obliquely on the twigs just above the leaf-scars. The latter are large, heart-shaped, and slightly concave; and on their surface may be seen about 7 little elevated cicatrices which correspond to the vascular bundles of the fallen leaves. No true terminal bud is formed; and at the apex of the twig there is an elevated small circular scar, which marks the spot where the tip of the branchlet fell off in summer. The twigs are very coarse, glabrous, or finely pubescent, shining and brown in colour, with a few plainly visible lenticels. The pith is large, buff or yellowish in colour, showing clearly on section the medullary rays. In *Cedrela* there is a large terminal bud, and the leaf-scar has 5 cicatrices. The chambered pith of *Juglans* will readily distinguish the black walnut and butternut.

VARIETIES

Several varieties are mentioned in books; *aucubæfolia*, *pendulifolia*, *rubra*, and *flavescens* being recognised by Schelle;² but it is doubtful if any of these are sufficiently marked to deserve recognition. The *Ailanthus flavescens*³ of gardens was determined by Carrière to be *Cedrela sinensis*. A form with variegated leaves is mentioned by Koch,⁴ but it is exceedingly rare. The Kew Hand-list only admits one variety, *pendula*, a form somewhat weeping in habit.

DISTRIBUTION

Ailanthus glandulosa has been only found truly wild on the mountains of the province of Chihli in Northern China; but it is cultivated in most parts of China, and doubtless was once a constituent of the forests of the northern coast provinces, most of which have been destroyed by the Chinese. I never saw it wild in any of the mountain forests of Central or Southern China. When first introduced

¹ A plate showing buds will appear in a later part.

² *Laubholz-Benennung*, 279 (1903).

³ See article on the "Ailanto or Tree of Heaven" by Nicholson, in *Garden*, 1883, xxiv. 63, with figure of flowers, fruit, and foliage, and many interesting details concerning propagation, etc.

⁴ Koch, *Dendrologie*, i. 569 (1869).

into Europe it was supposed to be the species of *Rhus* which yields Japanese varnish or lacquer; and even now it is often called in France *Vernis du Japon*. The tree, however, is unknown wild in Japan, and is seldom or never cultivated there. The Chinese in classical times were well acquainted with *Ailanthus*, which they called *ch'u*, a word explained as meaning "useless wood," as it was in ancient times (as well as at present) used only for firewood.¹ Popularly *Ailanthus* and *Cedrela* are now called *ch'un* trees, the former being distinguished as the "stinking *ch'un*," and the latter as the "fragrant *ch'un*."

In China the *Ailanthus* grows to be a large tree; but the timber is little valued. The root-bark is used, as a strong infusion, in cases of dysentery.² In the Pharmaceutical Museum, London, there are several specimens of barks bearing the Chinese name for *Ailanthus*; but these are doubtfully referable to that species; and the whole subject of the use of *Ailanthus* bark for dysentery requires further investigation.³

In the Kew Museum there are specimens of silkworms (*Attacus Cynthia*, Drury), which feed on the leaves of *Ailanthus* in North China; and there are also samples of the "wild silk" produced, which is made into one kind of pongee. This species of silkworm was introduced into France in 1858; and large numbers of *Ailanthus* trees were planted with a view to the feeding of the silkworms. The winter of 1879 killed off all the silkworms; and apparently the cultivation of the tree in France for the production of silk is a thing of the past.

In the Kew Museum there is a note attached to a specimen of the wood of *Ailanthus glandulosa* from Tuscany, which says that the bark yields a resinous juice; but there is no account of such a resin from Chinese sources; and exudation from the bark has not been observed in trees growing in England or in France. In India, however, the resin, called *muttee-pal*, is derived from the bark of *Ailanthus malabarica*, and is used both as an incense and as a remedy for dysentery.

INTRODUCTION

Ailanthus glandulosa was first introduced from China in 1751. In *Hortus Collinsonianus*,⁴ p. 2, a memorandum is copied which was left by Collinson, stating: "A stately tree raised from seed from Nankin in 1751, sent over by Father d'Incarville, my correspondent in China, to whom I sent many seeds in return; he sent it to me and the Royal Society." Père d'Incarville⁵ was a French Jesuit missionary, who died at Peking in 1757. In *Trans. Phil. Soc.*, 1757, a paper is printed, which was read on 25th November 1756, being a letter from John Ellis to P. C. Webb; and it mentions two trees which were growing, one in Webb's

¹ In the *Shu-Ching*, it is said: "In the ninth month they make firewood of the *ch'u* tree."

² On the therapeutical value of this drug, see articles by Drs. Dudgeon and Robert, in *London Pharmaceutical Journal*, ser. iii. iv. 890, and vii. 372.

³ The bark has been found to be an excellent vermifuge in cases of tapeworm. See Hætet, in *U.S. Dispens.* 15th edition, 1564.

⁴ Compiled by L. W. Dillwyn, and published at Swansea in 1843.

⁵ In Cibot, *Mém. Conc. Chinois*, ii. 1777, 583, d'Incarville's "Mémoire sur les vers à soie sauvage" is published, in which he speaks of the *Ailanthus* as the *frêne puant* (stinking ash) of North China.

garden at Busbridge, near Godalming, and another in the Chelsea Physic Garden, both raised from the seed sent by Père d'Incarville. The tree is here first described as *Rhus sinense foliis alatis, foliolis oblongis acuminatis ad basin subrotundis et dentatis*.¹

TREE OF HEAVEN

This name is often given to the tree in England, corresponding to the German *Götterbaum*. It is not the translation of any Chinese name, as has often been erroneously stated. Desfontaines' original description occurred in a rare book which has not been looked up by most writers on the tree. He was well aware that the tree came from China, but in selecting a name for the genus he took it from another species which he found figured in Rumphius' *Hortus Amboinensis*, v. cap. 57, tab. 132. This species, left undescribed by Desfontaines, is *Ailanthus moluccana*. Rumphius calls it *arbor cæli*, the equivalent of the native name in the Amboyna language, *Aylanto*, which signifies "a tree so tall as to touch the sky." "Tree of Heaven" is accordingly a translation of the name of Rumphius, and is more properly applied to the tall tropical species than to *Ailanthus glandulosa*, which does not attain any remarkable height.

CULTIVATION

The *Ailanthus* is easily propagated from seeds; but as trees bearing male flowers are objectionable on account of their odour, it is preferable to propagate the tree from root-cuttings obtained from female trees. In addition to the disagreeable odour of the male flowers, there may be some foundation for the belief prevalent in the United States that they cause stomachic disturbance and sore throat. The pollen from staminate flowers, doubtless, occasions a kind of hay fever.

The tree suckers freely from the root and to a great distance, as far as 100 feet from the parent stem. At Kew these suckers frequently appear between the tiles of the floor of one of the buildings near which an *Ailanthus* stands. At Oxford² a root-sucker sent up a flowering shoot, and, what is more remarkable, produced simple leaves, giving some support to the idea that plants with compound foliage originated from those with simple leaves. The tree has extraordinary vitality. Dr. Masters² gives an account of a tree which was cut down, the stump being left in the ground below the surface. Several years elapsed during which nothing was observed, but after about ten years suckers were seen coming up in a gravel path adjacent, and these, being traced, were found to issue from the old stump.

Ailanthus reproduces itself freely from stools, and the coppice shoots thus obtained are very vigorous.

It was long supposed that *Ailanthus* would succeed even on the worst soils, but this is an error. It only does well on permeable soils, which are fairly moist,

¹ In the herbarium of the British Museum there is a specimen labelled *Hort. Busbridge*, which is undoubtedly from the original tree. It was cut down in 1856 owing to the great amount of shade it produced near the house (*Gard. Chron.* 1857, p. 55). There is another specimen from Kew Gardens, 1779, showing that the tree was cultivated early there.

² *Gard. Chron.* 1887, ii. 364.

and for this reason it is successfully used to cover railway and road embankments in France. It will not grow well on compact clay or on chalky or absolutely poor soils. In England it has only been planted as an ornamental tree, and it is very suitable for planting in towns, as it is not injured by smoke and is free from insect attacks and fungous diseases. Though it suckers freely, this is no objection in streets, where the pavements or wheel traffic prevents them from making an appearance. The young shoots are often killed by frost, but this only serves to keep the tree within bounds without the use of the pruning knife. The *Ailanthus* only makes one shoot annually, late in the spring, which continues to grow till October or November, and this is the reason why it is spring tender, as the tips of the shoots do not become properly lignified. The tree, however, bears the greatest cold in winter, and was not injured by the severe frost of 1879.

The tree produces flowers in England when it is about 40 feet high; and it fruits pretty frequently, but the seeds are often infertile.

When the *Ailanthus* is cut back annually, it grows rapidly and produces foliage of enormous size, suitable for the so-called tropical garden. Leaves of plants so treated have measured as much as 4 feet long and 15 inches wide.

The *Ailanthus* succeeds in a great variety of climates, and is planted in regions so diverse as Northern India, the United States, France, Germany, and Italy. In France it has not been successful as a forest tree, as it is not a social species, and is speedily dominated by native trees, if it survives the seedling stage, when it is sensitive to spring frosts. In warmer climates it easily regenerates by seed, and in consequence has become naturalised in many parts of Europe (as on the arid slopes of Mount Vesuvius, where it stands very well the drought), and in the United States,¹ where it often runs wild in old fields. American writers praise the tree for the value of its wood and the rapidity of its growth, as it is said to make timber faster than any of the native trees that are used for firewood.

The wood is yellowish or yellowish green, and is not clearly distinguishable into well-marked heart and sap woods, though in old trees the centre of the stem becomes deeper in colour. The wood has a specific gravity of 0.6, and is easily worked, taking a good polish. It rives easily. It is used by wheelwrights as a substitute for elm and ash; but is inferior to these, as it does not possess their elasticity or their capability of resistance to fracture. It is said, however, to bear well alternations of dry and wet.

Mr. J. A. Weale of Liverpool, who has paid great attention to the study of timbers, and knows more about them than any one in the trade in this country, writes to us that this wood resembles that of the ash so closely in structure, that the only real difference between the two is in the large cellular compound pores which are formed in the *Ailanthus*, as shown in the microscopical section which he enclosed.

Elwes is assured by Prof. C. S. Sargent that it makes nice furniture, and he has a specimen from a large tree which was cut down in the Palace Gardens at Wells, Somerset, of which the timber was bought by Mr. Halliday, a cabinetmaker, for £8.

¹ Also in Southern Ontario. See Britton and Brown, *loc. cit.*

REMARKABLE TREES

The largest *Ailanthus* was that at Syon, which was 70 feet high in Loudon's time, and nearly 100 feet in 1880.¹ It is now dead.

At Kew a vigorous tree is growing in the garden behind the Palace, which measures 73 feet high and 8 feet in girth. Not far off a number of *Ailanthus* trees of varying size, but none very large, occurs in a group, and they seem to be root-suckers; probably one of the original trees was planted in this spot in the eighteenth century.

At Milton Rectory, Steventon, Berks, there are two trees of equal height (78 feet), one girthing 9 feet 1 inch, and the other 8 feet 6 inches. Both these trees bloom freely every year, producing fruit of a bright red colour on the south side of the trees; and the seeds, as they fall in the garden near hand, produce seedlings which are very vigorous.²

At the Mote, Maidstone, there are two large trees, one of which is 70 feet high and 8 feet in circumference.

At Linton Park, Maidstone, is a tree growing in a shrubbery which was nearly 80 feet high by 6 feet 6 inches in 1902.

At Broom House, Fulham, the residence of Miss Sullivan, is a tree 80 feet high, with a bole 9 feet long and 10 feet in girth, which divides into two main stems (Plate 13).

At Fakenham, Norfolk, Sir Hugh Beevor has measured a tree 75 feet by 8 feet 11 inches.

At Barton, Bury St. Edmunds, an *Ailanthus* which was planted in 1826³ measured in 1904 55 feet high, with a girth of stem of 5 feet 2 inches. Bunbury says that it is perfectly hardy at Barton, and did not suffer in the least from the severe winter of 1860. It was 3½ feet girth at 3 feet from the ground in 1862. It flowered abundantly in August of 1861, the greater part of the flowers being hermaphrodite, and a considerable number of fruits were formed, but all dropped off before coming to maturity. It fruited abundantly in 1868. Bunbury says, generally there is only one samara to each flower, but not unfrequently two or three; he never saw more than three.

At Belton Park, the seat of Earl Brownlow, is a fine specimen of the tree, for a photograph of which (Plate 14) we are indebted to Miss F. Woolward, who gives its height as 83 feet, and its girth as 6 feet. This seems to be the tallest tree recorded in England.

At Burwood House, Cobham, Surrey, the seat of Lady Ellesmere, Colonel H. Thynne has measured an *Ailanthus* 71 feet high by 10 feet 10 inches girth, which, though partly fallen down and supported by a prop, is still a fine tree.

The tree seems to require a climate which is at once both warmer and drier in summer than that of the northern and western counties of England, and we do not know of any trees of any great size now existing in Scotland, Ireland, or Wales, though Loudon states that there was one at Dunrobin Castle, Sutherlandshire, 43 feet high.

(A. H.)

¹ *Garden*, 1880, xviii. 629.

² The Rev. H. Hamilton Jackson kindly sent us this information in a letter dated Dec. 10, 1903.

³ Bunbury, *Arboretum Notes*, 88.

SOPHORA

Sophora, Linnæus, *Gen. Pl.* 125 (1737); Bentham et Hooker, *Gen. Pl.* i. 555 (1865).

TREES, shrubs, or perennial herbs, with naked buds and imparipinnate leaves. Flowers papilionaceous, in simple racemes or terminal leafy panicles. Calyx five-toothed, imbricate. Stamens ten, not united together, or rarely sub-connate. Ovary short-stalked, with many ovules. Pod moniliform, indehiscent, or tardily dehiscent.

The name *Sophora* was taken by Linnæus from the Arabic word *Sophera*, which indicated some leguminous tree. The genus belongs to the tribe Sophoreæ (Natural order Leguminosæ, division Papilionaceæ) characterised by imparipinnate leaves and ten free stamens. There are about twenty-five species of *Sophora*, generally spread throughout the tropical and warm temperate regions of the globe. The only species of importance which attain to timber size are *Sophora japonica* and *Sophora platycarpa*. *Sophora macrocarpa* from Chile and *Sophora tetraptera* from New Zealand are shrubs or small trees, which are frequently cultivated in the southern counties of England, and do not come within the scope of our work, although they are said to attain a height of 50 feet in the wild state.

Sophora platycarpa, Maximowicz, in *Mel. Biol.* ix. 70 (1873), (*Fuji-ki* in Japan), only lately¹ introduced into cultivation in England; but in the United States, where it has been grown for some time, it is said to have proved hardier than *Sophora japonica*.² It is a tree of considerable size, occurring in woods in Japan on the side of Fusiyama and in Nambu. It is similar in leaves and flowers to *Sophora japonica*; and, as will be pointed out in our account of that species, has been probably confused with it by writers on Japanese trees. The leaves are larger than in *Sophora japonica*, the leaflets being 2 to 3½ inches long, alternate, acuminate, glabrous or nearly so. The flowers are ½ inch long, white, and loosely arranged. The main difference is in the pod, which is membranous, flat, narrowly winged on each side, and irregularly constricted.³

¹ There are two plants at Kew which were raised from seeds obtained in 1896 from Späth of Bertin. See *Mittheil. der Dendr. Dendr. Gesell.* 1896, p. 27.

² A. Rehder in Bailey's *Cyclopædia of American Horticulture*, p. 1684 (1902).

³ *Sophora shikokiana*, Makino, in *Tokyo Botanical Magazine*, 1900, p. 56 (*Yuko-noki* in Japan), is described as a species closely allied to *S. platycarpa*, and as being widely distributed throughout the mountain districts of Japan. It is said to be a tree of considerable size.

SOPHORA JAPONICA, SOPHORA TREE

Sophora japonica, Linnæus, *Mantissa* i. 68 (1767); Loudon, *Arb. et Frut. Brit.* ii. 563 (1838); Shirasawa, *Iconographie des Essences Forestières du Japon*, i., Text, p. 86, Plate 50 (1900).

A large tree, with a straight cylindrical stem of considerable height in some cases, but more often in cultivated examples dividing at no great distance above the base; branches tortuous, with pendent tips; crown of foliage, large, broad, and rounded in shape. Bark brown or greyish and scaly, fissured longitudinally, but to no great depth; on young shoots and older branchlets, smooth and dark green.

Leaves deciduous, alternate, unequally pinnate, with nine to fifteen leaflets, which are sub-opposite, oval, pointed at the apex, often ending in a short bristle, dark green and opaque above, glaucous beneath. In the ordinary cultivated form they are apparently glabrous, but with a lens minute hairs may be detected on both surfaces. The petiolules are velvety; the main stalk is greenish, swollen at the base, and slightly pubescent. In certain wild specimens from China they are green and not glaucous beneath; and in Hupeh a well-marked variety occurs, in which the under surface of the leaflets, the petiole, and young shoots are densely white pubescent.

Flowers in large, loosely branched terminal panicles. They are somewhat variable in colour; in Central China white, at Canton a bright yellow, in cultivation in England pale yellow, sometimes tinged with purple. Calyx small, bell-shaped, five-toothed. Corolla, standard large, obtuse, round, recurved; wings oval-oblong; keel semi-orbicular, rounded, and of the same length as the wings. Pod long-stalked, 1 to 2 inches long, glabrous, fleshy, compressed, with a beak at the apex, and constricted between the seeds, which are one to five in each pod, dark brown in colour and kidney shaped.¹

In England the tree produces flowers regularly, late in the season, in August, September, and October, but seldom if ever fruits.

IDENTIFICATION

Sophora japonica is readily distinguished in summer by the leaves, the characters of which have been already given, and by the branchlets, which are angled, very smooth and dark green, both in the young shoots and those of the second year. When the young shoots are cut they emit a strong peculiar odour. In winter the characters of the buds and branchlets must be noted. The buds are spirally arranged on the shoots; solitary or in pairs, one placed above the other; naked, *i.e.* not surrounded by any true scales, and dark violet densely pubescent. They are

¹ *Seedling*.—Seeds sown early in the year at Colesborne produced two or three young plants, which showed the following characters in July:—Caulicle an inch or more in length, terete, green, glabrous, ending in a long whitish tap-root with numerous lateral fibres. Cotyledons oblong-spathulate, ⅝ inch long, entire, rounded at the apex, tapering at the base, sub-sessile, coriaceous, dark green and minutely pubescent above, pale green below. Stem white appressed pubescent, giving off alternately about six compound leaves; the lower three with five leaflets, the terminal leaflet being larger and broader in proportion to its length than the others; the upper three with 7 to 9 leaflets, uniform in size and shape; all the leaflets oval, entire, shortly-stalked, their under surface with a scattered appressed pubescence, dense on the midrib. Small ovoid densely pubescent buds are produced, one in the axil of each leaf, the shoot being terminated by an oblong white pubescent larger bud.

very small and lodged in the leaf-scar, which is oval, with the bud in the centre, and displays three crescentic small cicatrices left by the vascular bundles of the petiole. The leaf-scar is set obliquely on a projecting leaf-cushion. The branchlets in winter are the same as in summer, but they show more clearly their zig-zag nature, and at their apex will generally be seen a little stub which indicates the point where the end of the branchlet fell off in summer, no true terminal bud being developed. Occasionally a true terminal bud may be seen at the apex of the shoot, which is open and not concealed in the leaf-scar, minute, bearing two scales outwardly, and very pubescent.¹

VARIETIES

In addition to the pubescent form of Central China, not yet introduced, a few varieties occur, concerning the origin of which little is known.

Var. *variegata*.—Leaves dull yellowish white in patches. This form is neither robust in growth nor attractive in appearance.

Var. *pendula*² (Weeping Sophora).—One of the most formal of weeping trees. It is usually grafted by budding on seedlings of the common Sophora about 6 to 8 feet high; and from this elevation the branches hang down until on reaching the ground their tips spread out or turn up. It can be used as an arbour; and even in winter the light, smooth, green branches make it ornamental. The only trouble is in procuring smooth, straight stems of the ordinary Sophora of a sufficient height. F. L. Temple³ says: "In spring plant dormant Sophoras about $\frac{3}{4}$ inch in diameter in the fairly rich earth bottom of a greenhouse. Cut them back to the ground, and set them 1 foot apart each way; and by December first they will be out of the top of the house and as smooth as willows. Then lift and keep them protected in a cellar or frame, or heel them deep in a well-drained place till spring, when they can be planted in nursery rows, and grafted at the same time with the most gratifying results." With regard to the origin of the weeping Sophora nothing is known definitely; but Fortune⁴ states that at Shanghai in 1853 he saw "pretty specimens of *Sophora japonica pendula*, grafted high as we see the weeping ash in England." It is probable that this variety was imported early from China.

Var. *crispa*.—Leaves curled, the points of the shoots resembling as it were clusters of ringlets. We have never seen a specimen of this curious variety, which is not mentioned in the Kew Hand-list.

Var. *Korolkowii* (*Sophora Korolkowii*, Cornu).⁵—This has longer and narrower leaflets than the type, and the young shoots, leaf-stalk petiole, and under surface of the leaflets, are whitish pubescent. The flowers are said to be of a dirty white in colour. Köhne⁶ states that one of Dieck's introductions from Mongolia is identical with the plant cultivated at Segrez under this name, the origin of which is unknown. In the summer of 1904 I visited the Arboretum at Segrez, and saw this

¹ A Plate showing buds will appear in a later part.

² An excellent article upon different species of weeping trees was published in the *Gardeners' Chronicle*, 1900, xxviii. 477; and on p. 479 there is a good figure of a fine specimen of the weeping Sophora.

³ *Garden and Forest*, 1889, 164.

⁴ Fortune, *Residence among the Chinese*, 139.

⁵ Cornu's name is given on the authority of Zabel, in *Laubholz-benennung* (1903), p. 256. We have been unable to find Cornu's description of the species.

⁶ Köhne, *Dendrologie*, 1893, p. 323.

specimen, which is about 30 feet high with a stem a foot in diameter, bearing a large roundish crown like the common Sophora. In the absence of flowers or fruit, it is impossible to say whether it is a distinct species; but in foliage and other characters it differs so little from *Sophora japonica*, that probably Zabel¹ is correct in considering it to be only a form of that species. It seems to be well worth cultivation, judging from the vigorous growth and dense foliage of the fine specimen at Segrez.

Var. *violacea*.—This variety has also whitish pubescence on the shoots, petiole, and under surfaces of the leaflets, which are longish, with an acute or acuminate apex. The flowers are violet according to Dieck.² It does not appear to be in cultivation in England.

I incline to the belief that we have in these forms to deal with only two varieties of *Sophora japonica*, which is a widely spread species, and presents considerable variation in pubescence and in colour of the flowers in China.

Var. *oligophylla*, Franchet.³—This is a curious variety found by Père David at a tomb near Peking, where he observed two trees. The leaflets are very few in number, three or four, and the end one is trilobed; they are thicker in texture and more glaucous than is ordinarily the case. This variety would be well worth introduction.

DISTRIBUTION AND HISTORY

Sophora japonica, in spite of its name, does not appear to be really wild in Japan, although it is recorded from that country by Franchet⁴ and Matsumura.⁵ Shirasawa,⁶ the latest Japanese authority, says it is planted around habitations in both the sub-tropical and temperate regions of Japan, and that it was introduced from China. Sargent⁷ observes: "Even Rein (*The Industries of Japan*), usually a most careful observer, states that '*Sophora japonica* is scattered throughout the entire country, especially in the foliaceous forests of the north.' He had evidently confounded Sophora with Maackia,⁸ a common and widely spread tree, especially in Yezo. Sophora, which is only seen occasionally in gardens, does not appear to be a particularly popular tree with the Japanese." The Kew Herbarium specimens from Japan are from gardens near Nagasaki, no wild specimens having been ever received.

Sophora japonica is undoubtedly a native of China, and it is recorded from nearly all the provinces where Europeans have made botanical collections; but of its occurrence as a forest tree there is little information. It appears to be really wild in the province of Chihli. I have never seen it in the numerous mountain forests which I visited in Central China or Yunnan; and it is difficult to decide whether the trees seen at lower levels, where cultivation has been going on for centuries, are wild or planted. It has a wide range as a cultivated plant in China, as it flourishes from Peking to Hongkong and from Shanghai to Yunnan.

¹ See note 5 *supra*.

² Köhne, *loc. cit.*

³ Franchet, *Planta Davidiana*, i. 100 (1884).

⁴ Franchet et Savatier, *Enum. Plant. in Japonia*, i. 115.

⁵ Matsumura, *Shokubutsu-me-i*, 279 (1895).

⁶ Shirasawa, *loc. cit.*, Text, i. 86. The tree is called *Enju* in Japan.

⁷ Sargent, *Forest Flora of Japan*, 1.

⁸ Maackia is another name for *Cladrastis amurensis*; but it is possible that the tree confused with *Sophora japonica* in Japan is *Sophora platycarpa*, Maxim, which is very similar to it in foliage. Dupont, *Les Essences Forestières du Japon*, p. 66, gives a very complete account of the wood and the uses of a forest tree in Japan, which he considered to be *Sophora japonica*; but as it is evidently not that species, and as it is uncertain whether he referred to *Sophora platycarpa* or *Cladrastis amurensis*, I have not quoted his description.

It has been known to the Chinese from the earliest times, and has been always named by them the *Huai* tree. In the *Chou Li*, a Chinese classical book, dating from several centuries before the Christian era, it is mentioned as having a place in official audiences. In front of the high officials were placed three *Sophora* trees, beside which stood the counsellors. It was also used as firewood, and was planted in cemeteries, being the tree prescribed by law to be planted beside the tumulus, 4 feet high, in which officials of low degree were buried. The tumulus of the emperor was 30 feet high, and around it pine trees were planted. Feudal princes were honoured with cypresses; and common people were only permitted to have willows around their tombs. The *Sophora* was also used medicinally from the earliest times in China, the flowers, fruit, bark, and root being all employed. In the *Erh-ya*, the oldest Chinese dictionary (twelfth century B.C.), the *Huai* tree is called the *guardian of the palace*; and it is said to open its leaves by night and close them by day. The text is probably corrupt, and the periods of expanding and folding of the leaves are reversed. This is perhaps the first reference in any literature to the phenomenon of the sleep of plants. The term *guardian of the palace* no doubt refers to its use in official audiences.

With regard to the uses of *Sophora* in China at the present day, in addition to its ornamental character as a tree planted frequently in the courtyards of temples, it is also of considerable economic importance. In commerce the flower-buds (*Huaimi*, *huai-hua*, *huai-tze*), and pods (*huai-chio*, *huai-shih*) are met with everywhere; but considerable confusion has arisen in books as to the exact uses of these products. Shirasawa (*l.c.*) is inaccurate in stating that the Chinese use the bark to dye paper and cloth of a yellow colour. Mouillefert¹ says the leaves are used for dyeing; but this is also an error. The facts are simple: the flower-buds are used as a dye, and the pods as a medicine.

The flower-buds, as seen for sale, are mixed with stalks, etc., and are evidently collected when quite young as they are only about $\frac{1}{8}$ to $\frac{1}{4}$ inch long. They are oval and pointed at the stalked end, dark greyish in colour, and tasteless. When immersed in water they impart to it a fine yellow colour. These flower-buds, packed in large sacks, are exported in considerable quantity from Shanghai and Tientsin. Consul Meadows in a letter to Kew gives an account of the process of dyeing, which is one for dyeing blue cloth a green colour rather than for obtaining a yellow colour.² Debeaux³ asserts that the buds are moistened with water, and a quantity of common salt is added; the mixture is then put in a press, which squeezes out a liquor with which cotton or silk may be dyed yellow. He adds that the leaves do not contain any yellow colouring matter.

Every part of the tree abounds in a purgative principle; and it has been asserted that it is dangerous to work with the wood when it is fresh, owing to the

¹ Mouillefert, *Traité des Arbres*, 629.

² The process, according to Meadows, is as follows:—"To dye a piece of cotton cloth of narrow width (1½ feet) a thousand feet long, a mixture is made of 42 lbs. of *Sophora* buds, 8 lbs. of alum, and 666 lbs. of water, which is boiled in a large pot for six hours. In Chekiang both cottons and silks are first dyed a light blue, and are then put in the mixture just described, and all is boiled over again for three or four hours; the cloth is then taken out and dried in the sun. It is afterwards boiled and sun-dried once or twice again, according as a lighter or darker tint of green is required."

³ Debeaux, *Note sur quelques matières tinctoriales des chinois* (1866).

distressing symptoms which ensue; and turners of the wood suffer especially. The active principle resembles the *cathartine* which occurs in senna leaves. In the botanical garden at Dijon there is a well beneath a *Sophora* tree, and when its leaves or flowers are about to fall the gardener covers the well, having found by experience that the water acquires laxative properties by the infusion in it of the *Sophora* leaves or flowers.¹

The wood, according to Shirasawa (*l.c.*), differs remarkably in the colour of the heart-wood and sap-wood; the specific gravity is in dry air 0.74. It is tough and durable, though light and coarse grained; and the annular layers are marked by broad bands of open cells. In Japan it is used for the pillars and frames of their wooden houses, but is not of sufficient importance to have been included in the Japanese Forestry exhibit at St. Louis, nor is it mentioned in Goto's *Handbook of the Forestry of Japan* as a valuable wood.

INTRODUCTION

Petiver² (1703 or a little earlier) speaks of "Hai-hoa, *Chinensibus, flore albo, siliquis gummosis articulatis*," evidently the *Sophora*, and it is probable that the specimen was collected in the island of Chusan by Cunningham in 1700.

Desfontaines,³ quoting Guerrapain,⁴ states that the tree was first raised in Europe from seeds sent by Père d'Incarville (a Jesuit stationed at Peking) in 1747, the first trees being planted at the Petit Trianon by B. de Jussieu. It was unknown to what genus the tree belonged, until it flowered near Paris in 1779. It was introduced in 1753 into England by James Gordon, a celebrated nurseryman at Mile End.⁵ Mr. Nicholson obtained from Mr. James Smith, former curator of Kew Gardens, some interesting details concerning the Kew trees. Five plants were early planted at Kew, all of which were still there in 1864, but two no longer exist. One of the three trees remaining is near the rockery; not far off is the famous specimen in chains, while the third tree is in the village at Kew beside the house once occupied by Mr. Aiton, the first director of the Kew Gardens. These three trees, according to Mr. Nicholson,⁶ are probably as old as any existing elsewhere in England. There is, however, another tree at Kew beyond the Pagoda of which there is no history.

CULTIVATION

Sophora japonica is an ornamental tree, the peculiarities of which make it interesting. The leaves are dark, glossy green, of an unusual tint, and the younger branchlets are of the same colour. The leaves fall very late in autumn, and keep on

¹ Loudon (ii. 564), quoting from Duhamel, states that the bark and green wood of this tree exhales a strong odour which produces on those who prune it a remarkable effect. A plank cut from a tree at Kew in Elwes' possession shows a hard, compact, yellowish brown wood.

² Petiver, *Musei Petiveriani Centurie decem rariora Naturæ continens*, No. 930 (1692-1703).

³ Desfontaines, *Histoire des Arbres*, ii. 258 (1809).

⁴ Guerrapain, *Notice sur la culture du Sophora*.

⁵ *Hort. Kew*, first edition (1789), ii. 45. In *Andrews Repository*, ix. 585, there is a figure of a specimen from a tree 40 feet high in the collection of John Ord at Purser's Cross, Fulham, which was planted by him forty years before. Ord is stated to have received his plants from Gordon, "who introduced the species from China in 1753." It is also stated that the *Sophora* first flowered in England at Syon in August 1797. Loudon, however (*loc. cit.*), states that "the oldest tree near London is at Purser's Cross, where it flowered for the first time in England in August 1807."

⁶ Nicholson in *Woods and Forests* (1884), p. 500.

42 The Trees of Great Britain and Ireland

the tree fresh and green long after most trees have lost their foliage. The time of flowering is also very late, and this is a point of interest, although the flowers are not conspicuous or remarkable for size or colour. It is a very hardy tree in England,¹ and seems to be free from all attacks of fungi and insects. Its roots do not sucker, which is a point in its favour when planted in towns or in gardens or parks. It has been freely used as a street tree in Italy, where its dense foliage is an advantage in the hot summers. It is remarkable how little the foliage is affected by the hottest and driest seasons, and on this account it might be tried in dry and hot situations. It thrives fairly well in all soils that are deep and not too compact, but it will only grow vigorously in deep rich soils, where seedlings will sometimes attain a height of 12 feet in four or five years.² It is propagated by seeds, which should be sown in spring.

REMARKABLE TREES

The trees in the Kew Gardens have been alluded to as regards their history. The one which occurs near the Pagoda, in 1903, was 68 feet high and 8 feet 3 inches in circumference. The old tree, with the branches held together by chains, now measures (1905) 50 feet high and 13 feet in girth at a foot from the ground, the narrowest part of the short bole, which branches immediately into three main limbs. A fourth limb, very large, was blown off some years ago. Not far off is a smaller tree about 6 feet in girth near the ground; it branches from the base, forming a wide-spreading low tree.

At Syon, two trees of considerable size are now living, each about 70 feet high; one measured in 1903 12½ feet in girth, the other 12 feet.³

The tree in the Oxford Botanic Garden was 65 feet high by 12 feet 3 inches in girth in 1903 when measured by Elwes.⁴

That in the old Botanic Garden at Cambridge is one of the finest trees in England, as it has a very symmetrical bole. It measured in 1904, 73 feet high by 11 feet in girth. It is figured in Plate 16.⁵

We are not acquainted with any large specimens of the *Sophora* now growing in Scotland, Ireland, or Wales, though Loudon mentions one at Tynninghame, Haddingtonshire, 42 feet high,⁶ one at Castletown near Dublin 35 feet high, and one at Oriel Temple, Co. Louth, of the same height.

In France and Germany there are probably larger specimens than in this country. (A. H.)

¹ The *Sophora* has withstood, without injury, the severest frosts in Perthshire. See pamphlet by Col. H. M. Drummond Hay, *The Comparative Hardihood of Hardwooded Plants, from Observations made at Seggieden, Perthshire* (1882).

² Nicholson, in an excellent article on the *Sophoras* in *Woods and Forests*, July 30, 1884.

³ One of these is mentioned by Loudon, ii. 565, as being the largest near London, and measured in 1838 57 feet high and about 9 feet in girth.

⁴ This is said by Loudon (*l.c.*) to have been twenty years planted in 1844, though probably this is an error, as it was then 35 feet high.

⁵ Loudon says there were two trees in the garden, both 50 feet high, which had flowered occasionally.

⁶ There is a splendid *Sophora* in the grounds at Cobham Park, Kent, which I measured in 1905, and found to be 85 feet by 10 feet. There is also one in the Tilt Yard at Arundel Castle, 62 feet by 9 feet 6 inches.—(H. J. E.)

ARAUCARIA

Araucaria, Jussieu, *Gen. Pl.* 413 (1789); Bentham et Hooker, *Gen. Pl.* iii. 437 (1880); Masters, *Journ. Linn. Soc. (Bot.)* xxx. 26 (1893).
Dombeya, Lamarck, *Dict.* ii. 301 (*non* Cavanilles) (1786).

TALL evergreen trees, with naked buds and coriaceous leaves, which are widest at their bases and spirally arranged on the shoots.¹ Usually dioecious. Male flowers in catkin-like masses, solitary or in fascicles at the ends of the branchlets; anthers numerous, with a prolonged connective, from which hang six to fifteen pollen sacs. Female flowers terminal, composed of many scales spirally arranged in a continuous series with the leaves, there being no obvious distinction between the seed-scale and the bract; each scale bears one ovule attached to the scale along its whole length. Cones globular, composed of imbricated wedge-shaped scales thickened at the apex. Seeds, one on each scale and adnate to it, flattened and without wings.

The genera *Araucaria* and *Agathis* constitute the tribe *Araucarineæ*, which are distinguished from the other *Coniferæ* by having a single ovule on a simple scale. In *Agathis* the ovule is free from the scale, while in *Araucaria* it is united with it. *Cunninghamia*, which was considered by Bentham and Hooker and by Masters to belong to this tribe, is now generally classed with the *Taxodineæ*; in it each scale bears three ovules.

There are about ten species of *Araucaria*, inhabitants of South America, Australia, New Guinea, New Hebrides, New Caledonia, and Norfolk Island. *Araucaria Cunninghami* has been reported several times as growing in the open air in England; but in some cases it is evident that *Cunninghamia sinensis* was the tree in question, while in other cases small plants were referred to which were speedily killed by the cold of our winters.² *Araucaria imbricata* is the only species which is hardy in this country. There are fine specimens of some of the other species in the Temperate House at Kew, viz. *Araucaria Bidwilli*, 48 feet high; *Araucaria excelsa*, 48 feet; *Araucaria Cunninghami*, 47 feet; and *Araucaria Cookii*, 30 feet.

¹ *Araucaria Bidwilli* has the leaves also spirally arranged, but by twisting on their bases they assume a pseudo-distichous appearance.

² In a letter in the *Gardeners' Chronicle*, May 1, 1869, Mr James Barnes, then gardener at Bicton, states, in reply to a suggestion that the tree there might be *Cunninghamia*, that it was really *Araucaria Cunninghami*, and that it had attained a height of 36 feet, with a diameter of branches of 28 feet, in a sheltered plantation in that favourable locality. But this tree was no longer living when I visited Bicton in 1902.—(H. J. E.)

ARAUCARIA IMBRICATA, CHILEAN ARAUCARIA

Araucaria imbricata, Pavon, in *Mem. Acad. Med. Madrid*, i. 199 (1797); Lambert, *Genus Pinus*, 106, t. 56, 57 (1832); Loudon, *Arb. et. Frut. Brit.* iv. 2432 (1844); Kent in *Veitch's Man. Coniferæ*, ed. 2, 297 (1900).

Araucaria Dombeyi, A. Rich. *Conif.* 86, t. 20 (1826).

Araucaria chilensis, Mirb., *Mem. Mus. Par.* xiii. 49 (1825).

Araucaria araucana, C. Koch, *Dendr.* ii. 206 (1873).

Pinus araucana, Molina, *Sagg. Storia Nat. Chile*, 182 (1782).

Dombeya chilensis, Lamarck, *Encycl.* ii. 301 (1786).

Araucaria imbricata is the oldest name under the correct genus *Araucaria*, and is, moreover, the one most generally used. *Piñon* is the Spanish name in Chile, *Pehuén* the Indian name.

Araucaria imbricata is a tree usually 50 to 100 feet high,¹ with a cylindrical stem, only slightly tapering in adult trees, and attaining 3 to 5 feet in diameter. The bark is very rough and divided into large thick irregularly pentagonal or hexagonal scales. The branches, in whorls of 6 or 7, are at first very spreading, and in young or isolated individuals persist for a long time, but in the forest generally fall off until a broad umbrella-shaped crown of very crowded branches remains. In certain cases,² secondary shoots appear on the trunk among the older branches as they die off.

Leaves: all of one kind, spirally crowded on the branches, sessile, coriaceous, rigid, ovate-lanceolate, with a sharp point at the apex, slightly concave on the upper surface, glabrous, bright shining green, marked with longitudinal lines, bearing stomata on both surfaces, margins cartilaginous; persistent for 10 or 15 years, withering during the later period of their life; their remains may be seen for a long time on the trunk and branches as narrow transverse ridges.

Male flowers: catkins almost cylindrical in shape, solitary or 2 to 6 in a cluster, terminal, sessile, erect, 3 to 5 inches long, yellow in colour, composed of densely packed anther scales, the tips of which are sharply pointed and recurved; pollen sacs 6 to 9. The male flowers frequently remain intact on the tree for several years; they generally in Europe appear early in spring, the pollen escaping in June or July.

Female flowers: ovoid, solitary, terminal, erect, about 3 inches long, composed of numerous wedge-shaped scales, terminating in long, narrow, brittle points.

Cones: globular, brown in colour, 4 to 6 inches in diameter, falling to pieces when the seeds are ripe (in England in late summer, in Chile in January or February). The cones take two years to ripen, fertilisation occurring in the second year in June or July, when the scales open and expose the ovule to the pollen blown from neighbouring staminate trees. Three months after fertilisation the seeds are fully matured.

Seeds: adnate to the scale and falling with it, 1 to 1½ inch long, wingless, covered by a thick brown coat. There are about 300 seeds in a cone.

¹ I have seen in Chile trees exceeding even 100 feet in height.—(H. J. E.)

² Such a case exists in a large tree at Tortworth Court.—(H. J. E.)

Seedling.—The cotyledons are two in number, and on germination remain below the soil enclosed in the seed (Plate 15F). The caulicle, to which is attached the cotyledons, is thick, fleshy, and carrot-shaped, serving as a store of nutriment for the plant after that of the cotyledons is exhausted; it is directed downward into the soil, and terminates in a long, slender, fibrous root, which gives off a few lateral rootlets. The plumule, the portion of the axis with its accompanying leaves, which is formed in the embryo prior to generation, protrudes between the stalks of the cotyledons, speedily becomes erect, and develops into the young stem, which bears leaves similar in shape to those of the adult plant. The cotyledons sometime after the stem has grown well above ground wither away, the ends of their stalks being visible on the upper part of the caulicle. At the end of the first season the stem is 4 or 5 inches long, and bears alternate leaves about ¾ inch long, gradually increasing in size from below upwards and forming a crowded tuft at the summit. The lower end or so of the stem is reddish, with leaves small and scale-like. The fusiform caulicle, about an inch in length, is continued below into a root 8 or 9 inches long.

Sexes.—The *Araucaria* is usually dioecious, the trees being either male or female. It was long supposed that there was a difference in the habit of the two sexes, due, doubtless, to Pavon's account of the matter. *Araucarias* differ, however, remarkably in habit, and no inference can be drawn as to sex from the habit or character of the growth of an individual. Monoecious trees (as is the case in nearly every dioecious species) are of exceptional and very rare occurrence. The most noted of these occurred at Bicton.¹ Other cases have been recorded from South Lytchett,² near Poole, and Pencarrow in Cornwall.³ (A. H.)

DISTRIBUTION

This remarkable tree was discovered in or about 1780 by a Spaniard, Don Francisco Dendariarena, who was employed by the Spanish Government to examine the trees in the country of the Araucanos, with the object of finding out those whose timber was best suited for shipbuilding. His account of its discovery, as quoted by Lambert, pp. 106-108, is as follows:—

“In September 1782 I left my companion, Don Hippolito Ruiz, and visited the mountains named Caramavida and Nahuelbuta belonging to the Llanista, Peguen, and Araucano Indians. Amongst many plants which were the result of my two months' excursion, I found in flower and fruit the tree I am about to describe.

“The chain or cordillera of the Andes offers to the view in general a rocky soil, in parts wet and boggy, on account of the abundance of rain and snow which fall in these regions, similar to many provinces in Spain. There are to be seen large forests of this tree which rises to the amazing height of 150 feet, its trunk quite straight and without knots, ending in a pyramid formed of horizontal branches which decrease in length gradually towards the top, and is covered with a double bark, the

¹ *Gard. Chron.* 1890, viii. 588, 593, Fig. 118.

² *L.c.* 753.

³ Specimens in the museum at Kew.

inner 5 or 6 inches thick, fungous, tenacious, porous, and light, from which as from almost all other parts flows resin in abundance; the outer is of nearly equal thickness, resembling cork cleft in various directions, and equally resinous with the inner."

I may say that the district spoken of is not really part of the Andes at all, but a coast range separated from the Andes by a wide tract of low country, mostly covered with forest. And as regards the bark, though I did not see any old trees felled in Chile, the bark of trees of 40-50 years old felled in England does not show bark at all approaching the thickness described. Neither have I seen in the districts I visited myself any trees as tall as he describes, or more than about 120 feet. He states that it is also found "juxta oppidum Conceptionis." There are no mountains near Concepcion high enough for the Araucaria, and I think this must be based on false information.

Don Dendariarena goes on to say that "the wood of this tree is of a yellowish white, fibrous, and full of very beautiful veins, capable of being polished and worked with facility. It is probably the best adapted for shipbuilding, as has been shown by the experiments made in the year 1780, in consequence of which orders were given to supply the squadron commanded by Don Antonio Bacaro, then at anchor in the port of Talcahuano."

"The resin abounding in all parts of the tree is white, its smell like that of frankincense, its taste not unpleasant. It is applied in plaster as a powerful remedy for contusions and putrid ulcers, it cicatrises recent wounds, mitigates headaches, and is used as a diuretic, in pills, to facilitate and cleanse venereal ulcers. The Indians make use of the fruit of this tree as a very nourishing food; they eat it raw as well as boiled and roasted, with it they form pastry, and distil from it a spirituous liquor."

Lambert says: "In a letter which I have lately received M. Pavon mentions an important particular, not noticed in the above description, namely, that the male tree is not above half the size of the female, and seldom exceeding 40 feet in height." I am not able to confirm this from personal observation either in Chile or England, and Dr. Masters¹ says that there is no reliable distinction between the male and female tree, whilst it is said in an account of the Araucarias in the Piltdown Nurseries² that the habit of the tree is no guide to the sex.

It was first described by the Abbé Molina, who called it *Pinus araucana*. Ruiz and Pavon who explored parts of Chile soon afterwards sent specimens to Europe to a Frenchman named Dombey, which were described by Lamarck under the name of *Dombeya chilensis*, but the generic name he gave cannot stand because it was previously used for a genus of Sterculiaceæ.

In 1795 Captain Vancouver visited the coast of Chile, accompanied by Archibald Menzies, who procured some seeds which he sowed on board ship,³ and succeeded in bringing home living plants, which he gave to Sir Joseph Banks, who planted one of them in his own garden at Spring Grove, and sent the remaining five plants to Kew. One of these, after being kept in the greenhouse till about 1806 or 1808,

¹ *Gard. Chron.* 1890, ii. 667.

² *Ibid.* 1891, i. 342.

³ Sir Joseph Hooker, who knew Menzies personally, tells me that he took these seeds from the dessert table of the Governor.

was planted out on what is now called Lawn L, and was at first protected during winter by a frame covered with mats. Here it grew for many years and attained the height of 12 feet in 1836 (*vide* Loudon), but eventually died in the autumn of 1892 at the age of nearly 100 years.¹ This is probably the tree figured by Lambert.

The first person who gives any account of the tree in its native forests, so far as I know, is Dr. Poeppig, whose account of the tree is printed in *Companion to Bot. Mag.* i. 351-355. It did not, however, become common in cultivation till the celebrated botanical traveller William Lobb, who was sent to South America by the firm of Veitch, sent home in 1844 a good supply of seeds which produced most of the finest trees now in England.

No account of his travels were, however, published, and on applying to Messrs Veitch before I went to Chile in 1901 I was informed that his journals, which I wished to consult, could not be found. The late Miss Marianne North was the first English traveller who published any account of the tree in its native forests, which she visited on her last journey in November 1884, mainly, as she says, for the purpose of painting this tree. But, owing to the difficulty and danger at that time of reaching the Andes, she went to the coast range of Araucania, called Nahuelbuta, which lies between the sea and the town of Angol, in the same district where the tree was probably first discovered. After describing her ride up from Angol to the mountains, which are here covered with a beautiful vegetation, among which Gunnera, Lapageria, Embotrium, Fuchsia, Buddleia, Alstroemeria, and many other favourite plants in English gardens are conspicuous, she says:²—

"The first Araucarias we reached were in a boggy valley, but they also grew to the very tops of the rocky hills, and seemed to drive all other trees away, covering many miles of hill and valley; but few specimens were to be found outside that forest. The ground underneath was gay with purple and pink everlasting peas, and some blue and white ones I had never seen in gardens, gorgeous orange orchids, and many tiny flowers whose names I did not know, which died as soon as they were picked, and could not be kept to paint. I saw none of the trees over 100 feet in height or 20 in circumference, and, strange to say, they seemed all to be very old or very young. I saw none of the noble specimens of middle age we have in English parks, with their lower branches resting on the ground. They did not become quite flat at the top, like those of Brazil, but were slightly domed like those in Queensland, and their shiny leaves glittered in the sunshine, while their trunks and branches were hung with white lichen, and the latter weighed down with cones as big as one's head. The smaller cones of the male trees were shaking off clouds of golden pollen, and were full of small grubs; these attracted flights of bronzy green parrakeets, which were busy over them. Those birds are said to be so clever that they can find a soft place in the great shell of the cone when ripe, into which they get the point of their sharp beak, and fidget with it until the whole cone cracks and the nuts fall to the ground. Men eat the nuts too, when properly cooked, like chestnuts. The most remarkable thing about the tree is its bark,

¹ *Cf. Kew Bull.* 1893, p. 24.

² Marianne North, *Recollections of a Happy Life*, 2nd ed. ii. 323, 324 (1892).

which is a perfect child's puzzle of slabs of different sizes, with 5 or 6 distinct sides to each, all fitted together with the neatness of a honeycomb. I tried in vain to find some system on which it was arranged. We had the good fortune to see a group of guanacos feeding quietly under the old trees. They looked strange enough to be in character with them, having the body of a sheep and the head of a camel; and they let us come quite near. On the other side of the mountains they are used as a beast of burden, though so weak that ten of them could not carry the load of an average donkey. After wandering about the lower lands, we climbed through the bogs and granite boulders to the top of one of the hills, and came suddenly to a most wonderful view, with seven snowy cones of the Cordillera piercing their way through the long line of mist which hid the nearer connecting mountains from sight, and glittering against the greenish blue sky. Each one looked perfectly separate and gigantic, though the highest was only 10,000 feet above the sea. Under the mist were hills of beech forest, and nearer still the Araucaria domes, while the foreground consisted of noble old specimens of the same trees grouped round a huge grey boulder covered with moss and enriched with sprays of embotrium of the brightest scarlet. No subject could have been finer, if I could only have painted it, but that 'if' has been plaguing me for years, and every year seems to take me farther from a satisfactory result."

Inspired by this charming description, and by a desire to see the magnificent forests of Southern Chile, whence I hoped to introduce new trees and plants to our gardens, I visited Chile in the winter of 1901-1902, and after various difficulties caused by the dispute about the frontier, which nearly led to a war between Chile and Argentina, I started from the hospitable home of my friends, Mr. George and Senora Bussey at San Ignacio, to see the Araucarias in the Sierra de Pemehue, a region where they attain their greatest perfection, and which, having only been recently conquered from the Indians, had been described by no scientific traveller; though Senor Moreno has written an excellent account of the Argentine side of the frontier, which I visited later.

The Sierra de Pemehue is a range of mountains lying on the west side of the upper course of the great Biobio river, and is not, strictly speaking, a part of the Cordillera of the Andes, from which it is separated by that river. The greater part of it is covered with splendid forests, principally composed of beeches, *Fagus obliqua* and *Fagus Dombeyi*, and it was near the head-waters of the Renaico river that I first saw what is to me the most striking of all trees hardy in England, and the only Chilean tree which as yet seems to have acclimatised itself thoroughly in this country.

They were growing in scattered groups on the cliffs far above us at an elevation of 3000-4000 feet, and we did not enter the Araucaria forest till we got near the top of the pass, which crossed over a mountain called Chilpa, between the Renaico and the Villacura valleys. Here the trees were growing scattered among Coigue trees (*Fagus Dombeyi*), and higher up in a forest mainly composed of Niere (*Fagus antarctica*), many of which were killed by forest fires, which had not, however, destroyed the thick-barked Araucarias, though I saw here but few young trees and no seedlings.

Their average height was 80-90 feet, and the diameter 2-3 feet, and the branches were mostly confined to the top of the tree, where they form a dense, flat-topped crown. On 27th January I saw much finer specimens in the valley above Lolco, on the road to Longuimay, and my companion, Mr. Bartlett Calvert, was successful in getting some excellent photographs which are here reproduced. Plate 17 shows the appearance of mature and young trees growing in an open grassy valley at about 4500 feet, with the high volcanoes of Longuimay and Tolhuaca in the background. The old tree on the right of the picture is about 90 feet, and the young one about 20 feet high, showing sixteen years of growth from a point 2-3 feet from the ground where the annual growths could no longer be distinguished. I therefore suppose this young tree to be twenty to twenty-five years old from seed.

Farther on in the same valley we came to much larger trees, which showed the curiously irregular slabs of bark of which Miss North speaks. The largest trees I saw had a girth of 24 feet at breast height, and were 90-100 feet high. The longest fallen stems I measured were little over 100 feet, and I should say 80-90 was the average height of full-grown ones. Plate 18 shows the habit which the trees assume when grown thickly at about 3500 feet elevation in the upper Villacura valley.

On the wind-swept ridges which we crossed higher up the pass, at an approximate elevation of 6500 feet, the Araucarias were much more stunted and had a very different habit of growth, but the high wind which prevailed, as it usually does at this season, made it impossible to photograph them. Two days later at Los Arcos, the frontier post of Argentina, I found scattered groves of Araucaria for about fifty miles south, as far as the valley of Quillen, but when we reached the country about the head-waters of the Pichelifeu river, about lat. 39° 30' S., I saw no more except a few isolated trees which appeared to have sprung up from seeds dropped by the Indians on their old camping grounds.

I had previously been told by Mr. Barton of Buenos Ayres, who is engaged in cutting timber on the north shore of the great lake Nahuelhuapi, about 100 miles to the south, that the Araucaria was found near this lake, and I had great hopes of discovering and introducing a new southern variety or species, which might prove hardier than *A. imbricata*.

But notwithstanding what Poeppig says as to the probability of its extension as far south as lat. 46°, I saw not a single tree on my journey from San Martin *via* Nahuelhuapi to Puerto Montt in lat. 41° 50', and none of the explorers who have been recently employed in surveying the frontier have, so far as I know, found it south of about lat. 41°. Sir T. Holdich is my authority for this statement.

Some of the trees here had much smoother bark covered with long tufts of grey lichen, and in this part of the forest there were plenty of young seedlings coming up, some of which I took up and unsuccessfully attempted to transplant to my friend's garden at San Ignacio.

The geographical range of the tree is therefore a very limited one, extending only from Antuco in about lat. 38° 40' to lat. 40° in the Cordillera, and on the coast range from about lat. 38° 30' to an unknown point probably not south of about lat. 41°. For, though Poeppig says it occurs on the Corcovado, he was speaking only from

hearsay, and the sudden change of the climate, which here becomes an extremely wet one, is probably the reason why the tree does not exist on the west coast in a much higher latitude, as do the majority of the trees and plants which are associated with it.

Another point in which I must differ from Poeppig is the bareness of the Araucaria forests of other vegetation. Though, of course, where the trees are closely crowded not many plants grow in their shade, yet the number of beautiful terrestrial orchids and other plants which I found in the more open parts of the Araucaria forest was very striking, and Miss North's observations in the Nahuelbuta range quite confirm my opinion that the moderate shade of the Araucaria is not prejudicial to herbaceous plants.

The soil on which it grows is mostly of volcanic origin, sometimes covered with deep vegetable mould, but more usually dry and rocky; and the climate, though warm and dry in the months of December, January, and February, is cold and wet in winter.

The only exact particulars I can give of the climatic variations were taken during the winter of 1901 at Rahue in the upper Biobio Valley, near Longuimay, at an elevation of 700 metres, which is lower and thus probably warmer than that of the Araucaria region. These observations I have condensed as follows:—

	MAXIMUM.	MINIMUM CENTIGRADE.	
Between April 21 and 30	+ 26 (on 25th)	- 3 (on 30th)	
„ May 1 „ 31	+ 19 (1st, 25th)	- 7 (on 13th)	snow on 7 days.
„ June 1 „ 30	+ 22 (on 27th)	- 6 (on 24th)	snow on 8 days.
„ July 1 „ 31	+ 12 (on 27th)	5 (on 10th)	snow on 6 days.
„ Aug. 1 „ 30	+ 12 (on 19th)	6 (on 17th)	{ snow on 5 days. rain on 7 days.
„ Sept. 1 „ 30	+ 24 (on 27th)	? 10 (on 2nd)	{ snow on 1 day. rain on 12 days.
„ Oct. 1 „ 31	+ 30 (on 17th)	? 6 (on 8th)	{ snow on 2 days. rain on 5 days.
„ Nov. 1 „ 23	+ 25 (on 21st)	? ?	{ snow on 2 days. rain on 7 days.

Reduced to Fahrenheit this register shows a very similar climate to that of some parts of England, very variable all the year round, but probably hotter and more sunny in winter.

As regards the summer climate I may say that in the months of January and February, which are the height of summer, it was never cold by day, and the sun and wind often unpleasantly warm, but at night the thermometer often fell to near freezing-point, and on one occasion, on 1st February, my sponge was frozen in camp just south of Lake Aluminé at about 5000 feet. We know that the Araucaria has borne in Great Britain temperatures below zero Fahr. without injury on dry and suitable soil, but it evidently will not endure the continuous wet of the southern coast region of Chile.

In the *Forstliche Naturwissenschaftliche Zeitschrift*, 1897, iv. 416-426, Dr. Neger, who was naturalist on the Chilean Boundary Survey in 1896-97, gives an

account of *Araucaria imbricata*, which does not add anything of great importance for English arboriculturists to what I have already stated. He says that there are two types of Araucaria forest, one of which is characteristic of the rainy coast mountain range of Nahuelbuta and the west side of the Andes on the Cordillera of Pemehue; and the other, which is peculiar to the drier plateaux of the Argentine territory, on the east side of the watershed. He refers to Reiche's account of the Nahuelbuta forest in *Engler's Bot. Jahrbuch*, xxii. 110, which gives a good account of the flora. He does not confirm the statement that the male trees are smaller in size than the female, and speaks of trees occurring in deep valleys 40-50 metres high, and 2-2½ metres in diameter at about 3 feet, but does not give any exact measurements, so that this height is probably an estimate by the eye. He says that the seeds do not ripen until May in the year after flowering, but I found them ripe in February and fit to eat in January. He gives some excellent illustrations of Araucaria forests on Nahuelbuta, one of which shows a wider and more unbroken extent than any that I saw; another shows the ability of the tree to take root and grow in the crevices of bare rock. Another shows a forest at the foot of the great volcanic peak of Lanin, where some of the trees have been almost buried by sand and still retain their upright position. Lastly, he gives a small map of the distribution which, however, is not sufficiently detailed to be very accurate; this makes Antuco the most northerly point, and a point somewhere north of lat. 40°, the southerly range of the tree. He says that in the museum of Santiago there are geological evidences of the existence at a former period of Araucaria as far north as the Puna of Atacama.

REMARKABLE TREES

The finest tree which until recently existed in England was at Dropmore, which, however, began to die about four years ago, and was dead when the photograph (Plate 19) was taken in June 1903. It is said¹ to have been purchased at a sale in the Royal Horticultural Gardens at Chiswick in 1829, and in 1893 to have been 69 feet high. When felled in 1905 Mr. Page found it to be 78 feet 6 inches high, and the butt was 27½ inches in diameter at the base under the bark, which was about 2 inches thick, the measurable timber in it being about 65 cubic feet.

There are many fine specimens at Beauport, Sussex, the seat of Sir Archibald Lamb, Bart., where a plantation was made about forty years ago, which gives a better idea of the Araucaria at home than any I have seen in England. It contains 27 trees on an area 102 paces round, and the inside trees are clearing themselves from branches naturally. Twenty of them Sir A. Lamb says are over 50 feet high, and in 1905 I estimated them to contain an average of 25 cubic feet (Plate 20). The largest tree at Beauport, as measured by Henry in 1904, was 74 feet high and 7 feet 9 inches in girth. The trees produce seeds freely, and a seedling growing in a chink of the garden steps was 4 feet high in 1903, and in 1905 had grown at least 2 feet more.

At Strathfieldsaye, Berks, the seat of the Duke of Wellington, the Araucaria has produced self-sown seedlings, a group of which is shown in Plate 15 E.

¹ *Gard. Chron.* 1893, i. 232; also *L.c.* 1872, p. 1324.

At the Piltdown Nurseries in Sussex there are many fine specimens,¹ one of which is said to have been 50 feet by 9½ feet in girth in 1854. Messrs. Dennett and Sons, the present tenants of this nursery, inform me that they believe this is one of the oldest trees in the country, and that in April 1903 it was about 70 feet high (perhaps more), with a girth of 7 feet at 5 feet, and 11 feet close to the ground. But a correspondent of the *Gardeners' Chronicle*² says that in 1891 it was 65 feet by 10½ feet at 4 feet, and that 3½ bushels of seed were collected in this nursery in 1889, which produced hardier plants than imported seed. He also states that one of the trees which was cut down in 1880 threw up in 1884 a sucker from the roots, which grew 15 feet high in five years, and showed in 1891 no signs of branching out in any way.³ He also states that it does not matter when Araucarias are pruned, as they grow steadily all the year. The soil at Piltdown is a deep loam with gravel subsoil, and though, as it is here stated, it is generally thought that a dry, well-drained subsoil is essential to the success of this tree, yet I have seen in the garden of Foss bridge Inn in the Cotswold Hills, in a low damp situation close to the banks of the Coln, two Araucarias, male and female, about 40 feet high, which produced ripe seed in 1903, from which Mr. Holyoake, gardener to the Earl of Eldon of Stowell Park, has raised plants.

At Bicton, Devonshire, the seat of the Honourable Mark Rolle, there is a fine avenue of Araucarias, which has been often mentioned in print; but the trees in it do not appear to be increasing in height so fast as the good soil and climate would lead one to expect. When I saw them in September 1902 the best which I measured was about 50 feet high by 8 feet 9 inches in girth. Ripe seeds were falling at the time, from which seedlings were raised.

There are also fine trees at Castlehill, North Devon, the seat of the Earl Fortescue, which have produced seed for many years past.

At Tortworth Court, Gloucestershire, the seat of the Earl of Ducie, who has one of the best collections of trees in England, and to whom I am indebted for very much assistance and advice in this work, there are many large Araucarias,⁴ the best of which I found to be 53 feet by 7 feet 6 inches in 1904. It is producing many young shoots among the dying branches of the trunk.

In Scotland the Araucaria grows well not only in the south-west where, at Castle Kennedy, the seat of the Earl of Stair, there is a fine avenue, 200 yards long, in which the largest tree is 50 feet by 6 feet 2 inches in girth, and from which self-sown seedlings have sprung, but also in Perthshire, where there are fair-sized trees, one of which on the banks of the Tay in the grounds of the Duke of Athole at Dunkeld, I found in 1904 to be 50 feet high, but only 3 feet 11 in girth. It grows well at Gordon Castle exposed to the full force of the north-east wind, and has ripened seeds as far north as Inverness.⁵ But some of the trees recorded in Perthshire and other places in Scotland have been killed during severe frosts, and as a rule the growth is not so rapid as in the south of England. Two

¹ *Gard. Chron.* 1885, xxiii. 342.

² *Ibid.* 1891, i. 342.

³ Sir Herbert Maxwell informs me that he saw at Cairnmore an old trunk of Araucaria which had died twenty years ago, still standing, with a young growth 3 feet high from the stool.

⁴ Cf. *Gard. Chron.* 1890, ii. 633.

⁵ *Ibid.* 1868, p. 464; 1872, p. 1323; 1894, xvi. 603.

trees at Redcastle, Ross-shire, planted in 1843, measured by Col. A. Thynne, are 47 feet by 7 feet 4 inches, and 40 feet by 6 feet; the latter, though exposed to the east wind, is branched to the ground.

At Ardkinglas there is a very healthy tree 50 feet by 6 feet, and at Inverary, Minard Castle, Poltalloch, and other places in Argyleshire, there are several thriving trees of good size. At Loch Corrie, near Glenquoich, there are two trees at 450 feet above sea-level, one of which in 1905 was 43 feet by 6 feet 2 inches.

In Ireland it seems at home almost everywhere. At Fota, in the extreme south, Henry measured one 62 feet by 5 feet; at Ballenetray, Co. Waterford, a tree was recorded¹ in 1884 as being 65 feet 6 inches by 6 feet; at Woodstock, Co. Kilkenny, there is a tree which in 1904 Henry found to be 65 feet by 9 feet 9 inches; and at Castlewellan, Co. Down, the seat of the Earl Annesley, and many other places, good trees occur.

In the milder parts of Western France the Araucaria thrives, but does not appear to have grown as large as in England. The best is reported by M. de Vilmorin as growing at Penandreff, near St. Renan, Finisterre, which in 1890 was 50 feet high by 7 feet 4 inches in girth. In the *Revue Horticole*, 1899, p. 460, this is confirmed. In Germany I have not heard of any fine examples.

CULTIVATION AND SOIL

The Araucaria should always be raised from seed, home-grown seed being preferable; for though plants have been raised from cuttings, which have grown to a considerable size, this mode of propagation is the cause of much disappointment, and of many ill-shaped and unsightly trees, not only in the Araucaria, but in many other conifers. The seed should be sown singly in pots, laying the seed on its side with the thick end in the centre, and will germinate best in a frame or cold greenhouse, where they can be protected from mice and frost. The young plants should not remain in pots more than one or at most two seasons, for though the tap-root does not become so long as in the case of pines, it wants room; and if the climate and soil are not very favourable, the young tree should not be permanently planted out till it is 1 or 2 feet high. The seedlings vary much in vigour, and on cold or calcareous soil many die young; but under better conditions the tree grows at least 1 foot a year when established.

It should be planted only in a well-drained situation, as severe frosts will often kill the trees when small; and though not so particular about the constituents of the soil as most Chilean trees, seems to thrive better on a sandy soil free from lime, especially on the red sandstone and greensand formations.

In the *Gardeners' Chronicle*, August 15, 1885, is an excellent note by Mr. Fowler, whose experience of this tree at Castle Kennedy was extensive, on the cultivation of the Araucaria; and another valuable note on the same subject will be found in the same journal, November 13, 1886, by Mr. C. E. Curtis. Both these authorities consider that the exudation of gum which often occurs in unhealthy trees

¹ *Woods and Forests*, Feb. 6, 1884.

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is due to the roots of the tree having reached a cold wet subsoil, or from exposure to excessive cold. There seems to be no remedy for this disease, which usually kills the tree.

Araucarias do not thrive in the smoky atmosphere of a large town, and for this reason are not seen at their best in the immediate neighbourhood of London, nor do I know of any very fine ones in Wales or in the midland and northern counties of England.

USES

The gum which exudes from the bark is used in Chile as a salve for wounds and ulcers. It has a pleasant smell like that of turpentine, and sets hard when dry, but I am not aware that it contains any special intrinsic virtue.

The seeds are largely consumed by the Araucanos and other tribes of Indians, and are occasionally sent for sale to the markets of Valdivia and Concepcion. I have eaten them both roasted and boiled, and found them very palatable, with a nutty flavour somewhat like that of almonds.

The timber is said to have been formerly used in the dockyards of Chile, but is now considered inferior to that of the Alerce (*Fitzroya patagonica*), and perhaps owing to the remote positions in which the trees grow, is not now used except locally. Through the kindness of the Duke of Bedford I received two planks cut from a tree grown at Endsleigh, near Tavistock, of which the wood does not show any specially attractive quality. The Earl of Ducie describes it¹ as "not unlike good deal, but from the absence of turpentine and for some other reason it is smoother to the touch than the ordinary deals of commerce. In this respect its texture is not unlike that of redwood (*Sequoia sempervirens*). On testing a thin batten by breakage, it proved to be tough and strong for its size; but the fracture was abrupt, and showed little longitudinal fibre. The wood is somewhat heavier than ordinary deal." The timber is not mentioned in Stone's *Timbers of Commerce*. (H. J. E.)

¹ *Gard. Chron.* 1900, ii. 633.

GINKGO

Ginkgo, Linnæus, *Mantissa*, ii. 313 (1771); Bentham et Hooker, *Gen. Pl.* iii. 432, 1225 (1880); Masters, *Jour. Linn. Soc. (Bot.)*, xxx. 3 (1893).
Salisburia, Smith, *Trans. Linn. Soc.* iii. 330 (1797).

TREES, several extinct and one living species, bearing fan-shaped, fork-veined leaves on both long and short shoots. Flowers dioecious, arising from the apex of short shoots, which bear at the same time ordinary leaves. Male flowers: catkins, 3-6 on one shoot, each being a pendulous axis bearing numerous stamens loosely arranged. Stamen a short stalk ending in a knob, beneath which are 2-4 divergent anthers, dehiscing longitudinally. Female flowers, 1-3, more or less erect on the shoot, each consisting of a long stalk, which bears an ovule on either side below the apex. The ovule is sessile, straight, surrounded at its base by an aril or collar-like rim,¹ and naked (*i.e.* not enclosed in an ovary). Fruit: a drupe-like seed (sessile in the small bowl-shaped little developed aril) consisting of an orange fleshy covering enveloping a woody shell, within which, embedded in the albumen, lies an embryo with 2-3 cotyledons. The albumen is covered by a thin membrane which is only adherent to the woody shell in its lower part. Two embryos often occur in 1 seed, and of the 2 ovules only one is generally developed into a seed.

Ginkgo was formerly considered to belong to the Coniferæ, but recent investigations show that it is distinct from these, and is the type of a Natural order Ginkgoaceæ, which has affinities with Cycads and ferns. The seeds resemble closely those of Cycads, and at the end of the pollen tube are formed two ciliated antherozoids which are morphologically identical with the antherozoids occurring in ferns. Ginkgo, however, is a true flowering plant, as it produces seeds, and is a gymnosperm, since it bears ovules which are not enclosed in an ovary.

The extinct species have been found in the Jurassic and succeeding epochs. Gardner² considers the specimens which have been found in the white clay at Ardtun in the Isle of Mull to be specifically identical with *Ginkgo biloba*.

¹ Considered now to be a reduced carpel.

² J. S. Gardner, *British Eocene Flora* (1886), ii. 100.

GINKGO BILOBA, MAIDENHAIR TREE

Ginkgo biloba, Linnæus, *Mantissa*, ii. 313 (1771); Kent in *Veitch's Man. Coniferae*, 2nd ed. 107 (1900); Seward and Gowan, *Ann. Bot.* xiv. 109 (1900).

Salisburia adiantifolia, Smith, *Trans. Linn. Soc.* iii. 330 (1797); Loudon, *Arb. et Frut. Brit.* iv. 2094 (1838).

The Ginkgo when young is pyramidal in habit, with slender, upright branches: older, it becomes much more spreading and broader in the crown. It attains a height of 100 feet and upwards, with a girth of stem of about 30 feet. Bark: grey, somewhat rough, becoming fissured when old.

Leaves: deciduous, scattered on the long shoots, crowded at the apex of the short shoots, which grow slowly from year to year, their older portions being covered with the leaf-scars of former years. The short shoot may, after several years, elongate into a long shoot bearing scattered leaves. The leaves are stalked, and unique in shape amongst trees, recalling on a large scale the pinna of an adiantum fern; they show much variation in size (2-8 inches in breadth) and in margin, but generally are bilobed and irregularly crenate or cut in their upper part. There is no midrib, and the veins, repeatedly forking, are not connected by any cross veinlets. The stomata are scattered on the lower surface. In the bud the leaves are folded together and not rolled up, as in the crozier-like vernation of ferns.

Flowers and fruit: see description of the genus.

The drupe-like seeds have a fleshy outer covering of a bright orange colour when ripe, and when they fall upon the ground, this bursts and emits an odour of butyric acid which is very disagreeable.¹ They are imperfectly developed as they fall, though apparently ripe; and the fertilisation of the ovule and the subsequent development of the embryo occur while they are lying on the ground during winter. The kernels are edible, being known to the Chinese as *pai-kuo* (white fruits), and are sold in most market towns of China. They are supposed to promote digestion and diminish the effects of wine-drinking; and are eaten roasted at feasts and weddings, the shells being dyed red.

Fruit-bearing trees are now common in Southern Europe; but no fruit, so far as we know, has ever been produced in England. The well-known tree at Kew is a male, and produces flowers freely in exceptional years, *e.g.* in 1894, supposed to be due to the fact that the preceding summer was remarkably warm, with continual sunshine.

Extraordinary cases of abnormal formation of fruit have been observed in Japan. Shirai² described and figured in 1891 fruit which was produced on the surface of ordinary leaves of the tree. Fujii has studied since then the various stages of the development of ovules and of pollen sacs upon leaves. The so-called aril of the fruit is considered by him to represent a carpel, as he has observed transitional stages between the ordinarily shaped aril and a leafy blade bearing ovules.

¹ "The pulp surrounding the seed has a most abominable odour. Although warned not to touch it, I gathered the seeds with my own hands; but it took me two days' washing to get the odour off."—(W. Falconer in *Garden*, 1890, xxxviii. 602.)

² Shirai, in *Tokyo Bot. Mag.* 1891, p. 342.

Jacquin¹ grafted on the male tree at Vienna, when it was quite small, a bud of the female tree, from which a branch developed. This tree is now of large size; and numerous branches regularly bear male flowers, whilst one branch, now very stout, bears female flowers. This female branch puts forth its foliage about fourteen days later than the male branches, and retains them much later in autumn. In this case the shoot retains its individual characters, and the stock does not affect it even in regard to its annual development.

Seedling.—The germination in Ginkgo is not unlike that of the oak. We are indebted to Mr. Lyon² of Minneapolis for figures of the seedling, which are reproduced on Plate 15 C, D.

When the seeds are sown the hard shell is cracked at its micropylar end by the swelling of the embryo within. Through this opening the body of the embryo is thrust out by the elongation of the cotyledons, which remain attached to the caulicle by two arching petioles; between these the plumule or young stem ascends, while the root turns down into the soil. The cotyledons remain attached throughout the first season's growth. The first two or three leaves directly above the cotyledons remain small and scale-like. After reaching 4 or 5 inches in height the stem stops growing, having expanded into a rather close crown of ordinary leaves at its apex, which ends in a large terminal bud. The root attains in the first season about the same length as the stem, and develops numerous lateral fibres. This primary root, as is usually the case in Gymnosperms, persists as the tap-root of the plant.

Sexes.—Certain differences, besides those of the flowers, are observable in male and female trees.³ The male trees are pyramidal and upright in habit, the ascending branches being of free and vigorous growth. The female trees are closer and more compact in habit, more richly branched below, and the branches sometime become even pendent.⁴

Monsieur L. Henry⁵ states that in Paris the leaves of the female Ginkgo fell three or four weeks later than those of the male. Generally male trees are completely denuded of foliage by the beginning of November, while the female trees retain their leaves till the end of November or the beginning of December.

Burrs.—In Japan there often develops on old Ginkgo trees peculiar burrs, which are called *chi-chi* or nipples. These may be observed in an incipient stage on the large tree at Kew. They occur on the lower side of the larger branches of the tree, and vary in size from a few inches in length to 6 feet long by 1 foot in diameter. They occur singly or in clusters, and are generally elongated, conical in shape, with a rounded tip. If they reach the ground, as is sometimes the case, they take root, and then bear leaves. They are due to the abnormal development of dormant or adventitious buds. A description of this curious phenomenon and a photograph of a tree bearing a large number of these growths is given by Fujii in *Tokyo Bot. Mag.*

¹ Kerner, *Nat. Hist. of Plants* (Eng. trans.) ii. 572.

² See Lyon's paper in *Minnesota Botanical Studies*, 1904, p. 275.

³ Sargent denies this, and says it is impossible to distinguish the sexes till the trees flower; but observations on the Continent go to show that the sexual differences pointed out above really exist. See Sargent, *Garden and Forest*, 1890, p. 549.

⁴ See Schneider, *Dendrologische Winterstudien*, 127 (1903), and Max Leichtlin in *Woods and Forests*, Jan. 16, 1884.

⁵ *Bull. de l'Assoc. des anc. élèv. de l'école d'Hort. de Versailles*, 1898, p. 597, quoted in *Gard. Chron.* 1899, xxv. 201.

1895, p. 444. We are indebted to Mrs. Archibald Little for a photograph taken by her in Western China, of a tree 19½ feet round the base, and larger above, which very well shows these excrescences (Plate 23).

IDENTIFICATION

In summer the leaves are unmistakable. In winter the long and short shoots should be examined. The long shoot of one year's growth is round, smooth, brownish, and shining, the terminal buds being larger than the scattered lateral buds, which come off at a wide angle. The buds are conical, and composed of several imbricated brown dotted scales. The leaf-scars show 2 *small cicatrices*, and are *fringed above with white pubescence*. The short shoots are spurs of varying length, up to an inch or more, stout, ringed, and bearing at their apex a bud surrounded by several double-dotted leaf-scars. In *Pseudolarix* and the larches, which have somewhat similar spurs, the leaf-scars are much smaller, and show on their surface only one tiny cicatrice. In *Taxodium* there are no spurs, and the scars which are left where the *twigs* have fallen off show only one central cicatrice.

VARIETIES

The following forms are known in cultivation:—

Var. *variegata*. Leaves blotched and streaked with pale yellow.

Var. *pendula*. Branches more or less pendulous.

Var. *macrophylla laciniata*. Leaves much larger than in the ordinary form, 8 inches or more in width, and divided into 3 to 5 lobes, which are themselves subdivided.

Var. *triloba*. Scarce worthy of recognition, as the leaves in all Ginkgo trees are exceedingly variable in lobing.

Var. *fastigiata*. Columnar in shape, the branches being directed almost vertically upwards.¹

DISTRIBUTION AND HISTORY

The wild habitat of *Ginkgo biloba*, the only species now living, is not known for certain. The late Mrs. Bishop, in a letter to the *Standard*, Aug. 17, 1899, reported that she had observed it growing wild in Japan, in the great forest northward from Lebungé on Volcano Bay in Yezo, and also in the country at the sources of the great Gold and Min rivers in Western China. However, all scientific travellers in Japan and the leading Japanese botanists and foresters deny its being indigenous in any part of Japan; and botanical collectors have not observed it truly wild in China. Consul-General Hosie² says it is common in Szechuan, especially in the hills bounding the upper waters of the river Min; but he does not explicitly assert that it is wild there. Its native habitat has yet to be

¹ See *Garden*, 1890, xxxviii. 602. An interesting article by W. Falconer, who gives some curious details concerning the Ginkgo tree in the United States.

² *Parliamentary Papers, China*, No. 5, 1904; *Consul-General Hosie's Report*, 18. Mr. E. H. Wilson in all his explorations of Western China never saw any but cultivated trees.

discovered; and I would suggest the provinces of Hunan, Chekiang, and Anhwei in China as likely to contain it in their as yet unexplored mountain forests.

The earliest mention of the tree in Chinese literature occurs in the *Chung Shu Shu*, a work on agriculture, which dates from the 8th century, A.D. The author of the great Chinese herbal (*Pen-Tsao-Kang-Mu*, 1578 A.D.) does not cite any previous writers, but mentions that it occurs in Kiangnan (the territory south of the Yangtse), and is called *Ya-chio-tze*, "duck's foot," on account of the shape of the leaves. At the beginning of the Sung dynasty (1000 A.D.), the fruit was taken as tribute, and was then called *Yin-hsing*, "silver apricot," from its resemblance to a small apricot with a white kernel. In the *Chih-Wu-Ming*, xxxi. 27, there is a good figure of the foliage and fruit; and the statement is made that in order to obtain fruit the tree should be planted on the sides of ponds.

At present it occurs planted in the vicinity of temples in China, Japan, and Corea. It has always been the custom of the Chinese to preserve portions of the natural forest around their temples; and in this way many indigenous species have been preserved that otherwise would have perished with the spread of agriculture and the destruction of the forests for firewood and timber, in all districts traversed by waterways. Most of the curious conifers in China and Japan have a very limited distribution, and Ginkgo is probably no exception; though it is possible that it may still exist in the region indicated above.

I have never seen any remarkable specimens in China; but Bunge¹ says that he saw one at Peking, of prodigious height and 40 feet in circumference.

In Japan Elwes says that it is planted occasionally in temple courts, gardens, and parks. He did not see any very large specimen of the tree, the best being one in the court of the Nishi Hongagi temple at Kioto, which was of no great height, but had a bole about 15 feet in girth at 3 feet, where it divided into many wide-spreading branches which covered an area of 90 paces in circumference. This tree had green leaves and buds on the old wood of the trunk close to the ground, which he did not notice in other places.

Rein² says that the largest he knew of is at the temple of Kozenji near Tokyo, and this in 1884 was 7.55 metres in girth, and according to Lehman about 32 metres high. There is also one in the Shiba park, which in 1874 was 6.30 metres in girth. The tree is sometimes grown in a dwarf state in pots, but does not seem to be a favourite in Japan. The wood is somewhat like that of maple in grain, of a yellowish colour, fine grained, but not especially valued, though it is used for making chess boards and chessmen, chopping blocks, and as a groundwork for lacquer ware. The nuts are sometimes eaten boiled or roasted, but are not much thought of.

Ginkgo was first made known to Europeans by Kaempfer,³ who discovered it in Japan in 1690, and published in 1712 a description with a good figure of the foliage and fruit. Pallas⁴ visited the market town of Mai-mai-cheng, opposite Kiachta, in 1772, and saw there Ginkgo fruit for sale which had been brought from Peking.

¹ Bunge, in *Bull. Soc. d'Agric. du Depart. de l'Herault*, 1833.

² Rein, *Industries of Japan*.

³ Kaempfer, *Ameritates Exotice*, 811.

⁴ Pallas, *Reisen durch versch. Provinzen des Russischen Reiches*, 1768-1773, vol. iii.

Fortune¹ mentions that the tree grows to a very large size in the Shanghai district, and in the northern part of the Chekiang province. The Japanese name Ginkgo is their pronunciation of the Chinese *yin-kuo*, "silver fruit"; but the common name in Japan is *i-cho*.

INTRODUCTION

The tree was introduced into Europe about 1730, being first planted in the Botanic Garden at Utrecht. Jacquin brought it into the Botanic Garden at Vienna sometime after 1768. It was introduced into England about 1754; and into the United States in 1784, by W. Hamilton, who planted it in his garden at Woodlawn, near Philadelphia. It first flowered in Europe at Kew in 1795. Female flowers were first noticed by De Candolle in 1814 on a tree at Bourdigny near Geneva. Scions of this tree were grafted on a male tree in the Botanic Garden of Montpellier; and perfect fruit was produced by it for the first time in Europe in 1835.

CULTIVATION

Ginkgo is easily raised from seeds, which retain their vitality for some months. Female plants may be obtained by grafting. It is easily transplanted, even when of a large size. Trees of over 40 feet high have been successfully moved. It thrives in deep, well-drained, rich soil. It is useful for planting in towns, as it is free from the attacks of insects and fungi; and the hard leathery leaves resist the smoke of cities. It may also be freely pruned. It is of course best propagated by seed; but layers and cuttings may be employed in certain cases. Falconer (*loc. cit.*) says that it is not readily propagated by cuttings, and that it took two years to root a cutting in the gardens at Glen Core (U.S.A.). Pyramidal forms can be obtained by careful selection, and the broad-leaved variety by careful grafting. The Ginkgo is well adapted for cultivation in tubs or vases, and may then be trained either as a pyramid or a bush.

The tree has a formal appearance when young, and is not really beautiful till it attains a fair age. The peculiar form of the leaves renders it a striking object. The foliage, just before it falls in autumn, turns a bright yellow² colour, which makes it very effective in that season, but only for a few days, as the defoliation is very rapid.

REMARKABLE TREES

Ginkgo is perfectly hardy in England, and, as a lawn tree, is seen to great advantage. Many trees of considerable size occur in different parts of the country. The best known one is that at Kew, of which a photograph is given (Plate 21). In 1888 it was (measured by Mr. Nicholson) 56 feet in height, with a girth of 9 feet at

¹ See Fortune, *Wanderings in China*, 118, 251; *Residence among the Chinese*, 140, 348, 363; *Yedo and Peking*, 59.

² There is no trace of red in the autumnal tint, as is usual in other trees in their leaves before they fall. The tint in Ginkgo depends entirely on the yellow coloration of the disorganised chlorophyll corpuscles, and forms a beautiful object for the microscope.

a yard from the ground. It has a double stem, and in 1904 had increased to 62 feet high by 10 feet 4 inches in girth. Other remarkable trees near London¹ are:—

One at Chiswick House, which measured in 1889, 57 feet by 6½ feet, and in 1903, 62 feet by 6 feet 11 inches; and another at Cutbush's Nursery, Highgate, which was in 1903 56 feet high by 4½ feet in girth.

Ginkgo trees may be seen in the following places in London:—Victoria Park, Telegraph Hill, Lincoln's Inn Fields, Waterlow Park, Southwark Park.

At Grove Park, Herts, a tree measured in 1904 68 feet high by 8 feet 5 inches in girth.

At Bank House, Wisbech, the residence of Alexander Peckover, Esq., there is a tree which was 65 feet high and 7 feet in girth in 1904.

There is a very fine tree² at Frogmore, Windsor, which in 1904 measured 74 feet by 9 feet 3 inches, but divides into four stems (Plate 22).

At Barton, Suffolk, a tree planted in 1825 measured in 1904 50 feet by 2 feet 5 inches.

At Sherborne, Dorset, a tree 70 feet by 7 feet 7 inches in 1884.

At Melbury, Dorchester, the tallest tree in England is said to occur, being stated to be over 80 feet in height.³ The tree at Panshanger³ is reported to be 70 feet high by 10 feet at 1 foot above the ground. At Longleat³ there is a tree 71 feet by 9½ feet girth at 1 foot above the soil.

At Cobham Park, Kent, a tree 68 feet by 9 feet 4 inches.

At Badminton, Gloucestershire, a pair of symmetrical trees each about 50 feet by 5 feet.

At Blaize Castle, near Bristol, there is a good tree, of which Lord Ducie has kindly sent a photograph and a letter from Miss Harford, dated December 1903, which states:—"The Salisburia is, I am glad to say, in perfect condition, and a very fine graceful tree. Its height, measured last summer, was 72 feet. I have always heard that the one at Kew (which is not nearly so well grown) and the one in the Bishop's garden at Wells came over from Japan in the same ship as our tree."⁴

In Wales the finest tree that we know of is at Margam Park, Glamorganshire, the residence of Miss Talbot, which in 1904 was about 70 feet high and 6 feet in girth.

We have not heard of any fine specimens in Scotland or Ireland.

A curious form of the Ginkgo tree is reported⁵ to occur at Cookham Grove, Berkshire. This tree grows within 10 feet of the river wall, which surrounds the lawn, and when there is high water the roots are under water for several days at a time. The bole is only 2 feet in height, but measures 4½ feet in girth; at that point it breaks into many branches, some going upright to a distance of over 30 feet, while others grow almost horizontally, the spread of the branches being 45 feet.

¹ The well-known trees in the Chelsea Botanic Garden and in High Street, Brentford, are now mere wrecks.

² Figured in *Garden*, 1904, lxvi. 344.

³ *Flora and Sylva*, ii. (1904), p. 357.

⁴ Elwes has since seen and measured this tree, which he made to be 68 feet by 9 feet 3 inches, with a bole about 12 feet high.

⁵ *Gard. Chron.* 1886, xxv. 53.

62 The Trees of Great Britain and Ireland

Much finer trees occur on the Continent than those in England; and it is evident that while the tree is healthy and hardy in this country, it requires hotter summers and colder winters to attain its best development and ripen fruit. A fine pair, male and female, stand in the old Botanic Garden of Geneva, where they were planted in 1815. They were measured by Elwes in 1905, when the male tree was 86 feet by 4 feet 10 inches, with a straight upright habit, the female, which bears good seed, was considerably smaller. A famous specimen in the garden adjoining the palace of the Grand Duke of Baden at Karlsruhe measured, in 1884, 84 feet, with a diameter of 25 inches at 3 feet from the ground. Beissner¹ says trees occur in this garden of 25½ and 30 metres high, with stem diameters of 1.90 and 1.80 metres. The finest tree in Europe is probably one mentioned by Beissner,¹ which stands in the Botanic Garden at Milan, and measures 40 metres high and 1.20 metre in diameter. There is also a noble specimen in the gardens of the Villa Carlotta on Lake Como.

(A. H.)

¹ Beissner, *Nadelholzkunde*, 1891, pp. 191, 192. One of the trees at Karlsruhe is figured in *Gartenwelt*, iv. 44, p. 520.

LIRIODENDRON

Liriodendron,¹ Linnæus, *Sp. Pl.* 535 (1753); Bentham et Hooker, *Gen. Pl.* i. 19 (1862).

TREES, several extinct and two living species, belonging to the Natural order Magnoliaceæ, with deciduous, alternate, stalked, saddle-shaped, or lyrate leaves. Flowers: solitary, terminal, stalked, regular, enclosed in bud in a 2-valved spathe, which falls off when the flower opens. Floral receptacle: cylindro-conic, bearing from below upwards 3 imbricated petaloid sepals, 6 petals imbricated in two rows, numerous stamens, with anthers dehiscing outwardly by longitudinal slits, and a spindle-shaped column of numerous densely imbricated independent carpels. Each carpel is a 1-celled ovary, containing 2 ovules, and terminating in a style with stigmatic papillæ at its apex. Fruit: a cone of samaræ, falling off the receptacle when ripe, each containing 1 or 2 seeds.

Liriodendron appeared in the Cretaceous epoch, and numerous fossil species have been found in North America and Europe in the Tertiary period. Of the two now living, one occurs in the eastern half of the United States and Canada, the other is a native of Central China.

¹ *Liriodendrum* is the spelling used by Linnæus in his earlier descriptions of the genus in *Corollarium Gen. Pl.* 9 (1737), and *Hort. Cliff.* 223 (1737); but the form given above is the one now always adopted.

LIRIODENDRON CHINENSE, CHINESE TULIP TREE

Liriodendron chinense, Sargent, *Trees and Shrubs*, iii. 103, Pl. lii. (1903); Hemsley in Hook. *Ic. Pl. t.* 2785 (1905).

Liriodendron chinense, Hemsley, *Gard. Chron.* 1903, p. 370.

Liriodendron tulipifera, L., var. ? *chinensis*, Hemsley, *Jour. Linn. Soc.* xxiii. 25 (1886).

The Chinese tulip tree was discovered by Shearer¹ and Maries² in the Lushan mountains near Kiukiang, on the Yangtse, and was afterwards found by me growing plentifully in the mountain woods both north and south of Ichang, in Hupeh, at 3000 to 6000 feet altitude. Von Rosthorn³ found it farther west, at Nan-ch'uan in Szechuan. It does not occur on the lower levels, and is essentially a tree of the mountains bounding the valley of the Yangtse, from 107° to 116° E. longitude, and from 29° to 32° N. latitude. I never saw any large specimens, and it does not attain, so far as is known, the size of the American species. Von Rosthorn records it as about 50 feet in height. Maries notes it as a fine spreading tree occurring at a temple near Kiukiang. It was introduced in 1901 into cultivation from Hupeh by Wilson, who collected for Messrs. Veitch; and young trees may be seen in their nursery at Coombe Wood, and also at Kew. These seedlings in January 1905 were at Kew about 15 inches in height, and have stood without injury the cold of the last few winters; but it is too soon yet to decide whether this species will turn out to be hardy in this climate.

The Chinese tulip tree is almost indistinguishable in foliage from the American tree, but as a rule the leaves are more glaucous on the under surface, and the lobing is deeper and more obtuse. The flowers are greenish in colour and smaller in size than those of *Liriodendron tulipifera*. Moreover, the narrow petals spread out when fully open, and have not a tulip shape. The carpels are consolidated, so as to appear like a solid column, and are obtuse at the apex when ripe. In the American species the carpels are free from each other at an early stage, and have when ripe acute recurved tips.

In winter there is little to distinguish the two species, except that in *Liriodendron chinense* the twigs are grey (not shining brown), the buds come off at a very acute angle, and the leaf scars are oboval and not truly circular as they are in the common species.

The Chinese call the tree *Wo-ch'ang-ch'iu*, i.e. "goose-foot Catalpa," from the shape of the leaves, but the tree is of no economic importance with them. It apparently regenerates readily from the stool, as I found it, where the wood-cutters had been at work, as strong coppice shoots with enormous leaves, more than a foot across.

¹ In 1875. See L. M. Moore in *Jour. Bot.* 1875, p. 225.

² In 1878. See Hemsley in *Gard. Chron.* 1889, vi. 718.

³ Diels, *Flora von Central China*, 322 (1901).

LIRIODENDRON TULIPIFERA, TULIP TREE¹

Liriodendron tulipifera, Linnæus, *Sp. Pl.* 1st ed. 535 (1753); Loudon, *Arb. et Frut. Brit.* i. 284 (1838); Sargent, *Silva of N. America*, i. 19, tt. 13, 14 (1891).

A lofty tree, attaining in America in the most favourable conditions a height of 190 feet, and a stem diameter of 10 feet. Bark grey and smooth in young trees, becoming darker in colour and furrowed in old trees. Roots, fleshy with pale brown bark, having an aromatic odour and pungent taste.

Leaves extremely variable in shape, but generally saddle-shaped or lyrate in outline, with a rounded or cordate base, and a truncate emarginate apex,² the midrib being prolonged into a short bristle. Sometimes they are quite entire, but are more usually lobed, the lobes varying from 2-6 or even 8 in number, and often ending in a point. Venation pinnate. The leaves are 3-5 inches in length and in breadth, dark green and smooth above, lighter in colour and minutely pubescent underneath. Stalks about as long as the blades, angled and slender, so that the leaves quiver with any movement of the air. In autumn they turn bright yellow in colour, and give the tree a handsome appearance.

Two lateral stipules³ occur on the twigs, attached a little higher up than the insertion of the leaf-stalk. These are the scales which have formed the buds of the previous winter; and, as a rule, they shrivel up and fall off when the young leaves are fully matured; but some of them remain on vigorous shoots till late in summer.

The flowers resemble a tulip in shape, being 1½-2 inches long, with a width of 2 inches at the summit. The petals are greenish white, with an orange-coloured band at the base, which secretes nectar attractive to bees. These visit the trees in myriads in May, the flowering season in Illinois.

The fruit, light brown in colour, is a cone made up of a large number (about 70) of ripe carpels, which consist of a 4-ribbed pericarp surmounted by a flattened woody wing (the enlarged style). The wing may carry the seed by currents of air 300 or 400 feet from the parent tree. The carpels remain on the tree till thoroughly dry, some usually persisting throughout the winter on the receptacle, a few falling at a time as the wind dislodges them. The outer ones are nearly always sterile. The carpels will float in water for nearly a year without sinking; and this may explain the distribution of the tree along the banks of rivers. The seed has a fleshy albumen, in the summit of which is situated a minute embryo.

Seedling.—The seedling has two aerial short-stalked oval cotyledons about

¹ Usually called "Yellow Poplar" in the United States, "White-wood" also being a name in use amongst the western lumbermen.

² Lubbock, in *Trans. Linn. Soc. (Bot.)* xxiv. 84, ascribes the form of the leaves to the way in which they are packed in the bud.

³ Occasionally the stipules are attached as wings to the leaf-stalk either near its base or higher up; and in rare cases they even unite with the base of the leaf-blade, appearing then to be extra lower lobes of the leaf itself. For accounts of these peculiar stipules and remarkable forms of leaves occurring in tulip trees, see E. W. Bury in *Bull. Torrey Bot. Club*, 1901, p. 493, and in *Torreya*, 1901, p. 105, and 1902, p. 33.

$\frac{1}{2}$ inch in length. Above these on the stem follow the true leaves, the first and second orbicular in outline; the third and fourth showing lobes; all have long slender petioles. The first year's growth terminates in a bud just above the insertion of the fourth leaf. The primary root gives off a good many lateral fibres, which are delicate and brittle. Seedlings which germinated at Colesborne early in June were 3-4 $\frac{1}{2}$ inches high in August, with roots of about the same length or slightly shorter. According to Elwes there was no marked tendency to form a tap-root in any of the specimens which he examined.

VARIETIES

Several forms are in cultivation, which differ from the wild tree in habit, in form and colour of the leaves, and in colour of the flowers.

1. Var. *pyramidalis*, Lavallée.—Tree with erect branches, forming a narrow pyramid, like the fastigate oak.
2. Var. *integrifolia*, Kirch.—Leaves rounded at the base and without lobes. In this form, the shape of the leaves of seedling trees is preserved.
3. Var. *obtusiloba*, Pursh.—Leaves with only one rounded lobe on each side of the base.
4. Var. *heterophylla*.—Foliage variable; some leaves being entire, others with lobes, which are acute or obtuse.
5. Var. *crispa*.—Leaves with undulate margins.
6. Var. *variegata*.¹—Forms with variegated leaves, of which several sub-varieties have received names, as *argenteo-variegata*, *aureo-variegata*, *medio-picta*. That known as *aureo-marginata*² in which the edges of the leaves are yellow is the best.
7. Var. *aurea*.—Flowers yellow.

IDENTIFICATION

In summer, the shape of the leaves is unmistakable, resembling those of no other hardy tree: the variety *integrifolia*, though without lobes, preserves the truncate, slightly emarginate apex, in the centre of which may be seen the midrib prolonged as a short bristle.

In winter, the twigs and buds are very characteristic. Buds: terminal, larger than the lateral, which are alternate on the twigs, and arise from them at an angle of 45°. They are stalked, glaucous, glabrous, composed of 2 stipules joined together by their edges, forming a closed sac, in which is contained the young shoot;³ and on opening it a leaf will be seen embracing an interior bud. It is folded on its mid-rib with the stalk bent like a hook, bringing the apex of the leaf to the base of the bud. The twigs are glabrous, shining brown or slightly hoary, and marked by stipular rings just above the leaf-scars, which are circular, placed obliquely on prominent cushions, and dotted like a sieve with cicatrices of the fibrous bundles. The lenticels are few

¹ The variegated form in which the yellow marking occurs as irregular blotches in the central part of the leaves is well depicted in Lemaire, *Illust. Horticole*, xv. t. 571 (1868).

² A good figure of the variety is given in *Flore des Serres*, xix. 2025 (1873).

³ Within the outer bud or sac are contained several younger buds, one within the other, each with a folded leaf.

and minute. The pith is solid, but not continuous, being interrupted by woody cross-partitions. (A. H.)

DISTRIBUTION

In Canada the tulip tree occurs¹ in rich soil in the western peninsula of Ontario, from Hamilton to Huron Co. It forms a noble tree in the thick forest west of St. Thomas, and has been found in Nova Scotia.²

In New England it occurs in the valley of the Hoosac river, Mass., in the Connecticut river valley, and in Rhode Island, where it is frequent.³

It extends west to Southern Michigan as far north as Grand river, southward through all the States east of the Mississippi to Alabama, attaining its maximum size in the valleys of the Ohio river and its tributaries, and in the foot-hills and valleys of the Southern Alleghany mountains, in Tennessee, Kentucky, and North Carolina. West of the Mississippi it occurs commonly, though not in the south-eastern parts of Missouri and Arkansas. Its southern limit appears to be in Northern Florida, Southern Alabama, and Mississippi.

Sargent says of this tree that it is one of the largest and most beautiful trees of the American forest, only surpassed in the Eastern States by the occidental plane and the deciduous cypress.

It sometimes attains in the deep river bottoms and warm, damp, summer climate of Southern Indiana a height of 160-190 feet, with a straight trunk 8-10 feet in diameter clear of branches for 80-100 feet from the ground. Individuals 100-150 feet tall with trunks 5-6 feet in diameter are still common. The branches, which are small and short in proportion to the trunk, give this tree a pyramidal habit, except in the case of old or very large individuals, on which the head is spreading.

I have seen it growing in the neighbourhood of Boston, where, however, it did not seem to attain as large a size as in the south of England, and where seedlings do not come up freely so far as I saw. Near the gate of the Arnold Arboretum the largest tree, about 70 years old, was 85 feet high by 8 feet 6 in girth.

In Druidhill Park, Baltimore, it becomes a much finer tree, and surpassed in height any other species growing there. The tallest I saw was in a shady dingle, and measured 125 feet by 11 feet, with a straight clean stem. Older trees had rough bark coming off in scales.

In the mountains of North Carolina, at Biltmore, I saw much larger trees, and to give an idea of its development in this region I figure (Plate 24) a tree from a photograph⁴ kindly sent me by Mr. W. Ashe of the North Carolina Geological Survey, taken in the winter. This tree, which stood in Yancey Co., North Carolina, was a very characteristic specimen, more than 160 feet high and 6 feet in diameter at 5 feet from the ground. The smaller timber having been cut from around it only a few years previously, the form of the tree is perfectly typical, and shows the charac-

¹ Macoun, *Cat. Canadian Plants*, pt. i. 28 (1883).

² G. Lawson, *Proc. N.S. Inst. Science*, 86 (1891).

³ Dame and Brookes, *Trees of New England*, 104 (1902).

⁴ Pinchot and Ashe, *Bull. No. 6, North Carolina Geol. Surv.* pt. ii. (1898).

teristic sharp angles made by the smaller erect branches with the larger horizontal limbs.

Another photograph sent me by Mr. Ashe shows a group of *Liriodendron*, in the forests of Transylvania Co., N.C., 120-140 feet high and 4-5 feet in diameter, associated with *Quercus rubra* and *Betula lutea* which are not so tall. This magnificent forest is, like most of those accessible to the lumbermen, rapidly decreasing in area and beauty, owing to the growing demand for timber.

For further details of the distribution in North Carolina refer to Pinchot and Ashe's admirable account, pp. 39-41, and to a paper by Overton Price on "Practical Forestry in the Southern Appalachians."¹

The largest trees of this species, however, have been recorded by Professor R. Ridgway² from Southern Indiana and Illinois, near Mount Carmel, Illinois, which I had the pleasure of visiting under the guidance of Dr. J. Schneck in September 1904. Though the largest trees recorded by him have now been cut, reliable measurements were taken of a tulip tree which reached the astonishing height of 190 feet, exceeding that of any non-coniferous tree recorded in the temperate regions of the northern hemisphere. Another tree cut "8 miles east of Vincennes, was 8 feet across the top of the stump, which was solid to the centre; the last cut was 63 feet from the first, and the trunk made 80,000 shingles." The soil here is an exceedingly rich, deep alluvium, and the climate in summer very hot and moist.

It is stated in *Garden and Forest*, 1897, p. 458, that at the Nashville Exhibition a log of this tree was shown by the Nashville, Chattanooga, and St. Louis Railroad Company, which measured 42 feet long, 10 feet 4 inches in diameter at the butt, and 7 feet at the smaller end, containing 1260 cubic feet of timber, and about 600 years old.

INTRODUCTION

The tulip tree was probably introduced, according to Evelyn,³ by John Tradescant about the middle of the seventeenth century, but this is somewhat uncertain, though it was grown by Bishop Compton at Fulham in 1688.

According to Hunter the tree which first flowered in England was in the gardens of the Earl of Peterborough at Parsons Green, Fulham, and this he describes in 1776 as "an old tree quite destroyed by others which overhang it." At that time there were also some trees of great bulk at Wilton, the seat of the Earl of Pembroke in Wilts.

CULTIVATION

Though the tree can be propagated by means of layers, and in the case of varieties by grafting, yet as seeds are easily procured from the United States it is much better to raise it from seed. Cobbett, who was a great admirer of the tulip tree, gives a long account of it, and of the best means of raising it,⁴ and says that if sown in May, which he thinks the best time, it will germinate in the following May,

¹ Yearbook U.S. Dept. of Agric. (1900).

² Notes on Trees of Lower Wabash, Proc. U.S. Nat. Hist. Mus. 1882, p. 49; 1894, p. 411.

³ Evelyn's *Silva*, 214. Ed. Hunter (1776).

⁴ Woodlands, par. 523 (1823).

but that if sown in autumn, part will come up in the next spring and part in the following year.

Dawson in an excellent paper on the Propagation of Trees from Seed,¹ says, "The tulip tree invariably takes two years, and as the proportion of good seed is as 1 to 10, it should be sown very thickly to ensure even an ordinary crop."

Probably this opinion was based on his experience with seeds grown in New England, where they do not ripen so well as they do in the south, for my own experience, gained by sowing seeds received from Meehan of Philadelphia, is different. In the spring of 1903 I sowed part of the seeds in a greenhouse, where they began to germinate six weeks later. Of those sown in the open ground, perhaps 10 per cent germinated in June. The following summer was cold and wet, and the seedlings in the open ground made slow progress, being only 2-3 inches high in the autumn, whilst those kept under glass were from 6-15 inches high at the same time. The young wood seems to ripen better than that of most North American trees and, as the spring of 1904 was favourable, they were not checked by frost. But the seedlings are difficult to transplant, owing to the fleshy and brittle nature of their roots, and are therefore best kept in a box or large pot till they are two years old, when the roots should be trimmed and planted out in deep sandy soil, and watered the first year; after this they should be transplanted frequently until large enough to put in their permanent situation, and if tall and straight grown trees are desired the young trees must be very carefully pruned, as like the Magnolia they do not thrive so well if large branches are cut off.

The tulip tree rarely ripens its seed in England, and that which I got from a tree at Westonbirt in Gloucestershire in 1901 did not germinate. But I am informed by Mr. A. C. Forbes, that a self-sown tulip tree is growing in the sand walk at Longleat, and Colonel Thynne confirms this in December 1904, when he tells me the young tree is 8 feet high. This, however, is the only instance I know of in England where natural reproduction has occurred.

SOIL AND SITUATION

The tree requires a deep, moist, rich soil to bring it to perfection, preferring heavy land to light, and apparently disliking lime in the soil. It probably prefers a moderate amount of shade when young, and would be more likely to grow tall and straight if surrounded by other trees. But isolated trees sometimes grow with a clean straight stem, as at Leonardslee in Sussex (see below) even on dry soil.

In the *Gardeners' Chronicle* for 1879 there was much correspondence on the merits of this tree for general cultivation in England, from which I extract the following particulars, which will be valuable to intending planters.

Most of the correspondents agree that it grows best on heavy soil, inclining to clay, or with a clay subsoil. Sir W. Thiselton Dyer says it does not do well on the light, dry soil of Kew Gardens.

¹ Trans. Mass. Hort. Soc. 1885, p. 152.

Mr. Bullen says that it grows well in heavy clay in the damp and smoky climate of Glasgow, and a tree is mentioned at the Grove, Stanmore, on damp, gravelly clay, which in 1879 was 77 feet high by $9\frac{1}{2}$ in girth.

The tulip tree has been much recommended for planting in towns, and specimens may be seen in London at Victoria Park, Manor House Gardens, Lincoln's Inn Fields, Waterloo Park, Clissold Park, etc.

Mr. Hovey says that in America it is not so much planted for ornament as it deserves to be, presumably because American planters desire a quick effect, and that it does not transplant well after it is 4-6 feet high; but that it grows on gravel, sand, peat, or clay, and is not very particular in that climate as to soil. He has known it grow 30 feet high and more in 20 years.

It is very liable to be attacked by rabbits, which eat the bark even of large trees, and I have seen several which have been killed or much injured in this way.

REMARKABLE TREES

Though this tree is one of the handsomest when in flower, stateliest in habit, and most beautiful in the autumn tints of its leaves, it is not now planted in England nearly as much as it was a hundred years and more ago, having, like so many other fine hard-wooded trees, been supplanted by conifers and flowering shrubs, which are easier to raise and more profitable to the nurserymen, who now appear to cater rather for the requirements of owners of villas and small gardens than for those of larger places. But though the tulip tree loves a hot summer, it endures the most severe winter frosts of our climate without injury, and in a suitable soil grows in some parts of the southern counties, after it is once established, to a great size.

The largest living specimen I know of in England is at Woolbeding, in Sussex, the seat of Colonel Lascelles, and measures 105 feet by 17. Though not so perfect in shape as some others, it is a very beautiful tree, and seemed, when I saw it in 1903, to be in good health. It grows on a deep, alluvial, sandy soil, which suits plane trees and rhododendrons very well (Plate 25).

There was even a larger one at Stowe near Buckingham, which when I saw it in 1905 was dead, apparently barked at the base by rabbits. It was at least 107 feet high, with a bole of about 30 feet, and a girth of 13 feet at 5 feet, and 21 feet 4 inches at the ground.

Another very fine tree is at Leonardslee, near Horsham, the seat of Sir Edmund Loder, Bart., also in Sussex, and is growing at an elevation of 400-500 feet on soil which, though very favourable to rhododendrons, is too poor to grow either oak, birch, or larch to the same size in the same time. Sir E. Loder tells me that the tree cannot be more than 90 years old, and it is now 97 feet high, with a perfectly clean, straight trunk 25-30 feet high, which towers above all the native trees of the district (Plate 27).

At Horsham Park, the residence of R. H. Hurst, Esq., is a very fine and symmetrical tree which I measured rather hastily, as over 100 feet in height by 15 in girth.

Another very remarkable tree (Plate 26) is the one at Killerton, in Devonshire, which I am sorry to hear has suffered severely in the gale of September 1903. This tree must be one of the oldest now living, as Sir C. T. D. Acland tells me that in a picture of his house, taken early in the last century, it seems nearly as tall as at present, and it is mentioned by Loudon as being 63 feet high in 1843. When I measured it in 1902 it was 80 by 15 feet, with a bole about 18 feet long, and must have contained nearly 300 feet of timber.

A very fine tulip tree, on heavier, damper soil at Strathfieldsaye, Berkshire, the seat of the Duke of Wellington, measures 105 feet by 12; and though not such a well-shaped tree as the one at Leonardslee is of the same type.

The tree which Loudon refers to as being the tallest known to him at Syon, was, in 1844, 76 feet high, at about 76 years of age, but this is now dead, as is the old tree at Fulham Palace mentioned by Loudon, which he estimated at 150 years of age.

At Bury House, Lower Edmonton, there is a magnificent tree which John W. Ford, Esq., informs us is thoroughly sound and in perfect health. He estimates it to be 70 to 75 feet in height, the girth 5 feet from the ground being 17 feet 4 inches. The bole at 13 feet divides into five limbs, of which the biggest are 5 feet round. The soil is splendid, being brick earth.

At Deepdene, Dorking, there is a fine tree on the lawn, which in February 1904 was 83 feet high by 14 feet in girth.

At Petworth, the seat of Lord Leconfield, there is a curious old tree which has an immense burry trunk 17 feet in girth.

A tree was recorded at Longleat in 1877 as being 106 feet high and 10 feet in girth, but this, as I learn from the Marquess of Bath, is now dead, though one or two other large specimens remain.

There is a very fine tree at Margam, in Pembrokeshire, which, as measured in 1904, is 92 feet high by 13 feet 6 inches at 6 feet from the ground, with a spread of branches 57 feet in diameter.

An immense tree at Esher Place, Surrey, is mentioned by Mr. Goldring as having a girth of 22 feet.

At Barton, Suffolk, two trees¹ were planted in 1832. They first flowered in 1843. In the year following the severe winter of 1860 no flowers were produced, but the foliage was as good as usual. In 1904 these two trees had both attained the same height—79 feet; one having a girth of 7 feet 2 inches at 5 feet above the ground; the other divided into two stems at a point 2 feet from the ground where the girth was 10 feet 4 inches. The soil at Barton is good, consisting of 2 or 3 feet of loam resting on boulder clay.

At Ashby St. Ledgers, Rugby, the seat of the Hon. Ivor Guest, there is a good tree² which measured 80 feet in height by $16\frac{1}{2}$ feet in girth in 1900. This tree breaks into three stems at a little above 4 feet from the ground, and the girth is taken below this point.

At Hampton Court, Herefordshire, a tree³ on the lawn in 1879 was 80 feet

¹ Bunbury, *Arboretum Notes*, 60.

² Letter to Curator at Kew.

³ *Garden*, 1890, xxxviii. 178. The measurements refer to 1879, according to a note in *Woods and Forests*, April 23, 1884.

high by 12 feet 7 inches in girth, with an estimated cubic contents of timber of 223 feet. When I measured it in 1905 it was 95 by 13 feet, but the top and trunk were decaying.

At Erlestoke Park, Wiltshire, a tree,¹ growing near the bank of a lake, was 80 feet high by 14 feet in girth at 4 feet from the ground in 1902.

The following records from Hampshire were reported in *Woods and Forests*:²—North Stoneham Churchyard, near Southampton, a tree 12 feet 10 inches in girth; Cranbury House, near Winchester, a tree 11 feet 9 inches in girth; at Gramwell's Meadow, east of East Tytherley Manorhouse, near Romsey, a tree 85 feet high by 10 feet 5 inches in girth, with a stem free from burrs, planted in 1780. These measurements were taken in 1884. At Hale Park, in 1879, there was a tree 75 feet high with a short bole of 4 feet, girthing 18 feet 3 inches.

The finest tree at Kew, 70 feet high in 1844, is gone, but there still exists a well-proportioned specimen³ which stands at the end of the rhododendron dell. It is now (1905) 79 feet high by 9 feet 9 inches in girth. It produces fruit freely every year, but the seeds are always poorly developed and infertile.

In Scotland a tree was mentioned by Loudon as growing at The Hirsell, Coldstream, the seat of the Earl of Home, which was at that time 100 years old and 20 feet in girth 3 feet from the ground. I was informed by Mr. Cairns, head gardener at the Hirsell, that in 1903 it was slowly decaying, some of the larger branches being gone, but that what remained carry a large amount of healthy foliage, and flowers more or less every year.

At Drummonie Castle, Perthshire, formerly a seat of the Lords Oliphant, Hunter⁴ mentions a tree 8 feet in girth at 5 feet, and another at Gorthy Castle,⁵ girthing 9 feet 7 inches at 3 feet, which had been a good deal injured by cattle grazing in the park. He also (p. 400) speaks of a large tree at Castle Menzies, 10 feet in girth, but I did not see it on either of my visits to this interesting old place.

The tulip tree is not mentioned in the *Old and Remarkable Trees of Scotland*, but it grows at Gordon Castle, and even as far north as Dunrobin Castle in Sutherlandshire.

In the south-west of Scotland there do not appear to be any large trees, the biggest mentioned by Messrs. Renwick and M'Kay⁶ being one at Auchendrane House, Ayrshire, which was, in September 1902, 53 feet by 5 feet 8 inches, and one at Doonside, Ayrshire, which was 46 feet 9 inches by 8 feet 1 inch.

At Jardine Hall, Lockerbie, a tree⁷ measured in 1900 60 feet in height by 9 feet in girth.

At St. Mary's Isle, Kirkcudbright, a tulip tree⁸ was, in 1892, 10 feet 9 inches in girth.

¹ *Gard. Chron.* 1902, xxxii. 61.

² Issues of April 16 and 23, 1884.

³ Figured in *Gard. Chron.* 1890, viii. 219, where it is stated in the text that the tulip tree bears pruning well, and that there is an avenue of clipped trees in one of the courts at Chatsworth.

⁴ Hunter, *Woods, Forests, and Estates of Perthshire*, 145 (1883). This is apparently the tree mentioned in *Gard. Chron.* 1890, viii. 388, as being 60 feet in height then, and having recently flowered.

⁵ *L.c.* p. 371.

⁶ Renwick and M'Kay, *Brit. Assoc. Handbk.* 131 (1901).

⁷ *Garden*, 1890, xxxviii. 178.

⁸ M'Kay and Renwick, *Trans. Nat. Hist. Soc. Glasg.* Sept. 4, 1894, p. 17.

In Ireland large tulip trees are rare. There are two good specimens at Fota, which measured in 1903, one 87 feet high by 11 feet 7 inches in girth, the other 57 feet by 14 feet 7 inches.

In France the tulip tree, favoured by warmer summers, seems to thrive better, and attains a larger size than in England. Mouillefert¹ speaks of a tree at the Chateau de Frêne, near Chaulnes, in the department of Somme, which in 1899 was 38 metres in height by 5 in circumference. He also mentions having seen in 1902 at the Chateau de Cheverny, near Blois, tulip trees planted along the banks of a canal, which at 50-60 years of age measured 31 metres in height and 2 metres in girth at 5 feet from the ground, whilst plane trees of the same age close to them were only 24 metres high and 1.65 in girth.

He considers that in a suitable soil and situation such as the valleys in a granitic mountain range, or on damp, rich soils, in fact in such places as the ash, the poplar, and the plane thrive, this tree might be grown as a forest tree to produce valuable timber, or as copse wood, cut at 18 or 20 years of growth for turnery purposes.

Considering, however, the cost of raising this tree in the nursery, and its liability to suffer from autumn frost in a young state, I do not think the tree can be considered likely to become a forest tree in England, except possibly in a few choice situations in the south and south-west.

TIMBER

The timber of the tulip tree is now very much used in North America for many purposes, and is also largely imported to England under the name of white-wood, canary-wood, and yellow poplar. Stevenson says of it,² "Though classed among the light woods it is much heavier than that of the common poplar, its grain is equally fine but more compact, and the wood is easily wrought and polished. It is found strong and stiff enough for uses that require great solidity. The heart-wood, when separated from the sap and perfectly seasoned, long resists the influence of the air, and is said to be rarely attacked by insects. It is imported in the form of waney logs and in sawn planks of very fine dimensions, in which state it commands a price fully equal to that of the first quality of Quebec yellow pine.

Hough³ speaks of it as "light, rather strong, with close straight grain, compact, easily worked, and yielding a satiny finish. Sap-wood nearly white, heart-wood of a light lemon-yellow colour, or sometimes of a light brownish tint—whence its two seemingly contradictory names, white and yellow poplar, the former referring to the sap-wood, the latter to the heart."

Sargent says it is light and soft, brittle and not strong, is readily worked, and does not easily split or shrink. The heart-wood is light yellow or brown, weighing when absolutely dry 26-36 lbs. to the cubic foot. Large canoes were formerly made from it by the Indians, and it is now extensively used in construction, for the

¹ *Traité de Sylviculture*, 467-468 (1903).

² *The Trees of Commerce*, 96-103 (1902).

³ *The American Woods*, pt. i. p. 40, t. 2 (1893).

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interior finish of houses, and in boat-building, as well as for shingles, pumps, and wooden ware.

The only timber I know which it resembles closely in colour, texture, and grain, is that of *Magnolia acuminata*.¹

Neither Stevenson, Hough, nor Stone, however, speak of a form of this timber known as "blistered poplar," which is occasionally found, as I believe, only in old trees, and which is sometimes imported in small quantities to Europe. This seems akin to the figured maple wood known as bird's eye maple, but has the figure in oblong patches from 2 inches long downwards, of a dark olive colour on a paler olive-green ground, and is one of the most ornamental woods I know, fit to be used in the finest cabinet work. I saw large planks of this variety in the Exhibition at St. Louis, and have had some of it worked into the panels of a screen.

The wood of the tulip tree grown in England seems to be nearly as good in quality as the imported timber, though not quite so pure in colour. From a tree which was cut at Highclere a plank was sent me by the kindness of the Earl of Carnarvon, which has been used in the same screen, and I have a large book-case of which the back is made of the imported wood, selected by an experienced cabinet-maker as best for the purpose.

Mouillefert says that in Paris its use is increasing for all purposes for which the wood of the lime and poplar is suitable, and that it has when fresh cut a pleasant smell of orange, which, however, is soon lost as it dries. (H. J. E.)

¹ Mr. Weale tells me that the timber of this Magnolia, as well as that of *M. grandiflora* and *M. glauca*, come into the Liverpool market mixed with that of the tulip tree, and that though the two former may easily be distinguished by a person who knows them well, yet that *M. glauca* can only be identified with a lens, and that in consequence of this mixture, opinions differ as to the suitability of the wood for laying veneers upon. He thinks that if bone dry, the wood of the tulip tree is fit for this purpose, but not equal to that of American chestnut, American cherry, or Honduras mahogany, of which the latter is best. He also says that for pattern making Quebec yellow pine is distinctly superior, and worth from 1s. to 2s. a foot more.

PICEA

SPRUCE-FIRS

Picea, Link, *Abhandl. Akad. Wiss. Berlin*, 1827, 179 (1830); Bentham et Hooker, *Gen. Pl.* iii. 439 (1880); Masters, *Jour. Linn. Soc. (Bot.)* xxx. 28 (1893).

Abies, Linnæus, *Gen. Pl.* 294 (in part) (1737); D. Don in Lambert, *Pinus*, vol. iii. (1837), ex Loudon, *Arb. et Frut.* iv. 2293 (1838).

THIS genus includes the spruce-firs, which in England, following the practice of Don and Loudon, are still often called *Abies*. However, all botanists in England, on the Continent, and in America apply the term *Picea* to the spruces, and *Abies* to the silver firs.

Tall evergreen trees belonging to the tribe Abietinæ of the order Coniferae, with shoots of only one kind, bearing in spiral order peg-like projections ("pulvini"), from which the leaves arise singly. The needle-like leaves are either tetragonal or flattened in section, and persist for many years, rendering the foliage very dense. At the ends of the leading shoots there is a terminal bud, with 2-5 side buds directly under it; the buds are dry and not resinous.

Flowers monœcious. Male flowers solitary in the axils of the uppermost leaves, ovoid or cylindric, short-stalked, surrounded at the base with scale-like bracts, composed of numerous stamens spirally arranged, each with 2 pollen-sacs opening longitudinally, and a connective prolonged into a toothed crest. Pollen grains with 2 air-sacs. Female flowers solitary, terminal, erect, stalked, with a few empty scales at the base; composed of 2 series of scales, the bracts small and membranous, and the ovular scales bearing at their base 2 inverted ovules. Cones: generally becoming pendulous, but in certain species remaining erect or spreading; cylindrical or ovoid, with the bracts minute and concealed, and the scales enlarged and firm in texture, with entire or denticulate margins, and bearing on their inner surface 2 winged seeds. The cones are ripe in the first season, and after dispersal of the seed (the scales persisting on the axis) fall off in the following winter, or remain in some species much longer on the tree. The cotyledons are 5-15 in number, 3-sided, and serrate in margin.

Species of spruce occur in Europe, Asia Minor, the Caucasus, Siberia, Mongolia, China, Japan, the Himalayas, and in North America. The genus is marked out into two natural sections by the character of the leaves. These are defined by Willkomm as follows:—

1. *Eu-picea*.—True spruces. Needles 4-sided and 4-angled, with stomata on all their surfaces. The ripe cones are always pendulous.

2. *Omorica*.—Flat-leaved spruces. Leaves 2-sided, flattened from above downwards, stomata being only borne on their dorsal surface. Ripe cones pendent, horizontal, or erect.

Other divisions have been made, such as that of Link into two sections, *Genuine* and *Dehiscentes*; and that of Mayr into three sections, *Omorica* (not identical with Willkomm's section of the same name), *Morinda*, and *Casicta*; but it is most convenient to adopt Willkomm's divisions.

The arrangement of the leaves on *lateral branchlets* is different in the two sections. All spruces agree in the disposition of the leaves arising from the upper side of such branchlets, as these always point forwards and cover the shoot. But, in ordinary species, the leaves underneath, while they part into two lateral groups, alter little their direction, which is more or less forwards; and the under part of the stem is laid only partially bare. In almost all the flat-leaved spruces, the leaves below part into two sets, which are directed outwards at right angles to the shoot, which is laid quite bare. This arrangement differs from that of the yew and most silver firs, where the leaves are divided into two sets both above and below; and this distinction depends on the fact that in these spruces the stomata are on the dorsal surface of the leaf, whereas in the yew, etc., they are on the ventral surface; and in the effort to direct the stomata away from the light, a different arrangement results in the two cases.

The arrangement of the leaves on leader or upright branchlets is the same in all species of spruce, being radial, the leaves pointing outwards and slightly forwards. In certain species, as *P. Breweriana*, *P. Morinda*, the lateral branchlets are pendulous and not horizontal; and the leaves then are similarly arranged in both the lateral and the leader shoots.

The section *Eu-picea* will be dealt with in a later part.

KEY TO SECTION OMORICA.—The flat-leaved spruces are distinguished from the silver firs by the peg-like projections on the shoots, and from ordinary spruces by the flattened leaves with stomata only on their dorsal surface.

I. *Young shoots glabrous, yellow.*

1. *Picea hondoensis*. Central Japan.

Buds broadly conical, with scales rounded in the margin, opening red. Shoots of second year red. Leaves thin, slightly keeled on both surfaces, blunt or ending in a short point.

2. *Picea ajanensis*. Manchuria, Amurland, Saghalien, Yezo.

As in 1, but the buds open green, and shoots of the second year are yellow.

3. *Picea sitchensis*. Western North America.

Buds ovoid with ovate obtuse scales. Leaves deeply keeled on ventral green surface, almost convex on dorsal white surface, ending in very sharp, cartilaginous points.

4. *Picea morindoides*.¹ Native country unknown.

Buds and scales ovate-obtuse. Leaves linear, straight, slender, acuminate, terminating in a callous sharp tip, somewhat flattened and distinctly keeled on both sides, marked with two white lines on the upper surface, and dark bluish green on the under surface. Leaves radially spreading on the branchlets.

II. *Young shoots pubescent with short hairs.*

5. *Picea Omorika*. Servia and Bosnia.

Pubescence brown. Buds ovate, conical, with outer scales ending in long subulate points. Leaves flattened but thick, obtuse or ending in a short point.

6. *Picea Breweriana*. Oregon, California.

Pubescence grey. Buds ovoid, with outer scales ending in long points. Leaves scarcely flattened, but convex above and below, keeled on dorsal surface, with midrib prominent on ventral green surface, and ending in a short point. The leaves spread out in all directions on the shoot.

¹ A new species described by Rehder in Sargent, *Trees and Shrubs*, 95, t. 48 (1903). It is only known as a tree growing in the arboretum of G. Allard at Angers. I have seen no specimens and take the characters given above from Rehder. In habit it resembles *Picea Morinda*, the branches being pendulous. The cones resemble those of *Picea Alcockiana*.

PICEA OMORIKA, SERVIAN SPRUCE

Picea Omorika, Bolle, *Monatschrift des Vereines zur Beforderung des Gartenbaues*, 124 (1877); Masters, *Gard. Chron.* 1884, xxi. 308, 309, Figs. 56, 57, 58, and 1897, xxi. 153, Fig. 44; *Jour. Linn. Soc. (Bot.)* xxii. 203 (1886); Willkomm, *Forstliche Flora*, 99 (1897); Kent, in *Veitch's Man. Coniferae*, 442 (1900); Richardson, *Edin. Bot. Garden, Notes, No. 1* (1900); G. von Beck, *Die Vegetationsverhältnisse der Illyrischen Länder*, 286, 360, 440, 474 (1901).
Pinus Omorika, Pančić, *Eine Neue Conifere in den Oestlichen Alpen*, 4 (Belgrade, 1876); Masters, *Gard. Chron.* 1877, vii. 470, 620.

A tree with a tall, slender stem, said to attain 130 feet in height, with a girth of stem of only 4 feet, with short branches, forming a narrow pyramidal crown. The topmost branches are directed upwards, the middle ones are horizontally spreading, and the lower ones are pendulous, with their tips arching upwards. Bark brownish red, and scaling off in plates, the fragments often being heaped in quantity round the base of the tree. The leaves on vertical shoots stand out on all sides, but on horizontal shoots they point forwards on the upper side, being pseudo-distichous in three or four ranks on the lower side. They are flattened, 4-angled, straight, or curved to one side, $\frac{3}{4}$ -1 inch long, linear, acute or obtuse with an apiculus, convex, and shining green on the ventral surface, marked with stomatic lines on each side of the prominent midrib of the dorsal surface.¹ They persist for 4 or 5 years.

The buds, ovoid-conic with brown, membranous scales, the outermost of which end in long subulate points, are produced chiefly near the end of the shoot; and in unfolding, the uppermost scales are pushed off as a cap. The dark brown hairs, which are conspicuous on the young shoots, persist on the older branchlets of even 3 or 4 years' growth in wild specimens.

The male flowers, which are partly solitary and partly whorled, are stalked, ovoid-cylindric, bright red, $\frac{1}{2}$ - $\frac{3}{4}$ inch long, and are surrounded at the base by numerous membranous bracts.

Cones, shortly-stalked 2-2 $\frac{1}{2}$ inches long, bluish black when young, dark-brown when ripe, clustered, the upper ones being directed upwards, while the middle ones are horizontal, and the lower ones pendulous. Scales almost orbicular in outline, broad and convex, streaked on the outer surface, with the margin slightly bent inwards, undulate and denticulate. Bract obovate-cuneate, minute. Seeds small, $\frac{1}{10}$ - $\frac{1}{8}$ inch long, obovate, blackish brown, with a wing $\frac{1}{3}$ inch long, obovate in outline.

¹ On horizontal shoots, the leaves, by twisting movements on their bases, are inverted, so that the green surface is turned upwards and the stomatic surface downwards.

DISTRIBUTION

The Servian spruce was first made known to science by Pančić, who discovered it in south-western Servia, near the village of Zaovina, on 1st August 1875. Its area is a small one, occupying about 20 kilometres long by 15 kilometres wide on both sides of the Drina valley, the boundary between Servia and Bosnia. Here it occurs on limestone rocks at altitudes varying from 2700 to 5300 feet. It grows in small groves in the wetter places in the ravines, but it does not there reach such a height as it attains in the rockier parts of the mountains, where it forms part of the mixed forest of Austrian and common pines, common spruce, beech, and sycamore. Pure woods of Omorika occur at higher elevations, between 4700 and 5300 feet, where sub-alpine plants accompany it. Wettstein gives the following as the composition of the characteristic Omorika woods:—

Dominant Trees.—*Picea Omorika*, *Pinus sylvestris*, *Carpinus duinensis*, *Picea excelsa*, *Fagus sylvatica*, *Populus tremula*, *Abies pectinata*, *Ostrya carpinifolia*, *Salix sp.*, *Pinus austriaca*.

Underwood.—*Corylus avellana*, *Cotinus coggygria*, *Spiraea cana*, with *Rhamnus fallax* and *Lonicera alpigena* at high altitudes.

Ground-herbage.—*Aspidium Filix-mas*, *lobatum*, and *angulare*.

Wettstein¹ says that an Omorika forest has a peculiar and gloomy aspect, the slender stems with their short branches and columnar or spindle-shaped crowns looking quite different from any other type of European forest. In mixed forests, the straight single stems, arising out of the general mass of the other trees, are equally peculiar.

Omorika seedlings and young trees are only found in exposed rocky situations, and in the bottoms of wet shaded ravines. The tree in the wild state is strictly confined to limestone soil, and never grows on the slate formation which is found in parts of the Drina valley, yet when cultivated, it does very well, at least in youth, on soils which are not calcareous.

The largest tree² recorded is one felled by Pančić, which measured 42.2 metres in height, and 0.385 metres in diameter. It showed 137 rings, and the width of the rings gradually diminished from 0.28 cm. in the 3rd decade to 0.04 cm. in the 14th decade. Pančić says that the tree has an inclination to grow with a spiral stem, and that it loses its branches up to about half its height, the largest of the branches being only about 2 metres in length. The cones are borne, according to him, upright on the topmost branches only, but elsewhere they hang down with their tips directed slightly upwards.

Pančić, in his first account of the tree, reports that he had heard on good authority of its occurrence in the mountains of Montenegro; it has since been

¹ *Sitzungsber. kais. Akad. d. Wiss.*, xcix. 503; *Oesterr. Bot. Zeitschr.* 1890, p. 357.

² Letter of Pančić, quoted in Stein's article on "Omorika" in *Gartenflora*, 1887, p. 14.

reported to occur also at Bellova in the Rhodope mountains in Bulgaria; but, so far as we can discover, these statements have not been confirmed. A fossil species which has been identified with the existing tree by Webber has been found in the interglacial deposits at Höttingen near Innsbruck in the Tyrol. An allied species, *Picea omorikoides*, Webber,¹ has been found at Aue in Saxony in a preglacial deposit which is of the same age as the Cromer forest bed on the coast of Norfolk. Lokowitz has also found near Mulhouse in Alsace some remains of a spruce in the middle Oligocene beds which resembles *Picea Omorika*.

In the herbarium at Kew there are specimens collected by V. Crucic on the Drina, and others with good cones gathered by Elwes at 2000 to 3000 feet altitude.

(A. H.)

I visited the valley of the Drina in Bosnia in 1900 on purpose to see this tree, and after driving a long day east from Serajevo, reached Rogatica, from where Herr Gschwind, the obliging forest officer of the district, was good enough to accompany me to Han Semec, a Gendarmerie station on the road to Visegrad, about 15 miles from Rogatica. Han Semec is at an elevation of 3800 feet, and is surrounded by beautiful forests of Austrian and Scots pines, spruce, silver fir, and beech.

The climate of the district is very cold in winter and warm in summer. The minimum temperature being -33° Reaumur on 23rd December, $+30^{\circ}$, the maximum on 7th July 1897, the snow lying as long as 4-5 months.² The rainfall in summer is heavy, amounting to 116.2 centimetres, which fell on 124 days, and the weather was wet most of the time I was there.

After passing through some beautiful mountain meadows and primæval forest of large spruce and silver fir mixed in places with beech and aspen, as well as small oaks and large birch, we came to the edge of a deep rocky ravine running down to the Drina valley. On the steep limestone cliffs overhanging this ravine, which are a favourite haunt of chamois, *Picea Omorika* was growing in clumps, and isolated trees occurred among common spruce, Scots and Austrian pine.

The branches are short and drooping as compared with those of common spruce, and the cones being found only near the top of the tree, we had to cut one down in order to procure fruiting specimens; on this I found young cones of the year, cones of last year which had not yet opened, and which, according to the forester, contained good seed only when there was turpentine exuding from them, and old cones which hang two or three years on the tree after shedding their seed. In habit and appearance the tree resembles the American *Picea alba* more than any tree I know, though its nearest botanical affinities are with *P. sitchensis* and *P. ajanensis*. Plate 28, which is from two of several photographs kindly sent me by Herr Othmar Reiser of the Landesmuseum, Serajevo, Bosnia, gives an excellent idea of the forest and of individual trees.

The average size of the full-grown trees on these steep cliffs was not above 50-60 feet, with about 1 foot of diameter, but I found some measuring 80-90 feet high and 18 inches diameter. Young seedlings were scarce and difficult to find on the mossy rocks; but we collected 20 or 30 plants, of

¹ Engler's Bot. Jahrb. xxiv. 1898, Heft 4, 510, 504.

² Cf. Met. Beob. Land Stationen in Bosnien (1899).

which I brought the smallest home in a tin box alive, and planted the larger ones in the forester's garden at Han Semec. Those which I brought home have established themselves slowly, but a quantity of seed received in the autumn germinated well in boxes, and in November 1905 was much larger than common spruce of the same age. They were quite uninjured by the severe frost of May 21, 1905, which injured the common spruce very severely, and on my limy soil are growing faster and more vigorously than any other species of *Picea*.

The tree appears to have been first distributed by Messrs. Fröbel of Zurich about 1884, and has been found quite hardy in England, as might be expected from the climate of its native country.

The finest specimen I know of in England is in the garden of W. H. Griffiths, Esq., at Campden, Gloucestershire, where it was bearing a good crop of cones near the summit in August 1905, and measured about 25 feet in height; this seems to show that the tree prefers limestone. At Kew there are three fine trees which were raised from seed obtained from Belgrade in 1889. These trees are now (1905) 13 inches in girth at 5 feet from the ground, and the tallest one is 23 feet high, making a strong, vigorous leading shoot, and assuming the very narrow pyramidal form which is so remarkable in the wild trees. The other two are 18 and 20 feet in height.

At Tortworth Court it has attained about 15 feet in height, and produced cones containing in the year 1902 apparently good seed; but Lord Ducie tells me that no plants raised from them can now be found. Though the tree is a very ornamental one I do not expect it can have any value as a forest tree in Great Britain, its timber having, so far as known, no special use. Judging from the soil and climate of its native country it should succeed in the Highlands of Scotland, especially on limestone soil, as well as, or better than in England, and as seedlings can now be procured in small numbers it will no doubt be planted by all lovers of coniferæ.

(H. J. E.)

PICEA BREWERIANA, BREWER'S SPRUCE

Picea Breweriana, Watson, *Proc. Amer. Acad.* xx. 378 (1885); Sargent, in *Gardeners' Chronicle*, xxv. 498, f. 93 (1886), and *Silva N. America*, xii. 51, t. 601 (1898); Kent, in *Veitch's Man. Coniferæ*, 430 (1900).

A tree, attaining 100-120 feet in height, with a stem 2 to 3 feet in diameter above its enlarged base. Branches crowded to the ground, with slender, pendulous branchlets, which are often 7 to 8 feet in length and sparsely covered in their first and second seasons with greyish pubescence. Pulvini long and slender, directed forwards. Leaves often nearly an inch long, rounded on both surfaces, the dorsal surface keeled and bearing 10 to 12 rows of stomata, the ventral surface dark green, shining with a prominent midrib, apex obtuse or short pointed. The leaves, on account of the shoots being pendulous, are radially arranged (never pseudo-distichous), their apices pointing outwards and downwards.

Cones on short stalks ($\frac{1}{4}$ inch), oblong-cylindrical, gradually narrowed from the middle to each end, $2\frac{1}{2}$ to 5 inches long by $\frac{3}{4}$ to 1 inch wide; scales broadly obovate with entire rounded margins; bracts minute, concealed, oblong, with denticulate upper margin. Seed with long wing (three times the length of the seed itself). The cones are pendent, greenish, or purplish green when fully grown, becoming dull brown when ripe, and open to let out the seed in autumn, but generally remain on the branches till the winter of the following year. (A. H.)

This tree has a more limited range than any other spruce, being confined, so far as we know at present, to a few stations in northern California and southwestern Oregon, on the Siskiyou Mountains, where it was discovered at an elevation of about 7000 feet, in June 1884, by Mr. Thomas Howell, who directed me to the best place from which the locality can be approached, a settlement called Waldo, about 40 miles west of Grant's Pass station, on the Southern Pacific Railway.

I went to this station in August 1904 with the intention of visiting Waldo; but finding that Messrs. Jack and Rehder, of the Arnold Arboretum, had just returned, and hearing from them that there were no cones on the trees in that year, I did not feel inclined to spend three days on the trip. I am, however, much indebted to these able botanists for the following information, and especially to Mr. Rehder for a beautiful negative of the tree, which is here reproduced. (Plate 29.)

There seems to be only a small grove of the trees about 20 miles south of Waldo, over the Californian boundary, which is best reached by following the trail to Happy Camp, and turning west near the summit of the pass to a place called Big Meadows, which is four miles from the pass.

There is another place where it grows near Selma, which is more accessible

than Big Meadows, and other localities are mentioned by Sargent, who says that Professor Brewer, after whom the tree was named, had previously, in 1863, found a tree which was probably the same species, on Black Butte to the north of Strawberry Valley, at the western base of Mount Shasta, where, however, it cannot now be rediscovered.

Another locality for Brewer's spruce was found in 1898, by Mr. F. Anderson, on an unnamed but conspicuous peak at the headwaters of Elk Creek, about two or three miles west of Marble Mountain and eighty miles west of Mount Shasta. The elevation of the peak is about 8000 feet, and several hundred specimens were found growing near the summit; the trunks were 16 to 20 inches in diameter at 3 feet from the ground, and there were plenty of cones on the tops of the trees which were about 80 feet high.¹

It grows on the Siskiyou in company with *Pinus ponderosa*, *P. Lambertiana*, and *P. monticola*, but usually gregariously in groves by itself. The soil and climate are dry, but there seems to be no special reason why this tree has proved in the eastern States of North America so difficult to cultivate; and as some of the conifers of the Pacific Coast which will not grow, or are not hardy in the eastern States, as, for instance, *Abies bracteata* and *Picea sitchensis*, thrive in England, and the trees with which it is associated in America are hardy and produce good seed here, we need not despair of seeing this beautiful tree established in the south of England.

The late Mr. R. Douglas, of Waukegan, Ill., visited Oregon in 1891 on purpose to obtain the seeds, and collected a large quantity of cones, from which several hundred thousand seedlings were grown. But those sown in America perished in their first and second years from causes which are not known, and attempts to raise the tree in the Arnold Arboretum have also failed.

Some of the seed, however, was raised by the late Baron von St. Paul Illaire at Fischbach in Silesia, which were alive in 1895;² and small plants were reported in 1903 to be growing in the Royal Pomological Institute at Proskau in Silesia.³

The late Mr. Johnson, of Astoria, Oregon, transplanted a few small trees to his nursery, some of which are, I believe, growing near Portland. Brandagee found a few two-year-old seedlings among the old trees, and half a dozen of them reached the Arnold Arboretum alive.

One of these was sent from there to Kew in November 1897, and is growing near the Pagoda, being about $2\frac{1}{2}$ feet in height at the present time (March 1905). It is the only living specimen known to us in Britain.

The tree is said by Professor Sheldon to grow from 100 to 150 feet high, but Sargent gives 120 feet as the extreme height, and Messrs. Jack and Rehder did not see any higher than about 110 feet by about 9 feet in circumference. Douglas informed Baron von St. Paul that the largest tree measured by him was 121 feet high, and 2 feet 11 inches in diameter at $7\frac{1}{2}$ feet from the ground. As the region in which it grows is so limited, and forest fires are very prevalent and

¹ *Erythea*, vi. 12 (1898), and vii. 176 (1899).

² *Mitt. Deutsch. Dendr. Ges.* 1895, p. 42.

³ *Ibid.* 1903, p. 77.

destructive, it is to be feared that unless special measures are taken for its protection by the State of Oregon this very beautiful tree may become extinct.

The timber, which I only know from a specimen in the Jesup Collection of North American Woods, preserved in the American Museum of Natural History at New York, is said by Sargent to be considerably heavier than that of other American spruces, soft, close-grained, with a satiny surface, the sapwood hardly distinguishable. The specimen alluded to is $13\frac{1}{4}$ inches in diameter under the bark at 166 years old. (H. J. E.)

PICEA AJANENSIS, AJAN SPRUCE

- Picea ajanensis*, Fischer, ex Lindley and Gordon, *Trans. Hort. Soc.* v. 212 (1850), and in Middendorff, *Reise, Florula Ochotensis*, 87, tt. 22-24 (1856); Masters, *Jour. Linn. Soc. (Bot.)*, xviii. 508 (1880), and *Gard. Chron.* 1880, xiii. 115, and xiv. 427, with figures; Mayr, *Monograph der Abietineen des Jap. Reiches*, 53, 102, t. iv. (1890); Kent, in Veitch's *Man. Coniferae*, 425 (1900).
Picea ajanensis, var. *microsperma*, Masters, *Jour. Linn. Soc. (Bot.)*, xviii. 509 (1880).
Picea jezoensis, Carrière, *Traité Gén. Conif.* 255 (1855).
Abies ajanensis, Lindley and Gordon, *loc. cit.* (1850).
Abies jezoensis, Siebold et Zuccarini, *Flora Japonica*,¹ ii. 19, t. 110 (*ex parte*) (1844); Veitch, *Man. Coniferae*, ed. 1, p. 72 (1881).

A tree, attaining in Yezo 100-150 feet in height. Bark like that of the common European spruce, grey, and composed of irregularly quadrangular scales which do not fall off. Branchlets shining, glabrous, yellow, never becoming reddish. Free part of the pulvini long, directed backwards on branchlets of old trees, not widened or channelled at their bases on the upper surface of the branchlets, persistent on old branchlets. Buds broadly conic, with ovate scales rounded in margin, showing on opening the young leaves tinged with red. Leaves flattened, thin, blunt, or ending in a short point, slightly keeled on both surfaces; ventral surface green without stomata; dorsal surface silvery white with two broad bands of stomata. Cones purple when young, brownish when ripe, straight, oblong, tapering at each end, 2 to 3 inches long by nearly 1 inch wide; scales narrowly oblong-oval, coriaceous, erose, and denticulate in margin; bracts minute, concealed, broad-oblong, slightly narrowed below, their upper rounded denticulate edge giving off abruptly an apiculus. Seed with a wing, which is twice or thrice as long as the seed itself.

IDENTIFICATION. (See *Picea hondoensis*.)

DISTRIBUTION

Picea ajanensis appears to be confined to Manchuria, Amurland, that part of Eastern Siberia which faces the southern half of the Sea of Ochotsk, Saghalien, the three southern isles of the Kurile group, and Yezo. The spruce of Central China, which has been identified with it in *Index Florae Sinensis*, ii. 553, has pubescent shoots, and is probably identical with *Picea brachytila*, Masters. The accounts of the Ajan spruce on the continent of Asia are of ancient date, the only recent one being that in Russian by Komarov,² who states that it grows abundantly with species of *Abies* and *Pinus koraiensis* in mountain woods in all the provinces of Manchuria. It has not, however, been collected there by any British travellers.

¹ The figures given by Siebold represent (1) a flowering twig which came from a garden in Tokyo, and was probably, according to Mayr, *Picea hondoensis*; and (2) a branch with cones, copied from a Japanese drawing of *Picea ajanensis* from Yezo. The description applies to two species, and the name *jezoensis* cannot stand. The synonymy is very involved, but, accepting Mayr's view, the facts are clear enough. The Hondo spruce was first distinguished clearly by Mayr, and therefore receives his name *Picea hondoensis*. The Yezo and Amurland spruces are the same species, and receive the name *Picea ajanensis*, first given by Fischer.

² Komarov, *Flora Manshurica*, i. 200 (1901).

Farther north, according to Maximowicz,¹ it extends throughout the territory of the lower Amur and the coast province facing the Sea of Ochotsk, reaching its northern limit in the interior in the Stanovoi mountains about latitude 55° 50', and on the coast at Ajan, lat. 56° 27'. Schmidt² says that thick forests of *Picea ajanensis* occur in the lower Amur and in the coast territory. A mountain at 1000 feet in the Amgun valley was clothed with a thick mossy wood of this spruce, in the shadow of which snow still lay on the 30th May. On the crest of the Bureja range it occurs as a low prostrate shrub. It descends very seldom to the river banks. Middendorff also notes that it is confined to the hills on the coast of the Sea of Ochotsk. Occasionally it grows on swampy flats in Amurland.

Schmidt describes the bark as being moderately rough and divided into generally 6-angled plates, about an inch in diameter and $\frac{1}{2}$ to 1 line in thickness; and that the form and colour of the leaves are very variable, their points being either acute or obtuse.

In the island of Saghalien, in its south-western part, there is a coniferous forest composed of *Picea ajanensis* and *Abies sachalinensis*, which clothes the slopes of the mountains up to 800 feet on the coast, and higher in the interior, where even the lofty crests are covered with dark forests of these two species.

In the Kurile Isles³ this species is confined to the three islands north of Yezo, namely Kunashiri, Shikotan, and Etorofu, reaching its northern limit in the last named. In Shikotan it forms with *Abies sachalinensis* a dense mixed forest, which in habit and height and cover of the ground strikingly resembles the coniferous forests at moderate elevations in Germany. The cones borne by the tree in this island are, however, small in size, and the tree itself does not attain its maximum dimensions.

In Yezo, Mayr reports that he has seen trees 130 feet in height, and considers reliable the reports of the Japanese foresters that it occasionally attains even 160-200 feet. It occurs in all the mountains of Yezo, only reaching the coast in the west of the island, where it is found in cold, marshy localities immediately behind the dunes, being only separated from the sea by a growth of *Rosa rugosa* and shrubby *Quercus dentata*. The important forests of it lie in the western and central mountains of Yezo, and also in the high ranges of Kitami, Kushiro, and Nemoro, where it forms mixed woods with the Saghalien silver fir and *Picea Glehnii*.

INTRODUCTION

We do not know that any plants of the continental Ajan spruce have been grown in Europe.

John Gould Veitch visited Hakodate in 1860, and sent home specimens and seeds of a weakly form of the Yezo *Picea ajanensis*, which was described by Lindley⁴ as a

¹ Maximowicz, *Primitia Florae Amurensis*, 261, 392 (1859). See also Regel, *Tentamen Florae Ussuriensis*, 136 (1861).

² Schmidt, "Reisen in Amurland und Saghalien," in *Mém. Acad. Imp. Sc. St. Petersburg*, VII. series, xii. No. 2, pp. 15, 20, 63, 98 (1868).

³ Mayr, *loc. cit.* p. 102.

⁴ *Gard. Chron.* 1861, p. 22. This is *Picea ajanensis*, var. *microsperma*, Masters, *Gard. Chron.* 1880, i. 115.

distinct species, *Abies microsperma*. Plants raised from the seed "turned out to be unsuitable for the climate of this country."¹ This form, according to Mayr, and so far as I can judge myself, can hardly rank even as a variety, and is not in cultivation at the present time.

Maries² visited Yezo in 1879 and sent home specimens, now preserved in the Kew Herbarium, and seeds of the true *Picea ajanensis* from that island; and young trees should accordingly be in cultivation in this country. This plant was kept separate by Messrs. Veitch at first, under the name *Abies yezoensis*. Maries considered the Yezo spruce to be quite distinct in habit and aspect from the two spruces which he had seen on Fujiyama (*Alcockiana* and *hondoensis*).

Mayr informed me last year that the Yezo spruce was not introduced into Europe until 1891; and that most of the trees on the Continent passing under the name of *Picea ajanensis* belong to *Picea hondoensis*. The specimens which have been sent me from old trees of reputed *P. ajanensis* in England also belong to that species. (A. H.)

On account of the heavy floods which occurred in July 1904, I did not get far enough north in Hokkaido to see this tree at its best, but in the State forests of Shari, Kutami, and Kushiro, it occurs in great masses, and is one of the principal economic products of the island. I saw it thinly scattered in forests of deciduous trees between Sapporo and Asahigawa, where it was of no great size, and in the forest round the volcanic crater-lake of Shikotsu in the south-east of Hokkaido it formed, here and there, nearly pure forests of small extent, mixed more or less with *Picea Glehnii* and *Abies sachalinensis*, at an elevation of 1000 to 2000 feet. The vegetation in these forests was quite unlike anything that I saw in Central Japan, the ground being covered with a dense layer of humus, and in the more shady places two or three species of *Pyrola* were abundant. *Daphne*, *Gaultheria*, *Ledum*, and other plants not seen elsewhere occurred, with curious terrestrial orchids and many ferns. The trees rarely exceeded 80 feet in height by 4 to 6 feet in girth, but higher up near the lake I measured one as much as 100 by 9 feet.

The general appearance of the tree is very like that of *P. sitchensis*, though I did not notice that the roots became buttressed, which is probably only the case in wet soil. The natural reproduction is good, but the seedlings grow slowly at first and seemed to thrive best in shade. The Japanese name is *Eso-Matsu*.

TIMBER

The wood of this tree is soft, but probably as good as that of other spruces. I passed the night at a factory in the forest where it was being cut up into thin slices for export to Osaka, where large quantities are used for making matchboxes. It is also employed for boat masts and other purposes, and is worth in Tokyo about 10d. per cubic foot. On account of its softness, lightness, and fineness of grain,

¹ Kent, in Veitch's *Man. Coniferae*, *loc. cit.*

² See Veitch's *Man. Coniferae*, ed. i. p. 72 (1881).

it is largely used in Japan for chip-braid, a peculiar Japanese industry, which has lately attained considerable importance, the export for 1903 amounting to no less than 1,363,000 yen—equal to about £140,000. This braid is mainly used for making hats and bonnets, but it is also woven into floor-matting, and as shown at the St. Louis Exhibition is both ornamental and cheap.

There are many different varieties of chip-braid, some of which are dyed of different colours, and others are plaited with a mixture of silk. It is exported in bundles of 50 to 60 yards long and 1 to 1½ inches wide, and is valued according to quality at 1s. to 6s. per bundle. The best are made by mixing chips of *Populus tremula* and *Picea ajanensis*.
(H. J. E.)

PICEA HONDOENSIS, HONDO SPRUCE

Picea hondoensis, Mayr, *Monograph der Abietineen der Japanisches Reiches*, 51, t. iv. fig. 9 (1890); Shirasawa, *Iconographie des Essences Forestières du Japon*, text 20, tab. v. figs. 1-22 (1900).
Picea ajanensis, Hooker, *Bot. Mag.* t. 6743 (1884), and of most writers.
Abies ajanensis, Fisch., var. *japonica*, Maximowicz, *Iter secundum* (1862).

A tree, attaining 80 feet in height in Hondo, the main island of Japan. Bark dark grey, peeling off in small roundish scales and leaving light-coloured spots on the trunk. Branchlets shining, glabrous, yellow in the first year; but becoming reddish brown in the second year, and retaining the red colour in succeeding years till the scaly bark begins to form. The free portions of the pulvini are directed forwards, and on the upper side of the branchlets are enlarged transversely at their bases and show two channels where they become decurrent on the stem; they are shorter than in *Picea ajanensis*, and on older branchlets tend to disappear. Buds like those of *Picea ajanensis*, but opening with greenish leaves. Leaves as in that species, but slightly shorter. Cones, red when young, yellowish when ripe, slightly curved, oblong, tapering to each end, about 2 inches long by ¾ inch thick, erect on terminal younger branchlets; scales membranous, oval, broader proportionately to their length than in *P. ajanensis*, with denticulate erose margins; bracts minute, concealed, oval lanceolate, denticulate, gradually tapering to an acute apex. Seed with a short wing (less than twice the length of the seed).

The description just given enumerates the characters, chiefly those of the bark, shoot, and cones, on which Mayr relies to distinguish the Hondo spruce from the true *Picea ajanensis*.

Picea hondoensis, as grown in this country, where it is usually called *Picea ajanensis*, assumes a broadly pyramidal outline, the main branches being rigid and directed either upwards or horizontally. In sunshine the branchlets turn their tips upwards, exposing to view the pale surface of the leaves. The arrangement of the leaves on lateral branchlets is the one normal in flat-leaved spruces, *i.e.* the upper side of the branchlet is densely covered with leaves, which have their apices directed forwards, while on the lower side of the branchlet the leaves part into two sets, directed outwards at right angles and leaving the twig bare beneath. All the leaves direct their stomatic pale surfaces away from the light, so that these look towards the ground.

The young cones are bright crimson, and make the tree highly ornamental in spring.

IDENTIFICATION

Picea Alcockiana, in which the leaves are conspicuously white on the dorsal surface, is often confounded in gardens with *Picea hondoensis*; but these two species are readily distinguished as follows:—

Picea hondoensis.—Leaves flat, with bands of stomata confined to the dorsal surface. On the lower surface of lateral branchlets the twig is bare, with the leaves directed outwards at right angles.

Picea Alcockiana.—Leaves quadrangular in section, with lines of stomata on the ventral surface, in addition to the bands of stomata on the dorsal surface. On the lower surface of lateral branchlets the twig is not quite bare, and the leaves are directed forwards at an acute angle.

Picea hondoensis, *Picea ajanensis*, and *Picea sitchensis* have been distinguished, so far as leaves and branchlets are concerned, in the key to Section *Omorica*. The cones of these three species are much alike. Those of *Picea sitchensis*, however, have scales oblong in outline, with their upper edge scarcely emarginate or erose; the bracts are large and visible between the scales towards the base of the cone. In the other two species the scales of the cones are oval with erose margins, while the bracts are minute, concealed, and differently shaped.

The cones of *Picea Alcockiana* differ considerably from those of the three preceding species. Their scales are rounded, being nearly semicircular in outline, with the upper edge almost entire or only minutely denticulate; and their outer surface is markedly striated.

DISTRIBUTION

Picea hondoensis is confined to the central chain of mountains in the main island of Japan, occurring at altitudes above 4000 feet. Shirasawa (*loc. cit.*) mentions as localities, Fuji, Mitake, Novikura, Sirane to Nikko, Chokarsan to Ugo, etc.; and says that in the lower levels it is accompanied by *Tsuga diversifolia*, and ascends to 8000 feet in company with *Abies Veitchii*. Mayr states that on Fuji it is accompanied by *Picea bicolor* (*Alcockiana*), both occurring in mixed woods with *Larix leptolepis* and *Abies Veitchii*. Farther north, *Picea polita* joins the two spruces just named; and all three reach their northern limit in the high mountains of Iwashiro at 38° lat. Its southern limit is 35° lat.

Elwes saw very little of this tree in Japan, but near the top of the Wada-toge pass there were some small spruces growing at about 4500 feet elevation, which he believes to have been this species. *Tohi* is the Japanese name.

INTRODUCTION

Picea hondoensis was introduced in 1861 by John Gould Veitch. It was distributed as *Abies Alcockiana*, an unfortunate circumstance, due to the fact that the seeds of the two spruces growing on Fujiyama (*Picea hondoensis* and *Alcockiana*) were both collected for Mr. Veitch by natives and were mixed together. Dr. Masters cleared up the question as to the distinctness of these two species in an article in the *Gardeners' Chronicle*,¹ in which, however, he retained the name *Picea ajanensis* for the spruce, which Mayr afterwards separated as *Picea hondoensis*. If

¹ *Gard. Chron.* 1880, i. 115, and ii. 427.

Mayr's view of the specific distinctness of *Picea hondoensis* and *Picea ajanensis* be upheld, most of the specimens cultivated in this country under the latter name (and many also incorrectly labelled *Alcockiana*) must be renamed as *Picea hondoensis*.

The best specimen we have seen in England is a tree at Hemsted in Kent, which was planted by the Earl of Cranbrook in 1887, and, when measured by Elwes in 1905, was 44 feet high.

There is one at Benmore, near Dunoon, the property of H. S. Younger, Esq., which Henry measured in 1905 as 52 feet by 4 feet 4 inches, about twenty-five years planted.

At Fota, Co. Cork, there is a fine tree which, in 1904, Henry found to be 44 feet by 4 feet 3 inches. (A. H.)

PICEA SITCHENSIS, MENZIES' OR SITKA SPRUCE¹

Picea sitchensis, Carrière, *Traité Conifer.* 260 (1855); Trautvetter et Meyer, in Middendorff, *Reise Florula ochotensis*, 87 (1856);² Sargent, *Silva N. America*, xii. 55, t. 602 (1898); Kent, in Veitch's *Man. Coniferae*, 452 (1900).

Picea Menziesii, Carrière, *Traité Conifer.* 237 (1855); Masters, *Gard. Chron.* xxv. 728, figs. 161, 162 (1886).

Picea sitkaensis, Mayr, *Wald. N. Amerika*, 338 (1890).

Pinus sitchensis, Bongard, *Vég. Sitcha*, 46 (1832).

Abies Menziesii, Lindley, *Penny Cycl.* i. 32 (1833); Loudon, *Arb. et Frut. Brit.* iv. 2321 (1838).

Abies sitchensis, Lindley and Gordon, *Jour. Hort. Soc.* v. 212 (1850.)

A tree, sometimes exceeding 200 feet in height, with a trunk 4 to 20 feet in diameter, tapering above its enlarged and buttressed base; in Alaska dwindling to a low shrub. Bark with large, thin, red-brown scales. Branchlets yellow, shining, glabrous. Buds ovoid, acute at the apex, with ovate obtuse scales. Leaves arranged on lateral branchlets as in *Picea ajanensis*, ending in sharp cartilaginous points; deeply keeled on the ventral green surface, and almost convex on the dorsal surface, which has two white broad bands of stomata. The male catkins are solitary at or near the ends of the branchlets, and are of an orange reddish colour.

Cones: on short straight stalks, cylindrical-oval, blunt at the free end, $2\frac{1}{2}$ to 4 inches long by 1 to $1\frac{1}{2}$ inches wide, composed of oblong or oblong-oval scales, rounded towards the apex, denticulate and scarcely erose in margin; bracts lanceolate, denticulate, about half as long as the scales, and peeping out between them towards the base of the cone. The cones when ripe are yellow or brown, and generally fall off in the autumn and winter of the first year. Seeds, with a wing, three to four times as long as the seed itself.

The Sitka spruce seems to vary considerably over its wide area. There are specimens at Kew from the Columbia River, with pubescent young shoots, and bearing small cones which have oval, not oblong, scales, and minute almost orbicular bracts. Other specimens from Alaska have larger cones than usual, but with bracts shorter than usual, and the leaves are not so deeply keeled or so sharp-pointed as in the type.

Cultivated trees are generally broadly pyramidal in outline, and when old, often show the enlarged and buttressed base, so characteristic of wild trees; the roots sometimes extending superficially above the ground for several feet. The tree often produces on its lateral branches small erect shoots, on which the leaves spread radially in all directions.

(A. H.)

IDENTIFICATION. (See *Picea hondoensis*)

¹ Called also Tideland spruce on the Pacific coast.

² Trautvetter and Meyer are often cited as the authors of the name *Picea sitchensis*; but the correct date of their publication is later than that of Carrière's. See Trautvetter, *Flora Rossica Fontes*, 303 (1880).

VARIETIES

On the Continent, according both to Beissner¹ and to the late Prof. Carl Hansen, whose "Pinetum Danicum," published in the *Journal of the Royal Horticultural Society for 1892*, is a valuable contribution to our literature, a variety (*speciosa*) occurs in cultivation, which is light blue in colour and very decorative. It differs from the ordinary form in being slower in growth and in having leaves, which are shorter, stiffer, and more sharply pointed.

DISTRIBUTION

According to Sargent, this spruce extends farther north-west than any other North American conifer, being found in long. 151° west on the east end of Kadiak island, and all through the coast region of Alaska and British Columbia, west Washington and Oregon, and as far south as Caspar in Mendocino County, California.

In the north it is a small tree, sometimes only a bush, but on the coast of south-east Alaska is the largest and most abundant tree, and grows in company with the western hemlock. Here it attains over 100 feet in height, and ascends the mountains to about 3000 feet.

In the south of British Columbia it is larger in size, but in Vancouver's Island it did not seem common, and was not a conspicuous tree in the south-east parts of the island which I visited.

In Washington it grows to a very large size, and I measured one in swampy ground near a logging camp in the White River valley which was 23 feet in girth at 6 feet from the ground, and appeared to be 3 to 4 feet in diameter at the place where it was broken off at about 120 feet from the ground.

Prof. Sheldon, in a pamphlet on *The Forest Wealth of Oregon*, calls it the largest tree in the state, growing 200 to 300 feet high, and has figured as the frontispiece of this paper what he calls the largest Tideland spruce in the world. This tree grew on the coast in God's Valley, on the North Nehalem River, Clatsop County, Oregon, and measured 30 feet $11\frac{1}{2}$ inches in diameter at 2 feet from the ground, and 20 feet $4\frac{1}{2}$ inches at 6 feet from the ground.

He states that it is distinctly a moisture-loving tree, and in the extensive coast belt forest which it forms is an ideal lumber tree, free from limbs for a great part of its height.

It is not mentioned as growing in the great forest reserve of the Cascade Range, and, according to Sheldon, extends southwards along the coast as far as Curry County. In northern California it grows on rich alluvial plains at the mouths of rivers, or in low valleys facing the ocean, where it is associated with *Sequoia sempervirens* and *Abies grandis*, and thus may be said to be almost strictly confined to a region where there is perennial moisture in the air, and an annual rainfall of 50 inches and upwards.

¹ *Nadelholzkunde*, 392 (1901).

Sargent says its growth is very rapid, the leading shoots of young trees on Puget Sound being often 3 to 4 feet long.

John Muir measured a tree in Washington 180 feet high, at 240 years old, with a trunk 4 feet 6 inches diameter. Another near Vancouver, B.C., only 48 years old, had a trunk 3 feet in diameter.

In Alaska, Gorman measured two trees—one grown in a dense wood, well protected from wind, was 160 feet high, at 267 years old, with a diameter of 3 feet 11 inches; and the other on a hillside exposed to fierce north-east gales, was 4½ feet in diameter at 14 feet from the ground, and 434 years old. The heart of this tree was 32 inches from the south-west side, and only 16½ inches from the north-east side, showing the effect of prevalent winds on the production of branches and wood.

A tree measured by Muir at Wrangel, Alaska, was no less than 764 years old, with a trunk 5 feet in diameter, and this, I think, is the greatest age to which any recorded spruce has attained.

INTRODUCTION

Though discovered in Puget Sound in May 1792 by Archibald Menzies, who was surgeon and naturalist to Vancouver's expedition, it was not introduced to cultivation until 1831 by David Douglas, and was described by Lindley under the name of *Abies Menziesi* one year after Bongard had made it known to science under the specific name which we adopt. It is, however, still commonly known in Great Britain as Menzies' spruce, and his name it may well bear. According to Loudon, only a very few plants were raised in the Horticultural Society's Garden in the year 1832, of which some still survive.

The Oregon Association, which was formed a little later by a few Scottish arboriculturists for the purpose of introducing the conifers of the Pacific coast, and who sent out John Jeffrey as a collector about 1850, were fortunate in procuring a large quantity of seed, from which the pineta of Scotland and England have been stocked, and it has now become a common tree.

CULTIVATION

Though Menzies' spruce loves a wet climate, it loves a wet soil even more, and soon becomes unsightly and loses its foliage in dry localities. No conifer, except perhaps the Douglas fir, grows so rapidly where it has a suitable situation, and in some parts of Scotland it is now being planted experimentally as a forest tree.

It is easily raised, either from home-grown or imported seed, and is, like all spruces, slow of growth for the first few years, and requires at least five or six in the nursery before it is large enough to plant out.

At Durris, in Aberdeenshire, on the property of Mr. H. R. Baird, there is a plantation of Sitka spruce about 15 acres in extent, of which Mr. John Crozier, the forester in charge of the estate, gives us the following particulars in a letter dated 12th September 1904:—

"The plantation occurs at an altitude of 700 to 800 feet, the aspect being northerly, soil a sandy peat over boulder clay. The age of the plantation is twenty-five years; but there is no record either as to the number of the plants put out or the age when planted. They were, however, notched in, and their age would most probably be four years. They were planted rather irregularly, the distance varying from 6 to 9 feet, and both common spruce and Scots fir have been used to fill up between, to 3 feet between each plant. The average height of the Sitka trees is about 33 feet; and the girth at 5 feet taken at random is (where they had been planted 9 feet apart), 24 in., 22 in., 20 in., 25 in., 22 in., 22 in., 28 in., 22 in., 26 in., 25 in. The *largest* common spruces I could find on the same ground measured 9 in., 8 in., 11 in., 9 in., 11 in., 12 in., 16 in., 9 in., 10 in., 12 in., and their height was about 26 feet. I took the measurement of a hundred Sitkas over a track 20 feet broad, just as they came, and they averaged 22¾ in. Where the Sitkas had been planted at 6 feet apart, the common spruce and Scots fir are dominated, and the greater part of them quite dead. I drained some very wet parts a year ago, where both the Scots fir and common spruce had been killed through excess of moisture, but the Sitka had been very little harmed by it. Judging by what I have seen of the tree here and elsewhere, it will stand a greater degree of moisture than any other conifer I know. The plantation is altogether in a very healthy state."

A few hundred Menzies' spruces were planted out in 1879 on the mountain at Bronydd, on the property of Lord Penrhyn in North Wales, at 900 feet elevation; according to Mr. Richards, the forester, only half a dozen trees now survive, in a wretched condition. He states, however, that as the young growths come out late in the spring the tree is never touched by frost in North Wales. At Penrhyn there is a good specimen of the tree measuring 10 feet 6 inches in girth in 1904.

Menzies' spruce,¹ on account of its sharp needles, has been supposed to be free from the attacks of deer, rabbits, and hares; but recent observations made in the royal domain of Freyr in Belgium show that out of 10,000 plants introduced some years ago only 2000 remain, and these are not expected to survive long. This is much to be regretted, as they had grown splendidly.

REMARKABLE TREES

One of the largest trees we know of in the south of England is at Highclere, Berks, the seat of the Earl of Carnarvon, where we measured a tree in August 1903 which was 96 feet by 12 feet. The tree, having lost its lower branches owing to a heavy snow-storm, has put out new branches down the trunk, a somewhat rare occurrence in large conifers. Another very fine tree is growing at Barton, Suffolk, which was planted in 1847, and when measured by Henry in 1904 was 99 feet by 9 feet 3 inches. Both of these are in a dry climate but in a good soil.

At Bicton, Devonshire, I measured a tree in 1902 which was 85 feet by 11 feet

¹ Bull. Soc. Cent. Forest. Belgique, April 1901.

6 inches; and at Boconnoc, Cornwall, the seat of J. B. Fortescue, Esq., a tree was recorded in 1891 as being 85 feet high by 12 feet in girth at the age of 48 years.¹ In 1905 Elwes measured this and found it to be 86 by 15 feet.

At the same time¹ a tree growing at Howick Hall, Northumberland, the seat of Earl Grey, was 90 feet high at the age of 58 years.

At Beauport, Sussex, a tree measured in 1904 95 feet by 12 feet 10 inches. It has very wide-spreading superficial roots, one extending over the ground 16 feet in length. According to Sir Archibald Lamb, the tree five years ago was 12 feet 3 inches at 3 feet up, its present girth (1904) at that height being 13 feet 4 inches. (Plate 30.)

In Scotland the largest tree we know of, and probably the largest in Great Britain, is at Castle Menzies, said to have been 46 years old in October 1892, when its exact measurement was given by Mr. J. Ewing as 96½ feet high by 11 feet in girth. I measured it carefully in April 1904, and found it to be 110 feet high by 13 feet 2 inches. This tree is growing on the banks of a pond in good and damp soil, and has produced a greater amount of timber in a short time than any conifer I know in Scotland, except, perhaps, the Douglas fir, though *Sequoia sempervirens* may run it close in England. But spruce timber grown so fast is very soft, coarse, and knotty, close planting being essential to give the tree any economic value.

At Abercairney, Perthshire, there is a tree which was measured by Henry in August 1904, as 99 feet in height by 9 feet 9 inches in girth. This was 76 feet by 7 feet 5 inches in 1891.²

At the Keillour Pinetum,³ in the same county, on boggy ground on a hillside, there is a remarkable Menzies' spruce, 86 feet in height by 15 feet 9 inches in girth. It has wide-spreading buttressed roots, and is branched to the ground. According to a MS. account in the possession of Col. Smythe of Methven Castle this tree was planted in 1834 or 1835. In this pinetum many species of conifers were planted in these two years, and owing to the wet, boggy nature of the soil some kinds have grown slowly, such as *Picea nigra*, *Pinus Cembra*, *Abies balsamea*, and *Abies Pinsapo*. *Abies grandis* has perhaps succeeded best, next to *Picea sitchensis*, which has produced an amount of timber far in excess of the other species. *Abies grandis* here is 90 feet by 7 feet 3 inches. A *Picea alba*, planted presumably at the same time, is only 52 feet by 5½ feet.

Mr. Crozier reports that there is a Menzies' spruce 13 or 14 feet in girth at Dunrobin in Sutherland.

At Murraythwaite, in Dumfriesshire, the seat of W. Murray, Esq., a tree 78 feet by 8 feet 10 inches, planted about the year 1855, is growing near a pond, and is a fine healthy specimen, broadly pyramidal, and feathered to the ground.

A tree⁴ at Keir, near Dunblane, measured, in 1905, 82 feet by 9 feet 10 inches. At Smeaton Hepburn, Haddington, the seat of Sir Archibald Buchan Hepburn, Bart., where there is a remarkably varied collection of trees, a fine Menzies' spruce

¹ *Jour. Roy. Hort. Soc.* 1892, xiv. 486, 493.

² *Ibid.* 1892, xiv. 527.

³ Visited by Henry in August 1904.

⁴ This tree was reported in 1891 to be 61 feet by 7 feet 3 inches, and was then forty years old, *Jour. Roy. Hort. Soc.* (1892) xiv. 531.

measured, in 1905, 88 feet by 10 feet 7 inches. A very large tree is reported to be growing in the grounds of Major Ross at Killoch, Nairnshire.

In Ireland the finest example that we know is at Curraghmore, Waterford, the seat of the Marquess of Waterford. Mr. Crombie writes that it is now (March 1905) 106 feet in height, with a girth of 12 feet at 5 feet from the ground. This tree was reported¹ in 1891 to be 110 feet high (evidently an estimate) with a girth of 10 feet.

At Mount Shannon, Co. Limerick, there is growing a very vigorous tree, with branches to the ground, which in 1905 was 79 feet by 12 feet.

A tree at Clonbrock, Co. Galway, planted in 1881 and growing in boggy soil, was in 1904 56 feet high by 4 feet 8 inches in girth.

TIMBER

The wood is said by Sargent to be light, soft, and straight grained, not strong, with a satiny surface, and thick, nearly white, sapwood.

It is largely used on Puget Sound for purposes where cheap lumber is required, but I did not see it in the timber yards that I visited in Tacoma.

Laslett does not mention it in his work, but Stone, quoting Macoun, says that it is elastic, bends with the grain without splitting, and is much used in boat-building, for light oars, staves, doors, and window-sashes, resists decay for a long time, and is not attacked by insects.

I am informed by Mr. Rogers, one of the principal timber buyers for the Admiralty, that no other spruce makes such good light oars, and that in consequence it is now imported annually for that purpose. (H. J. E.)

¹ *Jour. Roy. Hort. Soc.* (1892), xiv. 562.

TAXUS

Taxus, Linnæus, *Gen. Pl.* 312 (1737); Bentham et Hooker, *Gen. Pl.* iii. 431 (1880); Masters, *Jour. Linn. Soc. (Bot.)* xxx. 7 (1893); Pilger, in Engler, *Pflanzenreich*, iv. 5, *Taxaceæ*, 110 (1903).

EVERGREEN trees or shrubs belonging to the division *Taxaceæ* of the order *Coniferæ*. Bark reddish or reddish brown, thin and scaly. Branches spreading, giving off branchlets, of one kind only, irregularly alternate, surrounded at their bases by brownish scales. Buds globular or ovoid, of imbricated scales. Leaves inserted on the branchlets in a spiral order, on upright shoots spreading radially, on horizontal shoots disposed by twisting on their petioles in one plane in a pectinate arrangement, the upper and lower leaves being of the same length, with their dorsal surfaces turned upwards and their ventral surfaces downwards. In fastigiata varieties all, or most, of the branchlets assume an erect position, and the leaves in consequence are arranged radially. The leaves are linear, flat, with recurved margins, dark green above, paler green below; the lower surface only bearing stomata, which never form conspicuous white bands; narrowed at the base into a short petiole, arising from a linear cushion on the twig; mucronate or acute at the apex and without a resin-canal.

Flowers dicecious, or in rare individuals monœcious, on the under surface of the branchlets of the preceding year, in the axils of the leaves, the female flowers being less numerous than the male flowers. Male flowers composed of a stalk, girt at its base by imbricated scales, and bearing above a globose head of 6-14 stamens with short filaments. The stamen is expanded above into a peltate connective, which bears on its lower surface 5 to 9 pollen sacs, united with each other and with the filament. The female flowering shoot, arising out of the axil of the leaf, is composed of a number of imbricated scales, in the axil of the uppermost one of which is borne an ovule, placed so close to the apex of the shoot as to appear terminal; in the scale next below a bud occurs, which occasionally develops into a second ovule. The ovule, which has a small membranous disc at its base, projects out of the scales by its micropyle. Seed sessile in a fleshy, juicy cup, forming an aril (the enlarged disc), open at the top and free from the seed in its upper part. The seed variable in form, 2, 3, or 4-angled, is generally ellipsoid and has a ligneous testa, containing oily white albumen, in the upper part of which is an axile straight cylindrical minute embryo with two cotyledons.

Yews differ from all other *Coniferæ* in the character of the fruit. They

resemble in foliage certain other genera of *Taxaceæ*, but are readily distinguishable as follows:—

Taxus.—Branchlets standing irregularly alternate on the branches. Leaves stalked, greenish underneath with no definite bands of stomata. Buds composed of imbricated scales.

Pruminopitys.—Branchlets and leaves as in *Taxus*, but with valvate bud-scales.

Cephalotaxus.—Branchlets opposite. Leaves like the yew in consistence, but with white bands beneath showing definite lines of stomata.

Torreya.—Branchlets sub-opposite. Leaves rigid and spine-pointed with white bands beneath, showing definite lines of stomata.

Saxegothæa.—Branchlets in whorls, ascending at an angle. Leaves with bases decurrent on the shoots, and with white bands beneath which are narrow and close to the median line.

The genus is widely distributed over large parts of North America, Europe, Algeria, and Asia, and occurs sporadically in the mountains of Sumatra, Celebes, and the Philippines. Seven distinct species have been described, each confined to a definite territory. These species are, however, rather geographical forms, only differing from one another in trivial characters of foliage and habit. The view taken by Sir Joseph Hooker¹ and by Pilger, the latest monographer of the genus, that they only constitute one species is probably correct. Many of the supposed specific distinctions, such as the density of the foliage on the branchlets, the size and form of the leaf, etc., are due in most instances to the influence of soil, shade, and climate. Moreover, in the varieties of the common yew, which are known to have arisen as sports in the wild state or in cultivation, greater differences occur in the characters of habit, foliage, and fruit, than are observable in the so-called species. In the account which follows, the geographical forms will be treated as varieties.

¹ *Himalayan Journals*, ii. 25 (1854), and *Student's Flora of Brit. Islands*, 369 (1878).

TAXUS BACCATA, YEW

Taxus baccata, Linnæus, *Sp. Pl.* 1040 (1753); Loudon, *Arb. et Frut. Brit.* iv. 2066 (1838); Lowe, *Yew Trees of Great Britain and Ireland* (1897); Kent, in Veitch's *Man. Coniferae*, 126 (1900); Kirchner, Loew, and Schröter, *Lebensgesch. Blütenpfl. Mitteleuropas*, i. 61 (1904).

The chief characters of the species have been given in the generic description. The different geographical forms are distinguished as follows:—

1. *Var. typica*, Common Yew.—A tree or shrub. Leaves falcate, acute, or acuminate, the apex diminishing gradually into a cartilaginous mucro; median nerve only slightly prominent above. Buds ovoid or globose, of closely imbricated brownish, rounded scales, usually not keeled on the back.

In certain Himalayan specimens the leaves are long and narrow, with a long acuminate apex, and the buds have keeled scales. Intermediate forms occur; and all Indian botanists and foresters seem to be agreed that the Himalayan yew cannot be separated from the European form even as a variety.¹

2. *Var. cuspidata* (*Taxus cuspidata*, S. et Z.²), Japanese Yew.—A tree or shrub. Leaves straight, scarcely falcate, median nerve prominent above, apex giving off abruptly a short mucro. Buds oblong, composed of somewhat loosely imbricated scales, which are ovate, very acute and keeled. In cultivated specimens the under surface of the leaves is yellow in colour, the buds being bright chestnut brown.

3. *Var. sinensis*,³ Chinese Yew.—A tree. Leaves short, rigid, median nerve not prominent above, apex rounded and giving off abruptly a short mucro. Buds ovoid, brownish, composed of densely imbricated scales, which are ovate, obtuse, and not keeled.

4. *Var. brevifolia* (*Taxus brevifolia*, Nutt.⁴), Pacific Coast Yew.—A tree. Leaves falcate, short, median nerve slightly prominent above, apex abruptly mucronate. Buds large, with loosely imbricated yellowish green scales, which are lanceolate, mucronate, and keeled.

5. *Var. canadensis* (*Taxus canadensis*, Marshall⁵), Canadian Yew.—A low, prostrate shrub. Leaves narrow, falcate; median nerve slightly prominent above, apex abruptly mucronate. Buds globose, small, with somewhat loosely imbricated, greenish, ovate, obtuse, keeled scales.

6. *Var. floridana* (*Taxus floridana*, Chapman⁶), Florida Yew.—A shrub or

¹ It has been described as a distinct species, *Taxus Wallichiana*, Zuccarini, in *Abhand. K. Bayr. Akad. Wissensch.* iii. 803, t. 5 (1843). Pilger, who ranks the different geographical forms as sub-species, keeps it separate from the European yew as sub-species *Wallichiana*.

² *Flora Jap. Fam. Nat.* ii. 108 (1846); Shirasawa, *Icon. Ess. Forest. Japon.* i. 33, t. 15 (1899).

³ *Taxus baccata*, L., Masters, *Index Floræ Sinensis*, ii. 546 (1902).

⁴ Nuttall, *Sylv.* iii. 86, t. 108 (1849); Sargent, *Silva N. America*, x. 65, t. 514 (1896).

⁵ Marshall, *Arb. Amer.* 151 (1785); Sargent, *Silva N. America*, x. 63 (1896). The plant cultivated at Kew as *Taxus canadensis*, var. *aurea*, a strong-growing, erect shrub, is apparently a variety of the common yew.

⁶ Chapman, *Flora South United States*, 436 (1860); Sargent, *Silva N. America*, x. 67, t. 515 (1896).

very small tree. Leaves very narrow, median nerve scarcely prominent, apex acute and gradually passing into the mucro. Buds small, with loosely imbricated, ovate, obtuse scales.

7. *Var. globosa* (*Taxus globosa*, Schl.¹), Mexican Yew.—A small tree. Leaves variable, narrow, straight, acuminate, mucronate. Buds of numerous ovate, rounded, obtuse, keeled scales.

DISTRIBUTION

I. COMMON YEW.—All authorities are agreed that the yew was formerly much more widely spread in Europe than is the case to-day. Conwentz² relies on three points to prove the ancient wider distribution:—(1) fossil remains; (2) prehistoric and historic antiquities; (3) place-names. He considers that nearly all the fossil remains of the Tertiary age, which have been described as species of *Taxus*, are not really yew. In more recent geographical strata, however, numerous fossil remains of yew have been found. Clement Reid³ gives the following list of deposits in which yew occurs in England:—

Neolithic.—Common in peat below the sea-level in the Thames valley and Fenland; Portobello, near Edinburgh.

Interglacial.—Hoxne, Suffolk.

Preglacial (Cromer Forest-bed).—Mundesley, Bacton, Happisburgh (in Norfolk), Pakefield (in Suffolk).

Conwentz has found fossil remains in numerous localities in England and Ireland; but his promised paper on the subject has not yet been published. Guided by place-names in Germany, he dug up fossil yew in many localities in that country.

He⁴ found under pure peat, 3 feet thick, in the Steller Moss not far from Hanover, some hundreds of stems of yews. He says that it is never found in the ramparts of prehistoric forts, but that it was often planted on fortifications by the knights of the Middle Ages.

He has prepared a list of some hundreds of English, Scottish, and especially Irish names of places taken from the yew. The Gaelic name for the yew is *iubhar*; and in Irish and Scottish place-names this generally appears Anglicised as *ure*, being sometimes corrupted into *o* or *u* simply. Youghal means yew-wood. Dromanure and Knockanure signify yew-hill. Glenure is the yew-glen. Gortinure and Mayo mean yew-field.

Conwentz examined prehistoric wooden boxes, buckets, and other vessels in the British Museum and in the Dublin Science and Art Museum, and identified the wood of some thirty articles as that of yew.

Yew is occasionally found in peat-mosses in Ireland, but is exceedingly rare as compared with pine and oak. Mr. R. D. Cole, who has kindly sent me a

¹ Schlechtendal, *Linnaea*, xii. 496 (1838); Sargent, *Silva N. America*, x. 63 (1896).

² *British Association Report*, 1901, p. 839.

³ *Origin British Flora*, 151 (1899).

⁴ *Bot. Centralblatt*, 1896, lxxi. 105; and 1900, Beihefte, ix. 223.

specimen of bog-yew, drew attention in 1903 to the occurrence of yew in Ballyfin bog in Queen's County. It was so plentiful there in former times that the farmers in the neighbourhood used it for gate-posts and in roofing houses. Mr. J. Adams has published a short account¹ of Mr. Cole's discovery, from which it appears that the cross-section of one trunk, 2 feet in diameter, showed no less than 395 annual rings. Another specimen showed 123 rings, only occupying a width of $1\frac{1}{2}$ inches. Mr. Cole informs me that in no case where the root was vertical did he find more than 18 inches deep of peat beneath; in other parts of the bog where the yews were found more deeply buried, their roots were twisted and out of their natural position, and were probably carried there by floods. Apparently then, the yew, unlike the common pine, never grew in any great depth of peat.

Large trunks of yew were formerly dug up on the shore of Magilligan in Co. Derry, between the rocks and the sea.² On the east side of Glenveigh, in Co. Donegal, thick logs are reported to be often found in the peat.³

In the Kew Museum there is a specimen of fossil yew, which was dug up in Hatfield Chase, near Thorne, Yorkshire, from under a bed of clay 6 feet in thickness; and another specimen is labelled, "Submarine Forest, Stogursey, Somersetshire."

Professor Seeley, F.R.S., in a very interesting letter, dated January 1904, says that he has seen "the broken stumps of yew trees standing as they grew by scores, possibly by hundreds, in Mildenhall Fen, about 1865, when the peat was entirely removed so as to prepare the land for corn. One tree sketched by Mr. Marshall, at that time Coroner for the Isle of Ely, from a section between Ely and Downham Market, showed the yew growing in sandy gravel with black flints. The roots were entirely in the gravel. Above the gravel is the 'Buttery Clay,' 2 feet 6 inches thick, into which the trunk of the tree extended vertically, rising about 1 foot into the Upper Peat, which was 4 feet 6 inches thick. This clay is marine, and is the delta mud of the Cam and the Ouse deposited on the Lower Peat and beyond it, where a depression of land admitted the sea over the Isle of Ely and killed the forests. A little part of the Scrobicularia Clay is 6 feet thick, and the peat above it 18 feet thick. The common trees in the peat there are pines and oaks. I have never seen the beech, and never heard of the lime. About the pine there is no doubt. It occurred in the forests of the Forest Bed of Norfolk, and at several localities in the peat of the fens, almost always on clay covered by peat."

In the present day the common yew is met with growing wild in most parts of Europe, from Scandinavia to the Mediterranean, and from the Atlantic to the western provinces of Russia. It has only recently become extinct in the Azores. It also occurs in Algeria, Asia Minor, the Caucasus, North Persia, the Himalayas, and Burma. The yew also extends into the mountains of Sumatra, South Celebes, and the Philippines.⁴

¹ *Irish Naturalist*, xiv. 1905, p. 34, with plate showing yew trunk and transverse section.

² Mackay, *Flora Hibernica*, 260 (1836).

³ Hart, *Flora County Donegal*, 237 (1898).

⁴ Specimens from these localities have been identified by Pilger as the Himalayan yew.

In England the yew is indigenous on all the chalky Downs of Sussex, Hampshire, and Wilts. According to Bromfield,¹ the yew is one of the few natural ornaments of our South Downs, over the bare sides and summits of which it is scattered abundantly as single trees, frequently of great size and antiquity; sometimes in groups; more rarely forming groves in the bottoms or valleys between these rounded hills, or in the steep woods which clothe their sheltered slopes. He mentions as one of the most remarkable of these yew groves, that at Kingsley Bottom, near Chichester. The yew is remarkably plentiful on the banks of the Wye, about Chepstow and Tintern, and grows in the most inaccessible positions on the limestone cliffs there, as it does also on the rocks of Matlock. The rocks at Borrodale and on Conzie Scar, near Kendal, are also truly natural stations of the yew.² The yew is frequent in the woods of Monmouthshire, and in the ancient forest of Cranbourne Chase in Dorsetshire.³ In the Wyre Forest it is certainly wild, occurring now as isolated trees amidst the beech and oak. In Seckley Wood, on the Severn, there are indigenous yew trees, one of which is remarkable for its curious pendulous habit.⁴ It ascends to 1500 feet in Northumberland.⁵

Concerning the occurrence of the yew as a wild plant in Scotland our information is scanty. Hooker⁶ states that it is indigenous as far north as Aberdeen and Argyll. White⁷ records it from Breadalbane in Perthshire. Lightfoot,⁷ writing in 1777, says it was found here and there in the Highlands in a truly wild state, and that there were the remains of an old wood of yew at Glenure in Upper Lorn, Argyllshire.

It is now of rare occurrence in the wild state in Ireland. According to Praeger,⁸ it is found on rocks, cliffs, in old woods, and on lake shores, now almost confined to the west. It is recorded from various localities from Kerry to Donegal, and Praeger considers that some of these instances may represent the last remnants of aboriginal stock; but it is impossible now to say definitely, as introduced trees grow around the supposed wild ones. The yews in the rough wood at Avondale, in Wicklow, may be wild. Many years ago Moore⁹ found the yew growing at Benyvena, in Co. Derry, in the crevices of the rocks, at an elevation of 1200 feet, when it assumed the appearance of a low shrub. In Smith's *Kerry* (1756), it is stated that "the yew grew in prodigious quantities in all our southern baronies until it was destroyed for making coals for the iron-works."¹⁰

In Norway the yew is called "Barlind," and, according to Schubeler,¹¹ grows wild only in the south, especially along the coast, the farthest point north known to him being near Sondmore, in lat. $62^{\circ} 30'$ N., where it attains the height of 32 feet. In the east it does not extend farther north than Hurdalen, lat. $60^{\circ} 35'$, where it attains a height of 8-10 feet. Schubeler mentions as the largest yews known

¹ *Flora Vectensis*, p. 472.

² Strangways in Loudon's *Gard. Mag.* 1839, p. 119.

³ *Stud. Flora Brit. Islands*, 369 (1878).

⁴ *Flora Scotica*, ii. 626 (1777).

⁵ Mackay, *Flora Hibernica*, 260 (1836).

⁶ Lowe, *loc. cit.* p. 28.

⁷ *Trans. Worcester Nat. Hist. Club*, 1847-1896, p. 16.

⁸ *Flora of Perthshire*, 283 (1898).

⁹ *Proc. Roy. Irish Acad.* vii. 290 (1901).

¹⁰ *Cybele Hibernica*, 331 (1898).

¹¹ Schubeler, *Viridarium Norvegicum*, p. 448.

to him in Norway some at Tufte, on the Christiana fjord, which are 42-43 feet high, with a girth of 3 feet 4 inches to 3 feet 9 inches. The thickest one was, however, 4 feet 10 inches at 2 feet from the ground. He figures (p. 458, fig. 84) what is very rarely seen in England, a self-layered yew, and says that he found in a wood at Hallangen a tree 24 feet in length with a diameter of only 6 inches.

In Sweden the yew grows as far north as lat. 63° 10', and thrives so well that a tree at Maltesholm, in Scania, is said to have had a diameter of 89 centimetres when only 75 years old. It occurs on the Swedish Island of Åland (lat. 60°), but only as a small shrub.

Its northerly limit in Russia appears to be Esthonia, its eastern limit also passing through that province, and continuing southwards through Livonia, Courland, Lithuania, Volhynia, Podolia, and the Crimea. It occurs also in Denmark,¹ but only in one place wild, viz., at Munkehjerg, the beautifully situated hotel near the town of Veile, in Jutland. Formerly the yew was much more widely spread in Denmark, but owing to the value of the wood the wild trees have been destroyed in most parts of the country.

In Belgium, where the yew is often planted, its occurrence in the wild state has been denied by some authors. Wildeman and Durand,² however, consider that it is probably wild in the neighbourhood of Huy and in Hainault.

In France³ it occurs chiefly in mountainous regions, as in the Vosges (where it is rare), Jura, Cevennes, Pyrenees, and Corsica. In the Pyrenees it ascends to 5400 feet, and, according to Bubani,⁴ is always rare (due to destruction by human agency), and only occurs on limestone and in cool and shaded situations. In France generally, it is most common on precipices and rocky spots, and nearly always on limestone. It never forms pure woods; but is, however, remarkably abundant in the forest of Sainte Baume (Department of Var), where the oldest and largest wild yew trees in France occur, some attaining a girth of 11½ feet. In Normandy, according to Gadeau de Kerville,⁵ it is not indigenous, being probably introduced at a very early period before the conquest of Gaul by Julius Cæsar. It is usually planted in churchyards and cemeteries as in England, and nowhere exceeds 19 metres (about 60 feet) in height. The largest in girth, about 33 feet, at 3 feet from the ground, stands in the churchyard of Estry (Calvados). There are also two very fine trees at the church of La Lande Patny (Orne). Several others are figured by this author, of which the one at La Haye de Routot (Eure) is remarkable, on account of having in the interior of its hollow trunk a chapel about 6 feet in diameter and 10 feet high, which was built in 1806, and dedicated to Saint Anne des Ifs by the Bishop of Evreux.

In Germany, according to Willkomm,⁶ the yew is most abundant in Pomerania, Hanover, and Thuringia, and he instances localities where it forms small pure woods. In the Darmbach forest district in the Eisenach Oberland there are, in

¹ Hansen, in *Jour. Roy. Hort. Soc.* xiv. 1892, p. 314.

² Mathieu, *Flore Forestière*, 509, 510 (1897).

³ *Les vieux arbres de la Normandie*, iii. 359 (1895).

⁴ *Prodrome de la Flore Belge*, iii. 6 (1899).

⁵ *Flora Pyreneæ*, I. 46 (1897).

⁶ *Forstliche Flora*, 275 (1897).

addition to many young plants, 311 yew trees of 1 foot or more in girth of stem. On the Veronica mountain at Angelroda in Thuringia, there are about 150 yew trees, of which the largest are possibly 600 years old. Apparently there were anciently two zones of distribution of the yew in Central Europe—a northern one which extended from the Netherlands through the coast provinces of Germany to the eastern shore of the Gulf of Riga, and a southern area comprising the mountainous regions of the Vosges, Jura, Black Forest, the whole of the Alps to Croatia, and the Carpathians. The yew also occurred in the hilly land of central Germany, where, at the present time, according to Drude,¹ it is indifferent to soil, as it grows on the muschelkalk near Göttingen, on the dolomite of Süntel in the Weser mountain district, and on primitive rock on the southern slope of the Rachel (up to 3300 feet altitude). On the dolomite it occurs as isolated trees, while in the ravines and rocky parts of Süntel it forms thick underwood. In the Bavarian Alps it ascends to 3800 feet, not being met with below 1240 feet.

In Switzerland the yew ascends in the Alps to 4660 feet. The largest and finest yew is at Geistler, near Burgdorf, at an elevation of 2400 feet above the sea. This tree is well figured in *Les Arbres de la Suisse*, t. xii., and is said to be 50 feet high by 12 feet in girth at 4 feet above the ground; it divides into several stems at about 10 feet up.

In Austria-Hungary the yew occurs in the Carpathians and the Alps, ascending in Transylvania to 5400 feet; and it is reported to occur in Roumania and Bulgaria.

The yew is generally distributed throughout the mountains of the Iberian Peninsula. In Spain, according to Laguna,² it almost always occurs as isolated trees, and is found in all the Cordilleras from the Sierra Nevada to the Pyrenees and the mountains of Asturias, also in the Balearic Isles. He has only seen it forming pure forest in the Sierra Mariola, near to Alcoy (Valencia). In the high part of that chain on its northern slope there exist what are called the *Teixeras de Agres*, groups of yews belonging to the town of Agres. Here, in 1870, there were still living some hundreds of ancient yews, with some young trees.

Gadow³ says, "There are numerous large and small trees forming a scattered forest, between Riano and Cistierna at about 3600 feet elevation, the terrain belonging to the reddish Permian rubble. The yew tree is widely distributed throughout the Spanish mountains and on the Serra da Estrella (in Portugal), but is rare everywhere. Most of the trees are solitary and old, with decaying tops. Younger trees are ruthlessly destroyed by their branches being lopped off, to be used in the cattlefolds partly instead of straw, and partly for repairing the fences and roofs. The vernacular name is *Tejo*."

Willkomm⁴ states that in the high mountains of Spain it occurs as isolated stunted trees, and says that on the Sierra de la Nieve there was an old yew tree which measured only 17 feet in height, although it had a girth of 17½ feet. In the south of Spain it ascends to 6500 feet.

¹ *Hercynische Florenbezirk*, 114 (1902).

² *Northern Spain*, 387 (1897).

³ *Flore Forestal Española*, i. 114 (1883).

⁴ *Pflanzenverbreitung auf der Iberischen Halbinsel*, 251 (1896).

In Italy, according to Piccioli,¹ the yew is found on the hills and in woods of the mountain regions of the Apennines and the Alps. It is only found in the maritime region in Liguria; but is common in Sardinia, where it ascends to 5660 feet. In Sicily it is found in the region of the olive, and occurs on Mount Etna, mixed with beech, to a height of 6000 feet. The yew, however, is not mentioned in Tornabene's *Flora Aetna*.

In Greece² isolated trees occur in mountain woods up to the sub-alpine region. It is recorded from near Kastania, in Pindus, Mount Olympus, and Oeta (Thessaly); Mount Parnassus, Mount Malero (Laconia), and other places.

The yew³ formerly occurred in the Azores, attaining timber size on Corvo and Flores, whence it was exported as a source of royal revenue. It is now apparently exterminated.

It occurs sporadically in the high mountains of Algeria,⁴ in the Atlas of Blidah, Djurdjura, and Aures. A photograph of a venerable tree in Algeria, taken by M. de Vilmorin, is reproduced in *Garden and Forest*, 1896, p. 265.

In the Caucasus⁵ it occurs throughout the whole territory, including Talysch, at altitudes varying from sea-level to 5660 feet.

In Asia Minor it occurs in Anatolia and Mysia, according to Boissier. Kotschy found it common in the Cilician Taurus from 6160 to 7600 feet altitude. Szovitch collected it in Armenia. It also occurs in North Persia.

Some wood⁶ found in the palaces of Nineveh, and recorded on a tablet as having been brought as "cedar" from Lebanon, proved on microscopical examination to be yew. (A. H.)

The yew, according to Gamble,⁷ is a conspicuous tree in the Himalayan forests, at 6000 to 11,000 feet altitude from Afghanistan to Bhutan. It occurs in the Khasia Hills at 5000 feet, and in Upper Burmah at 5000 to 6000 feet. Sound trees are very scarce, but a very large one cut in Sikkim in 1876 was quite sound. Gamble has measured trees 20 feet in girth; one, 16 feet in girth, had a cylindrical bole 30 feet high. Madden records a tree at Gangutri, near the source of the Ganges, 100 feet high and 15 feet in girth, which surpasses anything I know of elsewhere. I have seen fine yews at 9000-10,000 feet on the Tonglo ridge, which divides Nepal and Sikkim, and have found many orchids upon them, one of which, *Cælogyne ochracea*, has lived for 24 years in my collection. The growth in India varies from 23 to 55 rings per inch of radius. The timber weighs 46 to 59 lbs. per cubic foot, and is used for bows, carrying-poles, and native furniture, and if more common would be more extensively used, as it is very strong and elastic, and works and polishes beautifully. It requires, however, long seasoning.

Sir Joseph Hooker⁸ noted that at 9500-10,000 feet on Tonglo the yew is an

¹ *Le Plante Legnosa Italiana*, 31 (1890).

² Halácsy, *Consp. Fl. Græca*, iii. 459 (1904).

³ Trelease, *Missouri Bot. Garden Ann. Report*, viii. 1897, p. 169.

⁴ Battandier et Trabut, *Flore de l'Algérie*, 398 (1904).

⁵ Radde, *Pflanzenverbreitung in den Kaukasusländern*, 183 (1899).

⁶ G. Henslow in *Garden*, 1904, ii. 73.

⁷ Gamble, *Indian Timbers*, 413.

⁸ Hooker, *Himalayan Journals*, i. 168, 191, ii. 25 (1854).

immense tall tree with long sparse branches and slender drooping twigs, while at Choongtam (5000-6000 feet altitude) it is small and rigid, much resembling in appearance our churchyard yew. The red bark is used as a dye and for staining the foreheads of Brahmans in Nepal.

There is a specimen at Kew, collected by Sir George Watt in Manipur, which bore yellow berries.

In the United States¹ there are a number of large European yew trees in New York, Philadelphia, and Baltimore, showing that the tree must have been brought to the eastern United States more than a century ago. Sargent says that everywhere south of Cape Cod it appears to be perfectly hardy. Farther east it suffers from the cold in severe winters, and cannot be considered a desirable tree for general planting in eastern New England. T. D. Hatfield,² writing from Wellesley in Massachusetts, states that the variegated form of the common yew is hardy in places where the green type perishes.

II. JAPANESE YEW, var. *cuspidata*.—*Ichii* in Japan, *Onko* of the Ainos in Hokkaido. Though Sargent says³ that, judging from his observations, it is confined to the island of Yezo, it is stated in the *Forestry of Japan*, p. 88, that it is found also in Kiso and Nikko, and it was included in the list of trees growing wild in the royal forest of Kiso, though I did not see it myself. In Nikko it is planted in the temple gardens; a fine specimen, of which I give an illustration taken at this place (Plate 53), shows how much it resembles our yew in habit and appearance. This tree was about 40 feet high by 12 in girth. In the Hokkaido it grows scattered through the lowland and hill forests, among deciduous trees and conifers, but nowhere, so far as I saw, gregariously, and attains a large size, trees of 50-60 feet high with clear trunks 2-3 feet in diameter being not very rare. It sometimes produces beautifully veined burrs, and when old is often rotten inside.

It is a favourite in gardens in Hokkaido, as trees of considerable size can be moved without killing them. The wood, which seems milder, sounder, and more free from holes and flaws than in England, is much used by the Japanese for water-tanks, pails, and baths, and is cut into handsome trays, sometimes carved, which I bought quite cheaply in Sapporo. I also procured large planks and slabs of it, measuring as much as 26 inches wide, and quite sound, such as I have never been able to get from English yews. Chopsticks, clogs, and the Aino bows are also made of yew wood, and when cut into thin shavings very pretty braid is made from it.

I was informed by Mr. N. Masaki of the Imperial Art School in Tokyo, that the semifossil wood known at Sendai as *Gindai-boku* is dug from the bed of the Natonigawa river, near which deposits of lignite are found. This wood was believed by the carvers at Nikko to be fossil *Cryptomeria* wood, but is so like the bog yew found in Great Britain in grain and colour that I have little doubt that it is yew. This wood is only procured in small pieces of irregular shape, the largest that I saw being made into a tray about 20 inches square. It is very hard, of

¹ *Garden and Forest*, 1897, p. 400. Large trees also occur at Washington, *loc. cit.* 1896, p. 261.

² *Ibid.* p. 405.

³ *Forest Flora of Japan*, p. 76.

a rich reddish brown colour, and when polished or carved is extremely handsome.

The Japanese yew also occurs in Saghalien, the Kurile Isles,¹ Amurland, and Manchuria. Apparently it is very variable in habit, as Maximowicz² regarded the Amurland plant as a mere shrub, though in one place in the mountains he saw a tree a foot in diameter. Trautvetter² saw no difference between the yew in Amurland and in Europe, except that the seed of the former was smaller and more pointed.

The Japanese yew was introduced into England between the years 1854 and 1856 by Fortune,³ who states that he received it from Mr. Beale in Shanghai, to whom it had been sent from Japan. It was first cultivated and propagated by Mr. Glendinning of the Chiswick Nursery. It has not grown to be a tree in England so far as we know, as it assumes rather the form of a large branching shrub with two or three stems. It is usually distinguished from the other yews, as seen in cultivation, by the peculiar yellow colour of the under-surface of the leaves, which are broad, somewhat leathery in texture, and abruptly pointed. This yellow colour is not, however, confined to the Japanese yew, as it occurs in the Chinese yew, and also apparently in some Pyrenean specimens, and is perhaps due to climatic influences.

According to Sargent⁴ the Japanese yew was introduced into the eastern United States in 1862, and has proved to be perfectly hardy as far north as Boston. It grows rapidly in cultivation, and promises to become a large long-lived tree. Sargent speaks of a dwarf compact form of this plant with short dark green leaves in cultivation in the United States, which probably originated in Japanese gardens. It often appears under the name of *Taxus brevifolia*, but must not be confounded with the true *Taxus brevifolia* of the Pacific coast. This is doubtless the *Taxus cuspidata*, var. *compacta*, of the Kew Hand List, of which we have seen no specimen. Sargent has also seen in California a yew with fastigate, somewhat spreading branches, which had been imported from Japan, evidently another garden variety of *Taxus cuspidata*.

III. CHINESE YEW, var. *sinensis*.—The yew has only been found in China, in the provinces of Hupeh and Szechuan, where it is a very rare tree in the mountains at 6000 to 8000 feet, occurring on wooded cliffs. The largest tree seen by Henry was about 20 feet in height, but with a girth of 7 or 8 feet. The bark is almost a bright red in colour. Franchet⁵ considered the Chinese yew to resemble *Taxus cuspidata*, S. et Z., which in his opinion does not seem to differ from the European yew in any positive character. The Chinese mountaineers reported the timber to be red, strong, and of fine quality, and called the tree *Kuan-yin-sha*, "the fir of the Goddess of Mercy."

IV. PACIFIC COAST YEW, var. *brevifolia*.—Though this tree was introduced by William Lobb in 1854,⁶ it is still very rare, and we know no specimens of any size in

¹ Miyabe, "Flora of Kurile Isles," in *Mem. Boston Soc. Nat. Hist.* iv. 261 (1890).

² *Primitie Florae Amurensis*, 259 (1859).

³ *Gard. Chron.* 1860, p. 170. Article by Fortune on Chinese Plants introduced during his travels in China in 1854-1856.

⁴ *Garden and Forest*, 1897, p. 402.

⁵ *Jour. de Bot.* 1899, p. 264.

⁶ Veitch's *Man. Conifera*, ed. 1, 305 (1881).

England, though it might be so easily mistaken for the common yew, that we have possibly overlooked it. It would no doubt grow well in England, as it is a native of the colder and damper parts of the north-west coast of America, from Queen Charlotte Islands along the coast ranges of British Columbia, western Washington, and Oregon; in California on the Sierra Nevada at 5000 to 8000 feet, and as far south as Monterey; and extends eastward to the western slopes of the Rocky Mountains in Montana, where it becomes shrubby in habit. I have seen it in Washington on the slopes of Mount Tacoma, where it grew isolated in the dense forest, and attained no great size, though it occasionally reaches a height of 70 to 80 feet. In Vancouver's Island it is not uncommon in the rich, low meadows of the east coast, but the largest I saw were not over 30 to 40 feet high. The wood seemed indistinguishable from that of the European species, and was, like it, rotten at heart in old trees and full of holes. Sargent says that the Indians use it for bows, paddles, spear handles, and fish-hooks, but except for fencing posts it does not seem to be used by settlers.

V. CANADIAN YEW, var. *canadensis*.—This is only a creeping shrub with a stem occasionally a foot or two in height, and though it is said by Loudon to have been introduced in 1800, it has never obtained a place in English gardens. I have seen it common in Canada in thick forest, where it produced red berries very like those of our yew. Sargent gives its distribution as from Newfoundland to the northern shores of Lakes Superior and Winnipeg, southwards through the Northern States to New Jersey and Minnesota.

VI. FLORIDA YEW, var. *floridana*.—This is one of the rarest of North American trees, confined to a few localities in Western Florida, and, except by its habit, not easily distinguished from *T. canadensis*. It is usually shrubby, rarely attaining 25 feet high. It has never been introduced to cultivation in England, and is probably not hardy.

VII. MEXICAN YEW, var. *globosa*.—A tree about 20 feet in height, discovered in 1837 by Ehrenberg in Southern Mexico. There are also specimens at Kew of yews collected in Mexico by Hartweg, F. Müller, and W. Saunders, which vary considerably in foliage. This variety is scarcely known, as recent collectors have failed to rediscover the tree. It is very like the common yew.

(H. J. E.)

VARIETIES OF THE COMMON YEW IN CULTIVATION

These have in some cases originated as individual sports in the wild state; in other cases they are due to the art of the gardener, who has greatly increased the number of varieties by selection. They differ from the type in various ways:—(1) in habit (fastigate, prostrate, pendulous, and dwarf forms); (2) in the colour, shape, size, and disposition on the branchlets of the leaves; (3) in the colour of the fruit. André,¹ in an interesting article, illustrated by figures, has drawn attention to the remarkable differences which occur in the shape of the seed and of the aril in the different cultivated varieties; but it is probable that these are not so constant as he believed.

¹ *Revue Horticole*, 1886, p. 105, translated in *Garden*, 1889, xxxv. 36.

A. *Fastigate Forms*.—In these the branches take an upward direction (vertical or ascending), and the leaves tend to spread out radially from the branchlets.

1. Var. *fastigiata*, Irish Yew, Florencecourt Yew.

Taxus baccata fastigiata, Loudon, *Arb. et Frut. Brit.* iv. 2066 (1838).

Taxus fastigiata, Lindley, *Syn. Brit. Flora*, 241 (1829).

Taxus hibernica, Hook. ex Loudon, *loc. cit.*

Columnar and compact in habit, all the branches and branchlets being directed vertically upwards. Branches stout, branchlets few and short. Leaves, always spreading radially in all directions around the branchlets, dark green and shining, with the apex usually more obtuse than in the common yew. Dr. Masters considers the Irish yew to be a juvenile form,¹ in which the characters of the seedling (the radial disposition of the leaves and the upright habit) are preserved throughout the life of the plant. As the original tree was a female, and the variety is propagated by cuttings, all Irish yews are of the same sex. When they bear flowers they are generally fertilised by the pollen of common yews growing in their neighbourhood, and the seed resulting, when planted, generally produces plants indistinguishable from the common yew.² Dr. Masters¹ received from Mr. Tillett of Sprowston, near Norwich, sprays of an Irish yew which bore male flowers. This was apparently an instance of a monoecious tree, a phenomenon which occurs though rarely in the common yew. No true male Irish yew has ever been met with. The aril of the Irish yew differs usually from that of the common form in being more oblong in shape.

The Irish yew was discovered³ in the mountains of Fermanagh above Florencecourt by a farmer named Willis about the year 1780. He found two plants, one of which he planted in his own garden, and is now no longer living. The other was planted at Florencecourt, the seat of the Earl of Enniskillen; and from it cuttings were distributed, which are the source of all the Irish yews in cultivation. The original tree is still living, and a figure of it is given in Veitch's *Manual*, p. 141, as it appeared about thirty years ago. Kent says that in 1900 it had an open straggling appearance.

One of the finest Irish yews known to us is that at Seaforde, near Clough, Co. Down, the seat of Major W. G. Forde. This tree was reported to be 33 feet high in 1888,⁴ and 35½ feet in 1903.⁵ A plate of it is given (Plate 58), reproduced from a photograph kindly sent us by the owner, who reports the present measurements (1905) to be:—Height, 37 feet; girth at the ground, 9 feet; circumference of branches at 20 feet from the ground, 91 feet.

Two large trees exist at Comber, Co. Down, of which Mr. Justice Andrews gives the following particulars in a letter:—

“The Irish upright yew trees at Comber, mentioned in Mackay's *Flora Hibernica* (1836), p. 260, are the two large yews⁶ in the garden beside ‘Araghmore,’ the residence of Mrs. John Andrews. My earliest recollection of them goes back

¹ *Gard. Chron.* 1891, x. 68.

² Sir C. Strickland writes in *Gard. Chron.* 1877, vii. 151: “All the plants I have raised from Irish yew berries are exactly like the common yew.” But Elwes saw at Orton Hall three seedlings from the Irish yew of which one was fastigate in habit.

³ *Gard. Chron.* 1873, p. 1336.

⁴ *Ibid.* 1888, iv. 484.

⁵ *Ibid.* 1903, xxxiii. 60.

⁶ London figures one of these on p. 2067.

60 or 70 years, and they were then apparently as tall as they are now, but not so much spread out. I cannot accurately estimate their height and girth, but they are the two largest upright yews I have seen.”

At Brockhill,¹ Worcester, there are two large Irish yews, estimated by Mr. Lees to have been at least 100 years old. Very handsome specimens are also growing at Montacute House, Somerset.

The Irish yew is very effective as a garden tree, but requires pruning and wiring every two or three years in order to keep it in good shape. There is at Colesborne a terrace planted on both sides with Irish yews about 50 years ago, which are kept in shape by wire, and when so treated are of very uniform growth and habit.

Taxus fastigiata aurea is a form of the Irish yew, in which the young shoots are golden yellow. In *Taxus fastigiata argentea* the tips of the branchlets are white.

2. Var. *Chesthuntensis*.

Taxus baccata Chesthuntensis, Gordon, *Pinet. Suppl.* 98 (1862).

This was raised by William Paul of the Cheshunt Nursery from a seed of the Irish yew, which it resembles. The branches, however, are ascending, but not so erect as in the parent form. The leaves have an acute apex, and resemble in colour those of the Irish yew, being dark green and shining on the upper surface; they are broader and shorter than those of the common yew. It is less formal than the Irish yew, and is said to grow twice as fast.

3. Var. *elegantissima*.—This was raised, according to Barron,² by Fox of the Wetley Rock Nurseries, who had an Irish and a golden yew growing together, from which this came as a seedling. It is generally a dense compact shrub, but forms occur which are more open in habit. The leaves are usually radially spreading, but are often two-ranked on some of the branchlets; they are long, and terminate gradually in a long, fine cartilaginous point. Young leaves are golden yellow; adult leaves have white margins.

4. Var. *erecta*.

Taxus baccata erecta, Loudon, *loc. cit.* 2068 (1838).

Taxus baccata Crowderi, Gordon, *Pin. Suppl.* 98 (1862).

Taxus baccata stricta, Hort.

A dense broad shrub with erect and ascending branches. The leaves are dark green, shining, short, and acute; and are usually radially arranged, but often on the lower branchlets are disposed in two ranks.

The Nidpath Yew³ resembles this variety, but is more columnar in habit, with a tendency to spread at the top. The leaves, as seen on a shrub at Kew, are bluish green, and usually are all radially arranged.

A variety named *imperialis* is described as being a slender, tall form with ascending branches and dark green leaves.

¹ *Trans. Worcester Nat. Hist. Club*, 1847-1896, p. 211.

² *Gard. Chron.* 1868, p. 921. Veitch's *Manual*, 1st ed. 302, states that it was introduced by Messrs. Fisher, Son, and Sibray of the Handsworth Nurseries, near Sheffield.

³ Nicholson, *Dict. of Gardening*, iv. 12.

B. *Dwarf forms with leaves radially arranged on the branchlets.*

5. Var. *ericoides*.

Taxus baccata ericoides, Carrière, *Conif.* 519 (1855).

Taxus baccata empetrifolia, Hort.

A low shrub with ascending branches. Leaves generally radially arranged, but occasionally two-ranked, uniform in size, falcate, short, acute, tapering to a fine cartilaginous point.

6. Var. *nana*.

Taxus baccata nana, Knight, *Syn. Conif.* 52.

Taxus Foxii, Hort.

A dwarf shrub. Leaves generally radially arranged, some being two-ranked; very variable in length, but always short, straight or falcate, often twisted or curved.

C. *Varieties with leaves distichously arranged, assuming pendulous, prostrate, and other non-fastigiate habits.*

7. Var. *Dovastoni*, Dovaston Yew.

Taxus baccata Dovastoni, Loudon, *loc. cit.*, 2082 (1838).

A tree or large shrub, with spreading branches, arising in verticils, and becoming very pendulous at their extremities. Leaves dark green with an abruptly mucronate apex.

An account of the original tree, from which this variety has been propagated, is given in Loudon and in Leighton's *Flora of Shropshire*.¹ This tree was planted as a seedling about the year 1777 at Westfelton, near Shrewsbury. It was in vigorous health in 1900, and measured then 8 feet 10 inches in girth at 4½ feet from the ground. Nineteen years previously its girth was 7 feet 11 inches. It is described as having a single leader, with branches pendulous to the ground. The original tree is monoecious; one branch only producing fertile berries, from which seedlings were raised, which reproduced the habit of the parent.¹ Barron² states that all his Dovaston yews are female trees. Carrière³ sowed seeds of this form on many occasions, and the offspring was always like the common yew, doubtless due to his Dovaston yews being fertilised by the pollen of ordinary yew trees in the vicinity.

Carrière further states that MM. Thibaut and Keteleer obtained in 1865, from seeds of this variety, plants which were in the proportion of three-fourths variegated in foliage and one-fourth green; but in no case was the pendulous habit observed. The variegated plants passed into commerce as *Dovastoni variegata*; but these were simply ordinary variegated yews. A sub-variety, however, occurs in which the leaves of the Dovaston yew are variegated with yellow; and this is known as var. *Dovastoni aureo-variegata*.

8. Var. *pendula*.—Growing at Kew, this is an irregularly branching wide, low,

¹ *Gard. Chron.* 1900, xxvii. p. 146, where a figure and full details of the Dovaston yew are given.

² *Ibid.* 1868, p. 992. He gives the dimensions of the Westfelton tree in 1876 as 34 feet high by 7½ feet in girth. *Garden*, ix. 341.

³ *Traité gén. des Conifères*, ii. 763 (1867).

dense shrub, making no definite leader, with the tips of the branchlets pendulous. Var. *gracilis pendula* is said to have the branches and branchlets more elongated, and to attain a larger size than var. *pendula*.

9. Var. *horizontalis*.

Taxus baccata horizontalis, Knight, *Syn. Conif.* 52 (1850).

This resembles the Dovaston yew in the verticillate arrangement of the spreading branches. The branchlets, however, instead of being pendulous, are turned slightly upwards at the ends of the branches.

10. Var. *recurvata*.

Taxus baccata recurvata, Carrière, *Conif.* 520 (1855).

A large shrub, with branches somewhat ascending and elongated, and pendulous branchlets, which bear the leaves so arranged as to be all directed upwards, each leaf being recurved. The leaves resemble those of the Dovaston yew.

11. Var. *procumbens*.

Taxus baccata procumbens, Loudon, *loc. cit.* 2067 (1838).

A low prostrate shrub, keeping close to the ground, with branches long and ramified. This is distinct from *Taxus canadensis* in characters of leaves and buds.

D. *Varieties with leaves distichously arranged, in which the leaves are variously coloured.*

12. Var. *aurea*, Golden Yew.

Taxus baccata aurea, Carrière, *Conif.* 518 (1855).

A golden yew is mentioned in Plot's *History of Staffordshire* as occurring in that county in 1686. There are many kinds of golden yew, which are of different origin. The form generally known as *aurea* is a dense shrub or low tree, with narrow falcate leaves which are variegated with yellow. Golden yews of this kind are said to be all male trees. The original was reared by Lee of Hammersmith, and was afterwards planted at Elvaston Castle. It was monoecious,¹ and from it Barron reared several varieties. The variety known as var. *Barroni* has the leaves more decidedly yellow than those of the common golden yew; and one form of it is female and bears berries.

A great number of variegated yews of different kinds have been raised at Knap Hill, at the Chester Nurseries, and elsewhere. These have been obtained as seedlings in various ways; some were obtained by planting Irish yew amongst common golden yew; in other cases the seed-plants used were varieties like *elegantissima*, *erecta*, *adpressa*, etc.

13. Var. *Washingtoni*.—A low dense shrub, in which the leaves on the young shoots are golden yellow in colour.

¹ According to Barron the tree was a male; but he discovered on it a single branch bearing female flowers. See *Gard. Chron.* 1868, p. 921; also 1882, ii. 238.

14. Var. *glauca*.

Taxus baccata glauca, Carrière, *Conif.* 519 (1855).

A vigorous shrub, with leaves, which are shining and dark green on the upper surface, and glaucous blue beneath.

E. *Variety with differently coloured fruit.*15. Var. *fructu luteo*.

Taxus baccata fructu luteo; Loudon, *loc. cit.* iv. 2068 (1838).

This variety only differs from the common yew in the aril of the fruit being yellow. A tree of this kind was discovered about the year 1817 at Glasnevin, near Dublin, growing on the property of the Bishop of Kildare.

Cuttings, however, were first distributed from a tree noticed in the grounds of Clontarf Castle in 1838. This tree¹ was about 50 feet high in 1888. At Ardsallagh, Co. Meath, the residence of Mrs. M'Cann, there is a tree 30 feet high and 7 feet in girth, with yellow fruit, occurring in an avenue of old yews. There are several trees of this kind at Powerscourt,² the best one of which was about 40 feet high in 1888. Bushes raised from the seeds of these trees are reported to be bearing yellow berries, from which it would appear that this variety comes true from seed. It is remarkable that all the yellow-berried yews known, except the one mentioned above as collected at Manipur, should occur in the neighbourhood of Dublin.

F. *Variety with small leaves.*16. Var. *adpressa*.

Taxus baccata adpressa, Carrière, *Rev. Horticole*, 1855, p. 93; *Taxus adpressa*, Gordon, *Pinetum*, 310.

Taxus tardiva, Lawson, *ex* Henkel and Hochstetter, *Syn. Nadelh.* 361.

Taxus sinensis tardiva, Knight, *Syn. Conif.* 52 (1850).

A large spreading shrub with densely crowded branchlets, bearing remarkably small broad leaves, arranged on the shoots, as in the common yew. The leaves are dark green above, $\frac{1}{4}$ - $\frac{1}{2}$ inch long, elliptic linear in outline, with a rounded apex, from which is given off a short mucro. The aril is broad and shallow, not covering the seed, which is 3-angled and often depressed at the summit.

This is by far the most distinct of all the forms, geographical and horticultural, not only in foliage, but also in fruit. It has been considered by many botanists to be a distinct species, conjecturally of Japanese or Chinese origin. It is not known in Japan,³ except as a plant introduced from Europe; and there is no reason for doubting the positive information⁴ as to its origin given by Messrs. James Dickson and Sons and by the late Mr. F. T. Dickson of Chester, though there is a slight discrepancy in their two accounts. The latter states that it was found as a seedling by his father amidst some yew seedlings about 1838, while the former give

¹ *Gard. Chron.* 1888, iv. 576.

³ Matsumura, *Shokubutsu Mei-I.* 290 (1895).

² *Ibid.* 707.

⁴ *Gard. Chron.* 1886, xxix. 221, 268.

the date as 1828, and the locality as a bed of thorn seedlings in the Bache Nurseries, Chester.

Only female plants of this variety are known, and it is reproduced by grafting. Its flowers are doubtless fertilised by the pollen of common yew trees near at hand, and as a rule it produces a great crop of berries. Messrs. Dickson and Sons have frequently sown seeds which invariably produced the common yew.

Var. *adpressa stricta* is a form of this variety in which the branches are erect or ascending. It is not known whether it originated as a seedling or as a sport fixed by grafting. It was raised by Mr. Standish.

Var. *adpressa aurea* is a form with golden leaves.

Var. *adpressa variegata* is a form with the young shoots suffused with a silvery yellow colour. This was exhibited at the Royal Horticultural Society on August 27, 1889.

There are fine examples of var. *adpressa* in Kew Gardens.

SEEDLING¹

The two cotyledons, together with the seed-case which envelops them as a cap, are carried above ground by the lengthening caulicle; and speedily casting off the remains of the seed-case, act as if they were true leaves. They differ from the latter in bearing stomata on the upper and not on the lower surface, and in having their apices rounded and not acute. The young stem, angled by the decurrent bases of the leaves, gives off at first three or four opposite pairs of true leaves, which are succeeded in vigorous plants by a few alternate leaves, crowded at the summit around a terminal bud, which in all cases closes the first season's growth, when the young plant is 1 to 3 inches high. The caulicle, 1 to 2 inches in length, ends in a strong tap-root, which descends several inches into the soil, and gives off a few lateral fibres.

The growth of the seedling during the next four or five years is very slow, often scarcely an inch annually. Afterwards the growth becomes more rapid.

SEXES, FLOWERS, FRUIT, BUDS

The yew is normally dioecious; but exceptions occur, and in our account of the cultivated varieties two or three instances of monoecious trees have been mentioned. The celebrated yew at Buckland,² Kent, is monoecious. As a rule it is only a single twig or branch which bears flowers of a different sex from those on the rest of the tree. A yew³ at Hohenheimer, near Stuttgart, is reported, however, to bear male and female flowers irregularly over the whole tree, each kind, however, on separate twigs. There is a specimen at Kew of a branch, sent in 1885 by the Rev. T. J. C. Valpy of Elsing, Norfolk, which bears both male flowers and fruit.

¹ Figured in Lubbock, *Seedlings*, ii. 553, fig. 677 (1892).

² *Gard. Chron.* 1880, xiii. 556. There are specimens of this yew in the Kew herbarium.

³ Kirchner, *loc. cit.* 74.

Gilbert White thought that male trees are more robust in growth than female trees; but we are unaware of any accurate observations on this subject. Kirchner,¹ however, states that there is a slight distinction in the habit of the two sexes, male trees being taller with longer internodes and shorter leaves.

In early spring drops of mucilage may be observed glistening on the ovules of female trees in flower. The mucilage is secreted by the micropyle, and seems to entangle the grains of pollen which have been wafted on the ovules by the wind. The clouds of pollen which fly forth from the male flowers are well known. The pollen is liberated from the stamens by a very elaborate mechanism, which serves to protect the pollen grains in rainy weather. A good account of this is given by Kerner.²

A large quantity of fruit of the yew falls to the ground in autumn; but the seeds in this case do not as a rule germinate. Natural reproduction seems to be effected by birds like the thrush and blackbird, which, attracted by the fleshy aril, devour the whole fruit. The seeds, protected by their hard testa, escape digestion and are voided at a distance. They rarely germinate in the first year after ripening; seedlings come up as a rule in the year following, a few even appearing in the third year.

The buds of the different geographical forms appear to differ more than the leaves themselves. The terminal bud is invested closely by the uppermost and youngest leaves and continues the growth of the shoot. The bud scales on unfolding remain at the base of the growing shoot, and on older branchlets persist as dry brownish scales, forming an involucre at the bases of the branchlets. Lateral buds are developed on the twigs at irregular intervals. Many of these remain dormant, retaining the power to take on growth at any moment. This explains the readiness with which the yew submits to pruning, and the facility with which it produces coppice shoots when the stem is cut. Spray or epicormic branches are frequently produced on the upper side of the branches or on the stem; and these also originate in dormant buds.

True root-suckers are never formed; but layering occurs, though very rarely, in branches which have come in contact with the ground. (A. H.)

AGE, HARDINESS

With regard to the supposed great age of yew trees, which has been much exaggerated by authors—especially by the great Swiss botanist, De Candolle—we must refer our readers to Lowe, who has discussed the subject very thoroughly in chapter iii. of his work. He proves that the average rate of growth is about 1 foot of diameter in 60-70 years in both young and old trees. There is, however, abundant evidence to show that though old trees grow at intervals much more rapidly than young ones, they do not grow uniformly, but have periods of comparative rest, and that the increase of girth is fastest when old trees have lost their heads and the stem is covered with young shoots.

¹ Kirchner, *loc. cit.* 74.

² *Nat. Hist. Plants*, Eng. translation, ii. 145, 146 (1898).

No tree has such a remarkable faculty of covering up wounds or injuries by the growth of fresh wood from the outside; and even after the main stem is completely dead, fresh and entirely new stems may grow up around it and form a new tree around the dead one. For this reason most of the yews of very large size are mere shells, and even when no hollow can be seen from the outside, decay—which is often indicated by moisture running from holes in the trunk—has set in.

Three very curious sections showing the way in which these trunks grow are given by Lowe, pp. 78 and 79.

The yew, though occurring wild far north, as in Norway, is not perfectly hardy, and many instances are on record in which it has been injured or killed during severe winters. It was affected in Cambridgeshire¹ and severely injured at Glasgow by the severe frost of 1837-1838. In the winter of 1859-1860 the young shoots of many trees were killed at Burton-on-Trent.²

Many cultivated yews³ were killed by the frost of 1879-1880 in Switzerland, Rhineland, Hessa, Thuringia, etc. though in the same localities other native conifers were not injured by the severe cold. Duhamel⁴ states that in France the yew suffered much damage from the great frosts of 1709; and Malesherbes found several killed by the frost of 1789.

POISONOUS PROPERTIES OF THE YEW

The poisonous properties of the yew have been well known from the earliest times, and the subject has been so carefully investigated in the *Journal of the Royal Agricultural Society of England*, 1892, p. 698, by Messrs. E. P. Squarey, Charles Whitehead, W. Carruthers, F.R.S., and Dr. Munro, and summarised by Low in chapter x. of his work, that we need not do more than give a brief résumé of the present state of our knowledge. Through the kindness of Sir W. Thiselton Dyer, we have been able to peruse a file of the Board of Agriculture entitled "Yew Poisoning," in which the subject has been further discussed by that gentleman with whose opinions we are in complete accordance.

The conclusions drawn by Dr. Munro, after careful study from a medical point of view, are as follows:—

"Both male and female yew leaves contain an alkaloid.

"This alkaloid in both cases appears to agree with the taxine of Hilger and Brande. Taxine is probably the poison of the yew, but it is doubtful whether it has ever been obtained in a pure state, and its physiological effects have not been sufficiently studied. Other alkaloids are probably present in yew.

"Taxine is present in fresh yew leaves as well as in those withered or air-dried. It is also present in the seeds, but not in the fleshy part of the fruit.

"The yew poison may be one of moderate virulence only, and may occur in greater percentage in male than in female trees, or the percentage may vary from tree to tree without distinction of sex, and this may explain the capricious

¹ Lindley, *Trans. Hort. Soc.* 1842, ii. 225.

³ Kirchner, *loc. cit.* 62.

² *Gard. Chron.* 1860, p. 578.

⁴ *Traité de Arbres*, i. 302 (1755).

occurrence of poisoning. Also the half-dried leaves would be, *ceteris paribus*, more potent than the fresh.

"Further and extended chemical researches, in conjunction with physiological experiments, are necessary to clear up the matter.

"The principle having a specific uterine action is possibly not the same as that which causes death."

This poison, if taken in sufficient quantity, is deadly to man, horses, asses, sheep, cattle, pigs, pheasants, and possibly other animals, but under ordinary circumstances small quantities of the leaves may be and are habitually eaten by live-stock without apparent injury, whilst it seems proved that the wood of the yew may be used for water vessels and for baths, as in Japan, without any deleterious effects.

Sargent, *Silva of North America*, vol. x., 63, says "no cases of poisoning by *Taxus* in North America appear to be recorded"; and Brandis, *Forest Flora of British India*, p. 541, says that "in India domestic animals are said to browse upon *T. baccata* without experiencing any bad effects."

With regard to the danger of allowing this tree to grow in hedges and fields where stock are pastured, there seems to be abundant evidence, which is well summarised by Mr. E. P. Squarey, and which my own experience entirely confirms, that though animals which have been bred and fed in places where they have access to yew are more or less immune, probably because they never eat it in sufficient quantity to do harm, yet that animals freshly turned into such places when hungry, or in winter and spring when there is little grass, are liable to die from eating it, and that fatal effects most commonly ensue when loppings or partially withered branches and leaves are eaten.

It has been held in more than one case that landowners, and others responsible for keeping up fences, who allow yew trees to remain insufficiently fenced, are liable to an action for damages if another person's cattle from adjoining land eat the branches and die.

With regard to the danger of yew trees in game coverts we have little exact knowledge, but in certain cases there seems to be evidence of its being poisonous to pheasants, and the following passage, which was communicated by Sir William ffolkes, Bart., of Hillington Hall, Norfolk, to the editor of the *Journal of the Royal Agricultural Society*, 1892, p. 698, is worth quoting in full.

"Some years ago, when shooting through the coverts here the second time, we found about fifteen carcasses of pheasants under some yew trees. These could not have been overlooked the first time in picking up, as there was no stand anywhere near this place where so many pheasants could have been shot. My keeper informs me that it is after the pheasants have been disturbed by shooting that they take to perching in the yew trees. This may or may not be so, but at any rate it appears that, when they take to perching in these trees, they are apt to eat a few of the leaves. We now always drive them off the yew trees when they go to perch at night. I enclose some of the yew which poisoned the pheasants, and would like to add that never before this year have

we picked up a dead pheasant anywhere near these yew trees till the coverts had been shot."

We have no record of any case of deer being poisoned by yew, though no doubt in a heavy snow they might be tempted to eat it, and Mr. Squarey states that in the "Great and Little Yews" of which I write later, hares and rabbits, which are very numerous, have never been found dead from poisoning.

I may add that I have frequently seen yews of a few inches in girth barked and killed by rabbits where they are very numerous and hungry, but it is one of the last trees to be attacked.

CULTIVATION

The yew is best raised from seed, except in the case of varieties which are propagated by cuttings, which are taken off in April or August and put into sandy soil in a shady border, or, better, under a handlight, as they will then root more quickly.

Seed, if sown when ripe, will sometimes come up in the following spring, but usually lies over the first year, and is therefore treated like haws. The seedlings grow very slowly at first, and require several years of nursery cultivation before they are large enough to plant out.

They are easy to transplant in early autumn or in spring, and may be safely moved at almost any time of the year even when of large size, if care is taken to prepare the roots and keep them watered until new ones are formed.

The yew in Buckland Churchyard, about a mile from Dover, may be mentioned as an instance of the great age at which this tree may be transplanted with safety, if proper care and appliances are used. This tree was a very old and large one, divided into two stems, one of which, almost horizontal, was 10 feet 10 inches, and the entire trunk no less than 22 feet in girth. It was removed by the late Mr. W. Barron on March 1, 1880, to a position 60 yards off, where Mr. John Barron of Elvaston Nurseries tells me it is now in a vigorous state of health. An account of this tree is given by Lowe; and the manner in which it was transplanted, with pictures of its appearance before and after removal, is described fully in *Gard. Chron.* 1880, p. 556-7.

By sowing seeds there is some chance of obtaining variegated forms, which are among the most ornamental shrubs we have.

The Hon. Vicary Gibbs has found that at Aldenham the use of nitrate of soda increases in a marked degree the growth of young yew trees. Some yews planted by him in 1897 and treated with liberal quantities of this manure had attained in 1905 an average height of 12 feet, with a girth of stem of 16 inches at a foot above the base.

SOIL AND SITUATION

Though the yew grows naturally most commonly on limestone formations in England, it will grow on almost any soil except perhaps pure peat and wet clay,

and attains its largest dimensions on deep sandy loam. It grows better under dense shade than any tree we have, and may therefore be used for under-planting beech-woods where bare ground is objected to, and where the soil is too poor and dry or too limy for silver fir. In such situations, however, it grows very slowly and produces little or no fruit.

REMARKABLE TREES

No tree, except perhaps the oak, has a larger literature in English than the yew; and though a monograph on the *Yew Trees of Great Britain and Ireland* by the late John Lowe, M.D., was published by Macmillan so lately as 1897, I am able to add many records of trees not known to him, and shall not allude to most of the trees which he has described and figured.

It is strange that neither Loudon, Lowe, nor any other writer has, so far as I know, described the yews in the close walks at Midhurst, which, on account of their extraordinary height, form what I believe to be the most remarkable yew-grove in Great Britain or elsewhere.

The age and history of these wonderful trees is lost in obscurity, but it is said in Wm. Roundell's very interesting book on Cowdray¹ that Queen Elizabeth was entertained at a banquet in these walks, so they must have been of considerable age and size 300 years ago.

The close walks are situated close to the town on the other side of the river, and consist of four avenues of yew trees forming a square of about 150 yards, together with a grove of yews at the upper end which average, as nearly as I could measure them, about 75 feet in height, but some probably exceed 80. These trees are for the most part sound and healthy, though little care has been taken of them, and some have fallen. They are remarkable not only for their great height, which exceeds that of any other yews on record in Europe, but on account of their freedom from large branches, many having clean boles of 20-30 feet with a girth of 8-9 feet. They stand so thick together that on an area of about half an acre or less—I made 213 paces in going round it—I counted about 100 trees and saw the stumps of 10 or 12 more, which would probably average over 30 cubic feet to each tree without reckoning the branches.

The ground below is absolutely bare of vegetation, and though I found some small seedlings among the grass and briars on the outside of this area, I do not think the yew grows from seed under its own shade.

The photographs (Plates 54, 55) will give a fair idea of the appearance of this wonderful grove, and of the walks which lead to it. Some of the trees have a remarkable spiral twist in them like fluted columns, which I have not seen so well developed elsewhere.

The soil on which they stand seems to be of a light sandy nature, but deep enough to grow large fine timber of other species, and is, I believe, on the Lower Greensand formation.

¹ Cf. *Guide to Midhurst*, p. 41 (Midhurst: G. Roydon (1903)).

Another and perhaps the largest pure yew-wood in England is on the downs three miles west of Downton, Wilts, on the property of the Earl of Radnor. It is known as "The Great Yews," and contains about 80 acres. The trees are not remarkable for their size, and appear to have been partly planted, as the largest are at regular intervals and of about the same age. Probably at a time when yew-wood was wanted for bow-making an existing wood was filled up with planted trees, and no doubt these yews could tell some striking tales. Mr. E. P. Squarey, who took me to see them, and who has seen little change in them during the last 60 years, pointed out one under which some tramps had been caught in the act of roasting a sheep they had stolen, and related various tragedies which had occurred in this wild district in bygone times.

"The Little Yews" is the name of another wood about half a mile from the "Great Yews," which, though not of such large extent, contains much finer trees, many being from 8 feet to 10 feet in girth and 50 feet high. As in other yew woods (at any rate where rabbits exist) I found few or no young trees coming up, and the mixture of beech, ash, oak, thorn, whitebeam, and holly trees which are found in the more open spaces all appear to be self-sown. Several of the largest trees have been recently blown down.

After the Midhurst and the Great and Little Yews, I think the Cherkley Court Yew Wood is the best in England; and, thanks to the kindness of A. Dixon, Esq., the owner, I am able to give some particulars of this interesting place, which Lowe thought to be the finest collection of yews in existence.

The wood covers an area of 50 to 60 acres in a shallow valley forming part of the old Ashurst estate, about three miles from Leatherhead in Surrey, on the east side of the old pilgrims' road to Canterbury. It was formerly a rabbit warren, but is now carefully preserved by Mr. Dixon. It is said that 500 yew trees were once sold out of this wood by Mr. Boxall for 10 guineas each, and these two facts will probably account for the fact that there are now scarcely any young trees coming up, and but few trees with straight, tall trunks. Their average height does not exceed about 40 feet, and the majority of them are not well-grown trees, but there are some of great girth, of which the best is called the Queen Yew, and measures 14 feet 6 inches at 1 foot from the ground; then swelling out in a peculiar way and measuring 20 feet 4 inches at about 4 feet. At this height it begins to branch, and though the main stem goes up some way, the whole tree is certainly under 50 feet in height.

One of the most curious trees in this grove, called the Cauliflower Yew, was figured in the *Gardeners' Chronicle*, and copied in Veitch's *Coniferae*, ed. ii. p. 128. This tree has now lost much of its beauty, owing to a heavy snowstorm which occurred in 1884 and which did serious damage to the Cherkley Yew Wood.

Another place of great interest to naturalists, where the yew is in great abundance, is Castle Eden Dene, in Durham, the property of Rowland Burdon, Esq. This locality is renowned among botanists as the last in England where the ladies' slipper orchid (*Cypripedium Calceolus*) still exists. It is a deep valley about 3 to 4 miles long, running down to the sea, and, in some places, has steep cliffs of a

peculiar magnesian limestone formation, which decomposes into a red loamy soil, on which yews grow very freely, though they do not attain anything like the size that they do in the south of England. The largest which I measured was only 8 feet in girth. What makes them so picturesque is the way in which their roots spread over the bare rocks, and the mixture of curiously gnarled wych elms which accompany them. All the foot-bridges are here made of yew wood, but it is not cut except for home use, and is not increasing by seed—again, I think, on account of the rabbits.

There is a remarkably fine yew walk at Hatherop Castle, Gloucestershire, the seat of G. Bazley, Esq., which is supposed to be about 300 years old, in which the trees average about 60 feet in height with a girth of 9 to 12 feet.

The yew in Harlington Churchyard, near Hounslow, Middlesex, was considered by Kirchner (*loc. cit.* 60) to be the tallest yew tree in Europe, viz., 17.4 metres (57 feet). Lowe, page 85, gives the height in 1895 as 80 feet, on the authority of the Rev. E. J. Haddon. Henry saw this yew in October 1895, and measured the height as 50 feet only, and this is correct, within a margin of error of less than 2 feet. This tree is 17 feet 3 inches in girth at the base, where the bole is narrowest; above this it swells and is very gnarled, and at 10 feet up it divides into two great limbs.

A celebrated yew stands in the churchyard at Crowhurst, in Surrey, and has been described by Lowe (p. 201) and figured by Clayton.¹

Crowhurst, in Sussex, has another great old tree of which much has been written, and which Low figures (p. 38).

One of the finest yews in England is the Darley yew, growing in the churchyard at Darley Dale, Derbyshire. From a work on Derbyshire Churches, by the Rev. J. C. Cox, M.A., which has been sent me by Messrs. Smith, the well-known nurserymen of Darley Dale, I abridge the following particulars of it:—The churchyard is celebrated for what is claimed to be the finest existing yew tree in England, or even in the United Kingdom. Rhodes, writing of it in 1817, says that the trunk for about 4 yards from the ground measures upwards of 34 feet in girth; but Lowe gives (p. 207) measurements taken by four different persons between 1836 and 1888, of which the largest is 34 feet 6 inches by Mr. Smith in 1879, and the most recent and exact by Mr. Paget Bowman in 1888, which gives 32 feet 3 inches at 4 feet from the ground. This gentleman cut from it with a trephine nine cylinders of wood on one horizontal line which show 33 to 66 rings per inch of radius, showing an average growth of an inch in 46 years. There is a cavity in the tree about half-way up one of the trunks which will hold seven or eight men standing upright. At the ground the girth is 27 feet, and at this point no increase has taken place for 52 years. The height is not given, but a photograph by Mr. Statham shows it as about 50 feet.

I have chosen the tree at Tisbury for illustration as a specimen of the churchyard yew, for though figured by Lowe, his plate gives a poor idea of its symmetry, and it is one of the largest healthy yews in England. Though difficult to measure on account of the young spray which its trunk throws out, I made it in 1903 to be

¹ *Trans. Bot. Soc. Edinburgh*, 1903, p. 408.

about 45 feet high by 35 in girth. The trunk is hollow, and has inside it a good-sized younger stem, probably formed by a root descending inside the hollow trunk from one of the limbs. It is a female tree, and of its age it is impossible to form a correct estimate. (Plate 35.)

At Kyre Park, Worcestershire, the residence of Mrs. Baldwyn Childe, is a very fine yew tree growing near the wonderful grove of oaks which I have described elsewhere; it measures 55 feet high by 20 in girth. Under it the Court Leet of the Manor was formerly held.

The most widespreading yew I have seen is a tree at Whittinghame, the seat of Mr. Arthur Balfour, which I measured in February 1905. It grows near the old tower, formerly the property of Sir Archibald Douglas, one of the conspirators of Darnley's murder, and, according to a local tradition, this was plotted under its shade. The tree is not remarkable for height or girth, the bole being only about 12 feet high and 10½ feet in girth, but spreads out into an immense drooping head, the branches descending to the ground and forming a complete circular cage or bower about 10 yards in diameter, inside which, Mr. Garrett, the gardener, told me that 300 school children had stood at once. The branches lie on the ground without rooting, so far as I could see, and spread so widely that I made the total circumference about 110 paces. Mr. Garrett, with a tape, made it 125 yards. The appearance of the tree from outside is fairly well shown in Plate 36.

Another tree of this character, but not so large, grows at Crom Castle, on upper Lough Erne, and is described in the *Ulster Journal of Archaeology* by Lord Erne.¹ It is said to resemble an enormous green mushroom in contour, and has evidently been a trained tree, its horizontal branches being supported on timber supports upheld by about 60 stout props. Its total height is given as 25 feet, with a bole of 6 feet and a girth of 12 feet, the branches being 250 feet in circumference.

Yew trees in a wild state do not, as a rule, grow so large as those which are planted, probably because they are usually in poor rocky soil and crowded by other trees; but Lord Moreton tells me of a remarkably fine one which was shown him by Mr. Roderick Mackenzie, son of the owner of Fawley Court, in a wood on the Greenlands property on the Chiltern Hills. He described the tree as of the most symmetrical growth, and he guessed it to be nearer 70 feet than 60 feet high, with a girth of about 12 feet.

YEW HEDGES AND TOPIARY WORK

The yew, owing to the readiness with which it submits to pruning, forms an admirable hedge, and an excellent account of the conditions necessary to success in the making and keeping up of yew hedges is given by Mr. J. Clark in recent issues of the *Garden*,² to which we refer our readers.

One of the oldest and finest yew hedges in Great Britain is that at Wrest Park,³

¹ *Cf. Loudon, loc. cit.* 2081.

² *Garden*, 1905, lxxvii. 54 and 136.

³ *Gard. Chron.* 1900, xxvii. 375.

which is said to be 350 years old. There is a very high one of semicircular form enclosing the approach to the front door of Earl Bathurst's house at Cirencester.

Others¹ occur at Pewsey in Wiltshire, Melbourne in Derbyshire, Holme Lacy near Hereford, Hadham in Hertford, Albury Park near Guildford, etc.

An interesting account of the use of yew in topiary work is given by Kent,¹ who gives two illustrations of the remarkable effects produced by this art at Elvaston Castle. Leven's Hall,² Westmoreland, is also noted for the extraordinary forms into which the yew has been forced to grow. In a recent work³ by Elgood and Jekyll pictures are given of several remarkable effects produced by the yew, notably the Yew Alley at Rockingham, the Yew Walk at Crathes, and the Yew Arbour at Lyde.

There are some remarkable clipped yews in the garden at Gwydyr Castle, in the valley of the Conway, a beautiful old place now belonging to Lord Carrington, which have been the subject of careful attention from Mr. Evans, the gardener, for forty years. The largest is in the form of an immense round-topped mushroom, 36 yards round and about 36 feet high, with a perfectly smooth, close, regular surface. In the west garden at the same place there is a double row of yews, eleven on each side, of the same form, but very much smaller.

TIMBER

Since foreign timber has almost entirely superseded home-grown wood, the remarkable qualities of this most durable and beautiful timber have been almost forgotten, though, if we may believe what Evelyn, Loudon, Walker, and other old authors tell us, it was formerly highly valued, not only for bow-making, but for all purposes where strength and durability, when exposed to wet, were required.

At the present time, though I have made many inquiries, I cannot find a cabinetmaker in London who knows or uses the wood; it is rarely to be found in timber yards, and I was told by one of the principal timber merchants in York that I was, in his forty years' experience, the first person who had ever asked for it. It has little or no selling value, and may be bought occasionally for about half the price of oak.

In various old houses, however, examples may be found of its use for furniture, panelling, and inlaying, which show what the wood is worth, when well selected and thoroughly seasoned, to people who do not mind a little trouble.

Evelyn says that for posts to be set in the ground and for everlasting axle-trees there is none to be compared to it, and that cabinetmakers and inlayers most gladly employ it.

Loudon quotes Varennes de Feuilles, who states that the wood, before it has been seasoned and when cut into veneers and immersed some months in pond water, will take a purple-violet colour.

¹ Veitch's *Man. Coniferae*, 137 (1900).

² *Gard. Chron.* 1874, p. 264.

³ *Some English Gardens*, pp. 34, 42, 107 (1904).

Dr. Walker¹ speaks of the yew as a tree which grows well in the shade of rocks and precipices, especially near the sea-shore. "No timber is planted in Scotland that gives so high a price as that of yew and laburnum." He mentions a yew that grew on a sea-cliff, in the small stormy island of Bernera near the Sound of Mull, which, when cut into logs, loaded a large six-oared boat, and afforded timber to form a fine staircase in the house of Lochnell.

Sir Charles Strickland tells me that yew wood which is occasionally dug up in the bogs and fens of East Yorkshire is of a pinkish grey colour, and the most beautiful English wood he knows, but the samples of it which Henry has procured in Ireland are much darker in colour.

Miss Edwards states that in the Pyrenees water vessels are made of yew wood, which have the property of keeping the water cool in hot weather, and that there is a flourishing manufacture of such vessels bound with brass hoops at Osse.

Marshall is quoted by Loudon to the effect that about 1796 yew trees at Boxhill were cut down and sold to cabinetmakers at high prices for inlaying, one tree being valued at £100, and half of it actually sold for £50. Boucher says that, from his own experience, bedsteads made of yew wood will not be approached by bugs. Mathieu² states that in France the wood is sought for by turners, sculptors, and makers of instruments and toys.

The thin straight shoots of the yew which are cut by gipsies in the south of England make most excellent whip sticks, lighter than, and quite as tough as holly. I believe that yew would also make first-rate handles for polo sticks and golf clubs, though makers of these articles do not as yet seem to have used it.

Boulger³ says that in the library of the India Office there is a Persian illuminated manuscript on thin sheets of yew, and it also makes very ornamental boards for bookbinding.

As an example of what can be done with yew wood, I may refer to Macquoid's *History of English Furniture*, where a coloured illustration (plate iv.) is given of an extremely handsome armchair in Hornby Castle, the property of the Duke of Leeds. Macquoid says:—"The date is about 1550. It is made of yew, which adds to its rarity, for up to this time it was practically penal to employ yew wood for any other purpose than the manufacture of the national weapon; in this instance the wood has become close, as hard as steel, and of a beautiful dark amber colour."

At Hatfield House, the historic mansion of the Marquess of Salisbury, the small drawing-room is panelled entirely with yew wood, the doors being also made of fine burry pieces, but the workmanship in this case is not perfect, and the colour of the wood has been spoilt by varnish.

At Dallam Tower, Westmoreland, the seat of Sir Maurice Bromley-Wilson, the staircase is made of yew wood grown on the property.

Trees are occasionally found in which the whole body of the log consists of small burry growths something like that of maple, and when this is mixed with contorted grain of various shades of pink the effect is very good. But such trees

¹ *Economical History of the Hebrides*, vol. ii. pp. 205, 240 (1812).

² *Flore Forestière*, 511 (1897).

³ *Wood*, 346 (1902).

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are even now so valuable that they are cut into veneer, and I have a magnificent specimen of such in a sheet 8 feet long by 18 to 20 inches wide which has been mounted for me as a table by Messrs. Marsh, Cribb, and Co. of Leeds.

The reason why it is neglected for all these purposes is apparently as follows:— The tree is usually grown in the form of a bush, and does not often become tall and straight enough to form clean timber. It is not usually planted close enough to become drawn up into clean poles, and is rarely felled except when in the way, or when it has become decayed and unsightly.

No tree is so deceptive in appearance as an old yew tree. Not only is it usually full of holes and shakes, but the heartwood is generally more or less unsound when over a foot in diameter. Some defects are usually present in an old yew tree, and even when clean and sound, the heartwood is not so good in colour as the younger wood or the slabs; and as the bark grows over and covers all these defects it is generally impossible to say how much, if any, of the timber of a large yew will be useful until it is sawn through the middle.

It seems to be soundest and best in colour when of moderate age and not over 12 to 18 inches in diameter, though the slabs from old trees of which the heartwood is pale, shaky, or faulty often show the finest and most twisted grain.

(H. J. E.)

CRYPTOMERIA

Cryptomeria, D. Don, *Trans. Linn. Soc.* xviii. 166 (1839); Bentham et Hooker, *Gen. Pl.* iii. 428 (1880); Masters, *Jour. Linn. Soc. (Bot.)* xxx. 23 (1893).

A GENUS with one very variable living species, in Eastern Asia, belonging to the tribe Taxodineæ of the order Coniferae.

A tree with evergreen leaves spirally arranged and decurrent on the shoots, which are only of one kind. Flowers monœcious. Male flowers: spike-like, sessile in the axils of the uppermost leaves of the branchlets, composed of numerous imbricated stamens, which have a pointed connective, and 3 to 5 pollen sacs. Female flowers: globular cones solitary and sessile on the tips of branchlets near to those on which the staminate flowers occur, composed of numerous bracts with free recurved pointed ends spirally imbricated in a continuous series with the leaves. Ovular scales, each bearing 3 to 5 ovules, united with the bracts for three-fourths of their length and dilated into roundish crenately-lobed extremities. Fruit: a globular brownish cone, ripening in the first year, but persisting on the tree after the escape of the seeds by the gaping apart of the scales till the next year or longer; scales about 20 to 30 in number, peltate, stalked with a disc dilated externally, which shows on its outer surface the recurved point of the bract (incorporated with the scale in its greater part), and on its upper margin 3 to 5 sharp-pointed rigid processes. The stalk-like portion of the scale bears on its inner side 2 to 5 seeds, which are ovate-oblong, somewhat triquetrous in section, and narrowly winged, with a mucro near the apex.

CRYPTOMERIA JAPONICA

Cryptomeria japonica, Don, *Trans. Linn. Soc. (Bot.)*, xviii. 167, tab. xiii. 1 (1839); Hooker, *Icon. Plant.* vii. 668 (1844); Siebold, *Flora Japonica*, ii. 43, tab. 124, 124b (1870); Kent in *Veitch's Man. Coniferæ*, 263 (1900); Shirasawa, *Iconographie des Essences Forestières du Japon*, text 24, tab. ix. 25-42 (1900); Mayr, *Fremdländische Wald- und Parkbäume*, 278 (1906).

A tall tree, attaining in Japan a height of 150 feet or more, and a girth of 20 to 25 feet, the trunk tapering from a broad base. Bark reddish brown, and peeling off in long, ribbon-like shreds. Leaves persistent for 4 or 5 years, arranged spirally on the shoots in five ranks, curving inwards and directed forwards, awl-shaped, tapering to a point, compressed laterally, keeled on front and back, bearing stomata on both sides, with the base decurrent on the branchlet to the insertion of the next leaf. The buds are minute, and composed of three minute leaves, which are free at the base, and not decurrent.

The male flowers are clustered at the ends of the branchlets in false racemes, the leaves in the axils of which they arise being reduced in size, and fulfilling the function of bracts. They appear on the tree in autumn and shed their pollen in early spring, remaining for some time afterwards in a withered state.

The buds of the female flowers are also to be seen in autumn terminating some of the branchlets, and covered externally with small, awl-shaped leaves.

The shoot¹ is frequently continued in the leafy state throughout the cone ("proliferation"), and the extended portion often grows to several inches in length beyond the cone, and even in some cases bears male catkins.

Woody excrescences² of a conical shape often develop on the stem, to which they are loosely connected. They correspond to the "wood-balls" which are found on beeches and cedars, and like these are due to abnormal development of dormant buds.

Seedling: the cotyledons, which are generally 3 in number, the occurrence of 2 only being rare, are carried above ground by an erect caulicle, about $\frac{1}{2}$ inch long, ending below in a primary root, which is reddish, flexuous, and about 3 inches long, giving off a few lateral fibres. The cotyledons are linear, flattened, obtuse, and about $\frac{1}{4}$ inch long; two, narrowed at the base, are prolonged on the caulicle as ribs; the other, sessile on a broad base, is not decurrent; all bear stomata on their upper surface. The first leaves on the stem are in a whorl of 3, similar in shape to the cotyledons, but longer and with slightly decurrent bases. The leaves following are inserted spirally on the stem, and are longer, sharper-pointed, and more decurrent. All are spreading, with stomata and a prominent median nerve on their lower surface. The stem, roughened by the leaf-bases, terminates above in a cluster of 5 to 6 leaves, crowded at their insertion and directed upwards.

¹ Remarkable instances of proliferous cones and other abnormalities are described and figured in *Rev. Horticole*, 1887, 392.

² Figured in *Gard. Chron.*, May 30, 1903, p. 352.

VARIETIES

There are at least two well-marked geographical forms, var. *japonica* and var. *Fortunei*, which will perhaps be ranked as distinct species, when the trees are studied in the wild state. Other varieties, which have probably arisen in cultivation, are distinguished by peculiarities of the foliage.

1. Var. *japonica*, the type described by Don from Japanese specimens collected by Thunberg.—This is the form which occurs wild in Japan. The tree is pyramidal in habit, with straight, spreading branches and short, stout, dark green leaves. The cones are composed of numerous scales, bearing long acuminate processes, and showing long points to the bracts, making the outer surface of the cone very spiny, especially towards the summit. There are generally 5 seeds to each scale.

2. Var. *Lobbii*.¹—Tree narrow, pyramidal in habit, with short branches densely ramified. The leaves are long and light green in colour. The cones are like those of the preceding variety, but with the processes and tips of the bracts even longer and more slender. This is perhaps a geographical form, occurring in Japan, where it was collected by Wright. It has certainly proved hardier than the Chinese variety both in this country and on the Continent.

3. Var. *Fortunei*² or *sinensis*.³—A tree diffuse in habit, with deflexed branches and long, slender branchlets. Leaves long and slender. Cones with fewer scales (about 20), which end in short processes, the tips of the bracts being of no great length, so that the whole cone looks much less spiny than that of the Japanese forms. Seeds fewer, often only 2 on a scale, but apparently indistinguishable from those of the Japanese trees. This is the form which occurs wild in China, and which was first introduced into this country. It was described by Sir W. J. Hooker⁴ from specimens gathered by Sir Everard Home in Chusan. The Chinese form ripens its seeds three weeks sooner at Dropmore than the var. *Lobbii*.

4. Var. *araucarioides*.⁵—Branches deflexed, with the branchlets long, pendulous, and very distantly placed. Leaves small, stout, stiff, and curving inwards at the top, dark green in colour. Cones as in var. *japonica*, of which this is only a slight variety. It is described as a shrub or low tree; but this may arise from its being propagated from cuttings. Large trees occur, of a similar habit, which seem, however, to be sports from var. *Fortunei*.

5. Var. *pungens*.⁶—Leaves straight, stiff, spreading, darker green, and more sharply pointed than in common forms. I have not seen cones; and the origin of this variety is not clearly known.

¹ Gordon, *Pinctum* (1858), p. 54.

² *Cryptomeria Fortunei*, Hooibrenk, *Wien. Jour. für Pflanzenkunde*, 1853, p. 22.

³ *Cryptomeria japonica*, var. *sinensis*, Siebold, *l.c.* 49.

⁴ Hooker, *loc. cit.* He points out the difference in the cones of the Chinese and Japanese trees, but says that they are undoubtedly one species. Bunbury, *Arboretum Notes*, 172, remarks that the cones of the Barton tree, from Chinese seed, are very different from Don's figure of Japanese cones.

⁵ Carrière, *Traité Gén. Conif.* (1867), p. 193.

⁶ *Hort.* A sub-variety of this, *pungens rubiginosa*, is mentioned in *Garden*, iii. 1873, p. 322. The leaves are said to assume a coppery or tawny red colour from August until April.

6. Var. *spiralis*.¹—A slender shrub, with leaves strongly falcate and twisted spirally by their free ends around the branchlets, which assume in consequence a corkscrew-like appearance. A specimen of this at Kew also bears some branchlets with normal leaves.

7. Var. *dacrydioides*.²—Leaves very closely set and very short (about $\frac{1}{4}$ inch long) There is a specimen at Kew of this form, gathered by Maries and said to be wild. It is probably a depauperate form, originating in rocky, barren, exposed ground.

8. Var. *nana*.³—A dwarf, procumbent, dense, spreading shrub, with short acicular needles, closely set on the rigid branchlets and directed outwards. This form attains only 3 or 4 feet in height, and very often bears monstrous fasciated twigs.

9. Some slightly variegated forms of *Cryptomeria* have appeared in cultivation; in one the tips of the branchlets are whitish; in another the leaves are yellowish in colour.

10. Var. *elegans*, Masters, *Jour. Linn. Soc. (Bot.)* xviii. 497 (1881); *Cryptomeria elegans*, Veitch, ex Henkel und Hochstetter, *Synopsis der Nadelhölzer*, 269 (1865).—A fixed seedling form. The juvenile foliage is retained throughout the life of the tree, which bears the same relation to the type as *Retinospora squarrosa* does to *Cupressus pisifera*. It agrees in cones and in the anatomical structure of the leaves with the typical form.

In habit this is rather a large bush than a tree. The leaves, while spirally arranged on the shoot as in the ordinary form, spread outwards and are not directed upwards. They are decurrent on the branchlets, linear, flattened, curving downwards, sharp-pointed, grooved on the middle on both surfaces, and are light green in colour, changing in late autumn and winter to a reddish bronze colour, which gives the tree a remarkable and handsome appearance. There is a dwarf form of this variety, *Cryptomeria elegans nana*, which is a low, dense bush with crowded leaves, changing in colour in the autumn like the ordinary variety, except that the pendulous tips of the branchlets remain green.

The origin of this remarkable form is obscure. In Japan, according to Siebold, it is known as *to-sugi*, i.e. "Chinese *Cryptomeria*," and is said to have been introduced from China. Kaempfer mentions a *nankin-sugi*, introduced into Japan from China, cultivated on account of its beauty, which is possibly this variety.

Cryptomeria elegans was introduced from Japan to England in 1861 by John Gould Veitch.⁴ The largest specimen we know occurs at Fota; it is 42 feet high by 4 feet 9 inches in girth. In Cornwall this variety grows to a great size, the tops of the trees often bending down under the weight of their branches and foliage; and the outer lower branches commonly take root and grow into independent trees, which form a colony round the parent stem.⁵

At Tregothnan there is a very fine example (Plate 37) which measures 35 feet by 4 feet 6 inches, and at Killerton there is another almost equal in size. In the

¹ Siebold, *loc. cit.* 32.

² Carrière, *Traité Gén. Conif.* (1867), p. 193.

³ Knight, *Syn. Conif.* (1850), p. 22.

⁴ Veitch, *Man. Conifera*, 1st ed. 218 (1881): "Met with only in cultivation in neighbourhood of Yokohama."

⁵ *Jour. Hort. Soc.* xiv. (1892), p. 30.

pinetum at Cowdray this form also grows very well, and it is perfectly hardy at Colesborne and in Yorkshire. At Poltalloch in Argyllshire it also attains large dimensions.

IDENTIFICATION

Cryptomeria resembles *Sequoia* and *Araucaria Cunninghami* in having leaves which are spirally arranged and markedly decurrent on the shoots. The awl-shaped leaves of *Araucaria Cunninghami* strongly resemble those of the ordinary forms of *Cryptomeria*; but in the former they always end in bristle-like points, whereas in the latter they taper to a blunt point. The subulate leaves of *Sequoia gigantea* are closely appressed to the shoots in three ranks, with only their upper half free; whereas in *Cryptomeria* they are in five ranks, and are free from the shoots for the greater part of their length.

INTRODUCTION

The tree is said by Siebold¹ to have been introduced into St. Petersburg by the overland route through Siberia, several years before Fortune sent it to England. The credit of the introduction into England is, however, due to Captain Sir Everard Home,² who sent seeds to Kew from Chusan in 1842. Several seedlings were raised at Kew, which were kept in a greenhouse till 1847, and were then planted out; but they never did well. One planted near the rockery was living in 1880, when it measured 26 feet high by 2 feet 3 inches in girth; and another stood for some years near the main entrance. Both these trees have been cut down, and there do not appear to be any survivors of the first importation now at Kew or elsewhere. Fortune introduced the tree in quantity in 1844, when he sent seeds, apparently gathered in Chekiang, from Shanghai to the Horticultural Society. The first tree planted in France was at Chaverney in 1844, and the second at Angers in 1847. All the old trees in this country and on the Continent are from Fortune's seeds, and belong consequently to the Chinese form.

The variety *Lobbii* was introduced by Thomas Lobb in 1853 from the Botanic Garden of Buitzenborg in Java, where it had been sent from Japan in 1825 by Siebold.³ It differs only slightly from the ordinary Japanese form. Siebold⁴ states that he introduced the typical Japanese form into Leyden in 1861. John Gould Veitch introduced several kinds of *Cryptomeria*, as the result of his visit to Japan in 1860; but I have not been able to identify these, and according to H. J. Veitch,⁵ the typical Japanese form was first introduced by Maries in 1879. Probably there are no trees of this kind in England older than this date. The introduction of variety *elegans* has been already given above. (A. H.)

DISTRIBUTION IN CHINA

Cryptomeria was discovered in China in 1701 by J. Cunningham, who found it in

¹ Siebold, *loc. cit.* 48.

² John Smith, *Records of Kew Gardens* (1880), p. 289; Sir W. J. Hooker, *Guide to Kew Gardens*, 1847, p. 28, 1850, p. 14.

³ Siebold, *loc. cit.* 48.

⁴ *Ibid.* 51.

⁵ *Jour. Hort. Soc.* xiv. (1892), 30.

the island of Chusan, off the coast of Chekiang. His specimens, three in number, are preserved in the British Museum, and a branch with cones was figured both by Petiver¹ and Plukenet.² A few years previously, probably in 1692, it had been found in Japan by Kaempfer,³ whose specimen also is kept in the British Museum; and Thunberg⁴ obtained specimens in Japan, the material on which Don founded his description of the genus. It was collected in China at different times by Sonnerat,⁵ Millett,⁶ and Sir Everard Home;⁷ but we owe to Fortune the only account of importance of the tree in the wild state in China.

Fortune⁸ saw the tree for the first time in the plain of Shanghai in 1843, where it is planted in cemeteries and temple-grounds, and grows to a great size, the poles which are set up in front of temples and mandarins' offices being often of *Cryptomeria*. In 1844 he found it growing wild in the mountains south-west of Ningpo, where it forms dense woods with *Cunninghamia* and other trees. It is met with in the Chekiang mountains even at high elevations—the finest specimens seen by Fortune occurring in the Bohea hills, which he crossed in 1849. He was particularly struck with a fine solitary tree, at least 120 feet in height, which stood near the gate in the pass of the high range which separates the Chekiang and the Fukien provinces. At Ningpo the junks are mostly built of the timber of this tree.

Cryptomeria was also collected by Swinhoe⁹ in the country inland from Amoy, and by Père David in the interior of Fukien, where, he says,¹⁰ it is a beautiful tree, becoming rare in the wild state, but existing still in the mountains at moderate elevations.

Specimens¹¹ have been collected in other parts of China, but always, I believe, from planted trees. In Yunnan I only met with two trees, one (18 feet in girth) near a temple, and the other near a village. *Cryptomeria* apparently only occurs wild in China in the mountains of the Chekiang and Fokien provinces, between 25° and 29° N. lat., but may be found elsewhere when the interior of the country is better explored. In its native home in China the tree is subject to severe cold in winter, but the spring arrives suddenly with no late frosts, and the summer is much warmer than in England. In China the tree is called *kuan-yin-sha* ("goddess of mercy fir") in Yunnan, *kung-ch'io-sung* ("peacock-pine") in Szechuan, and *sha* ("fir") simply in Chekiang, where it shares the name with *Cunninghamia*, the timber of both trees being much used in the construction of houses and boats.

CRYPTOMERIA IN JAPAN

Both from an ornamental and economic point of view this is the most important

¹ Petiver, *Gazophylacium Naturæ et Artis* (1702), tab. 6, fig. 3, "*Cupressus chusanensis*, *Abietis folio*, from Chusan"; and *Phil. Trans.* xxiii. (1703), p. 1421, No. 70.

² Plukenet, *Amaltheni Botanicum* (1705), text 69, tab. 386, fig. 3.

³ *Amenitates Exotica* (1722) p. 883. Kaempfer's figure is published in *Icon. Kaempferi* (1791), t. 48.

⁴ *Flora Japonica*, 265 (1784).

⁵ In 1776. Lamarck, *Ency. Bot.* ii. 244.

⁶ Collected at Macao, where the tree is only planted. Hook, *Jc. Plant.* vii. t. 668 (1844).

⁷ Sir Everard Home collected specimens (British Museum and Kew) in Chusan and near Woosung, and his notes say "from trees near tombs and joss-houses."

⁸ Fortune, *Residence among the Chinese* (1857), pp. 145, 184, 189, 256, 277, 412.

⁹ Specimen at Kew.

¹⁰ *Plantæ Davidianæ*, i. 291 (1884).

¹¹ By Anderson, near Momi in Yunnan, and by Dr. Faber, on Mount Omei in Szechuan.

tree of Japan, as it is also the largest, and though it is now difficult to say how far its natural distribution extends, it has been planted everywhere from such a remote period, and grows so rapidly that it is now the most conspicuous tree in all those parts of Japan which I visited except in the island of Hokkaido.¹

I saw it wild in the primeval forests which cover the mountains on the frontier of the provinces of Akita and Aomori in the extreme north, near a station called Jimba, at an elevation of about 1000 feet, where the lower edge of the forests and more accessible valleys have already been denuded of their best timber. The Japanese Government have lately made a good road up one of the valleys, which enabled me to see the forest at its best under the guidance of their obliging foresters. The hills are here very steep, often with a slope of 30° to 40°, and covered on the north-east aspects with an almost pure growth of *Cryptomeria*, and though on the south-west aspects a few deciduous trees, such as maple, magnolia, oak, chestnut, and *Æsculus* were mixed with it, I saw no other conifer. This forest is not truly virgin, because from time to time trees have been cut for shingles and tub staves, which are made in the forest and carried out on men's backs as usual in the remoter parts of Japan. But in many places it was quite dense, and the undergrowth consisted largely of ferns, *Aucuba*, *Skimmia*, *Hydrangea*, and a variety of other shrubs, and tall, rank-growing herbaceous plants such as *Spiræa* and *Rodgersia podophylla*.

The trees average in size 100 to 110 feet high by 2 to 3 feet in diameter, and are clean for half their length or more, in the denser parts of the forest. The largest trees which have been felled here do not exceed about 100 feet in timber length and about 4 feet diameter. The rings of one of 5 feet in girth which I measured showed 116 years' growth, of which about 87 were red heart-wood. Another close by was very flat-sided, measuring 3 feet 9 inches in diameter one way, and only 2 feet 9 inches the other, the centre on that side being only 1 foot from the nearest point of the bark. This tree was about 136 years old, over 100 years growth being red heart-wood.

Many trees were more or less curved at the butt, and many others forked low down into two, three, or more stems. There were plenty of cones on the trees which had sufficient light, but a careful search did not discover a single self-sown seedling, all the young trees which were coming up—and those not numerous—being evidently suckers or growths from the stool. The dense layer of coarse, sour humus and half-decayed leaves and branches form a bed in which the seedling after germination cannot take root, but on the railway banks and other exposed surfaces not overgrown by dense grass young seedlings appeared and grew freely. Many of these trees had large climbers, such as *Vitis Coignetæ*, *Schizophragma*, and *Wistaria*, growing nearly to their tops. Plate 38, taken from a negative kindly given me by the Japanese Imperial Forest Department, shows the appearance of this forest. Plate 39 A, from the same source, shows a mature forest of *Cryptomeria* in the island of Shikoku. Plate 39 B shows the trunk of the tree and the manner of felling still adopted in Japan, *cf.* p. 137.

The forester told me that the system adopted in this forest, now that it is

¹ Mayr quotes Dr. Honda for the fact that the most southern locality where it grows wild is in the island of Yakushima, the northernmost of the Riu-Kiu islands, where in a dense forest at a high elevation it forms immense trunks.

accessible, would be clean felling, followed by replanting as soon as possible, in the same manner as is generally adopted in the south of Japan.

I could not learn the exact range of *Cryptomeria* as a wild tree,¹ but in the north, where the winter is long and hard, and the snow lies deep for months, it prefers the shady aspect, though it does not attain the same gigantic proportions as it does farther south.

Nikko is approached by a magnificent avenue of *Cryptomerias* on both sides of the road, 20 miles long, known more or less imperfectly by every visitor to that place, but which can only be properly appreciated by going some way east of Imaichi station, to the point where the trees in good soil attain their greatest dimensions. I took a photographer here specially to take the picture reproduced, and measured the finest trees I could find, of which the tallest was about 145 feet high, and the average 110 to 120 feet, with a girth of 12 to 20 feet on the better soils. Many of the trees have been planted so close together that they have now grown into one tree. The one which I figure (Plate 40) is composed of six stems, which measure 21 feet in greatest diameter, and about 60 in girth. Cf. Sargent, *Forest Flora of Japan*, p. 75.

The age of these trees, of which many have been blown down by recent gales and some felled, is, as near as I could count the rings of wood, 260 to 270 years, of which over 200 is red wood. The bark is not over $\frac{1}{2}$ to $\frac{3}{4}$ inch thick, and though some of the trees were beginning to decay at the heart, others were quite sound. The soil is generally a rich black humus overlying a yellow tufaceous volcanic gravel, and the influence of bad soil on the trees is seen very clearly at a point about three miles east of Imaichi, where the road crosses a low ridge of dry and sandy soil, and where they are not more than 80 to 90 feet high by 6 to 8 feet girth.

At the celebrated temples of Nikko there are larger trees than any that I saw in the avenue. The best—shown in Plate 41—is about 150 feet high by 23 feet in girth, but I could not measure the height exactly on account of its position. They are said to be about 300 years old, being probably older than those in the avenue, and seem mostly in perfect health on a slope facing south where the soil is evidently deep and good.

But these magnificent trees are quite eclipsed by those which I saw later at the celebrated monastery town of Koyasan, in the province of Kishu, not nearly so well known to European tourists as it should be. The magnificent cemetery at this place is over a mile long, and planted as an irregular avenue with many lateral annexes—each of which was in the past the private burying ground of great families—with *Cryptomeria* trees which are said to be 400 years old, and which, I believe, surpass in grandeur any other trees planted by man in the world. They grow at an elevation of about 2800 feet, in a climate which is much milder, and gives evidence of a much heavier rainfall than that at Nikko; for many of the trees had shrubs growing on them as epiphytes on their trunks. In one case a tree of *Cupressus obtusa* has its stem, 6 to 8 inches thick, completely embedded in the trunk of a sound and

¹ In *Forestry of Japan*, p. 18, it is only said that splendid natural pure woods of it occur in the Nagakizawa State forests in Akita, and in Yakujima in the island of Kyushu, which I had not time to visit, but whether there is any notable difference between the trees in these distinct areas, separated by nearly ten degrees of latitude, is not stated, so far as I can find. According to Shirasawa (*loc. cit.*) fossil *Cryptomeria* trees of great dimensions have been found in nearly all parts of Japan.

healthy *Cryptomeria*, from whose sap alone it must now be deriving its sole nourishment, as no decaying wood is visible, and it is about 20 feet from the ground. The shape of the trees here is more picturesque and less regular than at Nikko, some having spreading branches quite near the ground; the best of these measured 133 feet by 19 feet 3 inches, with a spread of 25 yards.

The finest trees in the cemetery, and probably the finest in existence, stand on the right at its extreme end, close to an enclosure, just before reaching the large barn-like temple called "Mandoro," or hall of ten thousand lamps, which is itself surrounded and backed up by a grove of superb trees standing very thickly together. Of the trees on the right just before reaching the temple one had previously been measured by Prof. Honda of Tokyo University, who made it 58 metres high. I made it 180 feet with a girth of 24 feet. But though this may be the tallest it is not so fine a timber tree as the one standing just beyond it, which does not swell so much at the ground, but carries its girth higher up and is cleaner. This tree is broken off at about 150 feet, but seems quite vigorous, and certainly contains 2000 feet or more of sound timber.¹

So far I have spoken only of the *Cryptomeria* in a wild state and as an ornamental tree, but it is also planted very largely in many parts of Japan for timber, and forms a most profitable source of revenue to many of the smaller landowners and farmers as well as to the State. Its cultivation has attained a maximum in the district of Yoshino in the province of Yamato, and from *The Forestry and Forest Products of Japan*, published at Tokyo in 1904, we learn that this cultivation dates back 400 years, and covers as much as 38 per cent of the whole area of the district, of which no less than 93 per cent is forest land. The inhabitants have probably brought the art of profitable timber growing to a higher point of perfection than any other people in the world, no less than 85 per cent of the local male population consisting of woodmen, sawyers, timber carriers, and foresters. The quantity of *Cryptomeria* timber alone exported from Yoshino amounted in the year 1902 to 8,857,000 cubic feet, valued (I presume locally) at 1,695,000 yen, equal to about £175,000 sterling.

The trees are planted out at three years old after being twice transplanted in the nursery, where they are raised from seed and kept shaded during the first year. This, at least, is the rule in the Kisogawa district, though I was told that in the south *Cryptomerias* are more cheaply and quickly raised from cuttings, and that these produce as good trees as seedlings.

About 4000 per acre are usually planted, and weeded once or twice a year for three years, when they suppress the weeds by their shade. The plantations grow very fast, and are pruned from the eighth to the twenty-third year after planting out. Thinning is done at the earliest at twelve years, and the thinnings form such a profitable source of revenue that income is probably returned quicker by such a *Cryptomeria* plantation than by any other tree. The final felling takes place at about 120 years old, when as many as 180 trees, containing 15,000 cubic feet, may be found on an acre. The previous thinnings are estimated at 16,000 cubic feet, making the total product per acre in 120 years over 30,000 feet. This result, which

¹ Mayr, however, states that he measured a tree at Takaosan which attained 68 metres (over 200 feet) in height by 2 in diameter.

appears astonishing, is perhaps exceptional, but all the plantations I saw gave evidence of extremely rapid growth, and showed a larger proportion of clean useful poles and timber than any plantations which I have seen in other countries.¹

TIMBER

The wood is used for almost every purpose in Japan, but especially for tubs, staves, and building. Though not as valuable as the best wood of *Cupressus obtusa* for high-class buildings and internal work, it is, when properly selected, sawn, and planed, highly ornamental both in colour and grain, easy to work, durable, and strong enough for most purposes. It has also a most agreeable odour due to the presence of a volatile oil called *sugiol* by Kimoto,² who gives an analysis of it, and states that the wood on this account is used for making *saké* casks, the *saké* acquiring a peculiar pleasant aroma.

It varies very much in colour and figure, the most valuable being the wide planks—sometimes 3 to 4 feet wide and over—which are used for doors, ceilings, and partitions in the best houses. The darkest in colour comes from the southern island of Kiusiu, and is known as *Satsuma sugi*. When it shows a very fine red grain in old gnarled butts it is known as *Ozura-moko*, the best of this colour being very valuable. There is also a grey-coloured variety known as *Gindai sugi*, which appears to be taken from trees which have died before felling, but I could not get very definite information on this point.

The finest example I know of the ornamental use of *Cryptomeria* wood is the ceiling of the large dining-room in Kanaya's Hotel at Nikko, which is composed of panels about 30 inches square, cut from the butts of trees which show very curly and intricate graining, and without polish have a natural lustrous gloss. The Japanese never paint or varnish the wood in their houses inside or out, and attach more importance than European builders do to its quality, colour, and figuring. It seems very strange that none of the numerous travellers and writers on Japan have, so far as I can learn, as yet paid any attention to the beauty of the Japanese timbers. As a rule *Cryptomeria* is spoken of by English-speaking Japanese and Europeans as cedar, but *sugi* is the native name.

The bark of the tree is also largely used, when taken off in large sheets, for covering outbuildings of secondary importance, but does not appear to be so much valued or so durable as the bark of *Cupressus obtusa*, *Thujaopsis dolabrata*, or *Sciadopitys verticillata*. An ounce of the seed contains about 50,000 seeds. For raising trees to plant in the colder parts of Europe I should certainly prefer seed from the natural forests of the north to what is grown in the subtropical climate of South and Central Japan, and I should therefore warn anyone wishing to plant this tree largely to be very careful about the origin of the seed or plants.

The value of this wood varies considerably in Japan according to locality and

¹ Tables of Production and Rate of Growth in Japan are given by Honda in *Bull. Coll. Agric. Tokyo Imp. Univ.* ii. 335 (1894-1899).

² *Bull. Coll. Agric. Tokyo Imp. Univ.* iv. 403 (1900-1902).

quality, but about 80 yen per 100 cubic feet, equal to about 1s. 8d. per foot, is the price in Tokyo, and selected half-inch boards for ceilings and panellings cost from 2s. to 4s. each.

Rein, in *Industries of Japan*, p. 226, speaks of a *Cryptomeria* which he measured in 1874 having at $1\frac{1}{2}$ metres high a girth of 9.41 metres, equal to about 30 feet. This grew on the Sasa-no-yama-toge, between Tokyo and Kofu, at about 750 metres above sea level.

Weston, in *The Alps of Japan*, mentions trees high up on the eastern side of the pass between Nakatsugawa and the Ina-kaido, called the Misaka-tōge, on the northern slope of Ena-San, which measured at 3 feet from the ground no less than 26 feet in girth. It would not be supposed possible that in a country where neither machinery nor horse-power is used for the removal of timber such large trees could be utilised, but the Japanese are very ingenious in the handling of large logs in their mountain forests.

I was presented by Baron Kiyoura, Minister of Agriculture, with a most curious and interesting series of sketches, which I found in the Imperial Bureau of Forestry, showing the means adopted for felling and transporting large timber growing in rocky gorges and the most inaccessible situations. These I exhibited at a meeting of the Scottish Arboricultural Society at Edinburgh on 10th February 1905.

The *modus operandi* is as follows:—First men climb up the trees and lop off all the large branches, so that the tree may not lodge among its standing neighbours when felled. Ropes are then attached to the trunk and carried round a windlass, so that it may be pulled over in the right direction.

When the tree is felled it is cut into suitable lengths, often 20 to 30 feet long, and a hole cut in the end, to which a stout rope is attached. By this it is sometimes dragged, sometimes lowered, to the nearest slide, which is built up of smaller timber. Or, if the locality is too distant from a slide or from a stream large enough to float it, a platform is built on the mountain-side, on which it is sawn into boards, which are carried out of the forest on men's backs, or on sledges on the snow.

A most ingenious plan, which I have seen in no other country, is adopted where the slope of the mountain is too steep to let a log slide at its own pace.

The slide is built in a zig-zag form, and at each angle a bank is made and covered with earth and bark to check the impetus of the log, whose upper end when so checked is reversed by means of a strong pole laid across the slide, and then goes downwards till it reaches the next angle, where it is again checked and reversed by its own weight.

To see a large gang of men, all singing in chorus at their work, moving timber in a mountain forest under the direction of their foremen, is one of the most interesting sights I beheld in Japan, and I could not sufficiently admire the pluck, activity, and ingenuity they showed in the very dangerous and difficult work which is necessary when logs get jammed, as they often do in these rapid mountain torrents; and when men, standing on small rafts fastened to boulders in a roaring rapid, or let down from above by ropes, have to dislodge the logs from where they have stuck fast.

Cryptomeria japonica yields in Japan a turpentine or semi-solid resin, named *sugi-no-janai*, which was shown at the Edinburgh Forestry Exhibition. This resin, which is very aromatic, is used as incense in Buddhist temples, and as a plaster for wounds and ulcers.

CULTIVATION

The tree ripens seeds in good summers in the south of England, which are easy to raise, and the seedlings grow rapidly after the first year. Seeds which I gathered in 1900 from a tree at Stratton Park, Hants, the seat of the Earl of Northbrook, and sowed in the open ground, germinated at the end of April, whilst others sown in a pot on Christmas Day and kept in a greenhouse, germinated on 17th April, and grew much better than those sown in the open. Some of the young trees planted out at two years old are now (January 1905) 3 to 4 feet high, and have not suffered at all from the spring frosts.¹

The seedlings are easy to transplant, and might be raised in nurseries at a lower rate than many trees, though they should have some protection for the first two or three years, and if kept in pots the roots should not be allowed to become cramped, and if twisted round the bottom of the pot should be carefully spread when planted out. The tree may also be propagated from cuttings, and this plan is sometimes adopted in Japan, as being cheaper and quicker than raising seedlings, but except in the case of varieties, should not be adopted if tall, straight trees are desired. I have seen in the garden of Mr. Chambers at Grayswood, near Hazlemere, Sussex, a self-sown *Cryptomeria* which had germinated in a chink of the garden steps, and which is now growing at Colesborne, and I have no doubt that others might be found in suitable situations, as Mr. Bartlett has lately found a seedling at Pencarrow, Cornwall, growing at the base of the parent tree. *Cryptomeria* seems to be more adaptable to various kinds of soil than many exotic trees, and does not mind a moderate amount of lime, but loves a situation well sheltered from cold winds, and a soil deep enough and light enough to keep its roots moist during summer. I have not seen it grow well on heavy clay, where it suffers from spring frost. If timber and not ornament is the object, I should plant it about 10 feet apart, alternate with some fast-growing conifer, such as common larch or spruce, which might be cut out when the trees became too crowded.

Mayr² considers that in warm, damp parts of Europe the *Cryptomeria* may probably be planted profitably as a timber tree in sheltered valleys and in good soil, but recommends the mixture of other trees as nurses wherever the winter temperature is low, and says that alders are preferred by the Japanese for this purpose. He says that a plantation of this tree in East Friesland had attained 12 metres in height and 23 centimetres in diameter; and on the island of Mainau, on Lake Constance, he measured, in 1897, a tree which was 18 metres high and 40 centimetres in diameter.

¹ But the severe frosts of May and October 1905 have injured several and killed some of the weakest of these seedlings.

² *Fremdländische Wald- und Parkbäume*, p. 285.

REMARKABLE TREES

The finest specimens of *Cryptomeria* known to us in England are at Hempsted, the seat of the Earl of Cranbrook, in Kent, which Lord Medway thinks were planted before 1850. They grow in a sheltered situation on a greensand formation, and the largest exceeds *Sequoia sempervirens*, planted near it, in height. I made it 80 feet by 8 feet, and another tree 72 feet by 8 feet 2 inches. Both are symmetrical, and seem to be growing fast (Plate 42).

At Pencarrow, in Cornwall, a number of trees were planted by Sir W. Molesworth in 1848-9, and have thriven very well, though the soil is not very favourable. Mr. Bartlett informs us that the tallest of them, which grows on a dry, steep, stony bank, crowded by other trees, is now 68 feet by 5 feet 6 inches. The largest, on moister soil, is 62 feet by 8 feet. Six other trees, planted in 1875, vary from 48 feet by 5 feet down to 33 feet by 4 feet 3 inches. At this elevation, 450 feet, there is often snow, and the thermometer sometimes falls to 12° and 14°.

At Castlehill, in North Devon, the late Earl Fortescue planted many *Cryptomerias*, but though they have grown well, they are mostly rather bushy than tall trees, and may have been raised from cuttings. One of them, which was 8 feet in girth and only 40 feet high, was covered with burr-like excrescences as much as 8 inches long.

At St. George's Hill, near Byfleet, growing on Bagshot sand on the highest part of the hill, surrounded by pines, is a tree 64 feet by 5 feet 5 inches.

At Kitlands,¹ near Leith Hill, Surrey, there is a large *Cryptomeria*, planted by the late D. D. Heath, Esq., the branches of which have taken root and formed a grove, whose branches in turn root outside.

There is a fine tree at Killerton, which in 1902 was about 75 feet high, by 6 feet 5 inches in girth, though owing to its situation it was difficult to photograph or to measure exactly. A tree at Bicton is nearly equal to it in height and girth. At Eastnor Castle, Worcestershire, the property of Lady Henry Somerset, there is a tree 65 feet high by 5 feet 10 inches in girth.

At Fonthill Abbey, Wilts, the seat of Lady Octavia Shaw-Stewart, there is a beautiful tree 67 feet high by 9 feet 3 inches in girth. At the entrance gate of Rufford Abbey, Notts, the seat of Lord Savile, there is a fine tree about 62 feet high.

At Dropmore a large tree, planted in 1847, was cut down in 1904,² and measured 68 feet 6 inches by 5 feet 9 inches. Though it seemed in perfect health, Mr. Page informed me that the heart was partly decayed. There are still three good specimens at Dropmore—two of the Chinese kind, planted in 1847, which measure (February 1905) 64 feet by 5 feet 6 inches, and 62 feet by 6 feet 7 inches; the third, var. *Lobbii*, planted in 1853, is 74 feet high by 4 feet 7 inches in girth. These measurements were kindly sent by Mr. Page.

At Barton, Suffolk, one, planted in 1848, was found by Henry in 1904 to be

¹ Nisbet in *Victorian Surrey County History*, ii. 575 (1905).

² *Gard. Chron.* Jan. 21, 1905, p. 44. This tree was reported to be 41 feet high in 1868 (*l.c.* 1868, p. 464).

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63 feet by 5 feet 3 inches, and proves that the tree will thrive on good soil even in the east of England.

At Williamstrip Park, Gloucestershire, the seat of Lord St. Aldwyn, there is a tree 45 feet by 5 feet, probably one of the first introduced.

At Penrhyn, North Wales, there is a fine tree, 64 feet by 5 feet 5 inches.

The best example I know of the growth of *Cryptomeria* as a forest tree is at Tan-y-bwlch, in Merionethshire, the property of W. E. Oakeley, Esq., where a large number of seedlings were raised about 40 years ago from a tree which is now 62 by 6 feet, and has apparently not grown much lately.

The best of its progeny, growing on a slate formation where rhododendrons flourish exceedingly, near sea level, is already 53 by 4½ feet, and many others average about 40 by 3½ feet. Some are growing among beech and oak, others in a plantation of larch and Corsican pine facing north. In the latter the average girth of 8 trees was 3½ feet, whilst larch of the same age was little over 2 feet, and Corsican pine about the same. Mr. Richards, forester to Lord Penrhyn, who saw this plantation shortly after it was made, agreed with me that its success would amply justify planting *Cryptomeria* on a large scale in North and West Wales in sheltered places on good land up to about 300 feet above the sea. But, judging from a large board sent me by Sir John Llewellyn, grown in South Wales, the timber is much lighter and softer than it is in Japan, and perhaps will not be equal for outside work to that of Douglas fir grown on similar land.

At Dynevor Park, in Caermarthenshire, the seat of Lord Dynevor, there are some well-grown trees, the tallest of which is 56 feet by 6 feet 10 inches.

At Belshill, Northumberland, the property of Sir W. Church, there is a tree 50 feet by 4 feet 8 inches, which is about 50 years old and quite healthy.

In Scotland the tree seems quite hardy, and at Keir, the seat of A. Stirling, Esq., a tree planted in 1851 has increased from 42½ feet in 1892 to 52 feet by 8 feet girth in 1905. It has the trunk covered with burrs. At Castle Kennedy, the seat of the Earl of Stair, there is a tree 56 feet by 6 feet 1 inch.

In Ireland there are several fine trees. At Coollattin, Wicklow, the property of Earl Fitzwilliam, a tree measured 63 feet high by 6 feet in girth in 1906. At Woodstock, Kilkenny, a tree of the variety *Lobbii*, which was planted by Miss Tighe in 1857, is now (1904) 67 feet high by 6 feet 7 inches in girth. Close by this tree is a wonderful group of *Cryptomerias*, which have been produced by natural layering. The parent tree in the centre is about 50 feet high, and around it are over 20 trees, with straight stems, which are themselves layering, so that in course of time a grove may be produced.

At Fota there are many examples of *Cryptomeria* and its varieties. The form *spiralis* is about 15 feet high. The variety *araucarioides* is 31 feet by 3 feet 8 inches in girth, very compact in habit. *Elegans* is 42 feet by 4 feet 9 inches. The variety *Fortunei* measures 72 feet high, with a girth of 8 feet, a beautiful pyramidal tree, displaying the stem below with its characteristic stringy bark. This tree was planted in 1847.

(H. J. E.)

PYRUS

Pyrus, Linnæus, *Gen. Pl.* 145 (1737); Bentham et Hooker, *Gen. Pl.* i. 626 (1865).

Malus, Ruppert, *Fl. Jen.* ed. 3, 141 (1745); and Medicus, *Phil. Bot.* i. 138 (1789).

Sorbus, Linnæus, *Gen. Pl.* 144 (1737).

TREES and shrubs belonging to the sub-order Pomaceæ of the order Rosaceæ. Branchlets of two kinds, long and short shoots, the flowers in certain species being borne on the latter only. Leaves deciduous, alternate, stalked, simple or pinnate; stipules deciduous. Flowers in cymes or corymbs, regular, perigynous or epigynous, calyx-lobes 5, petals 5. The receptacle (the end of the axis) is hollowed out, the ovary being attached to its interior. A disc is present, either annular or coating the receptacle. Ovary with 2 to 5 cells, each cell containing 2 ovules. Fruit, a pome, the external fleshy part being formed of the receptacle, while the interior or core is the developed ovary; cells 2 to 5, with a membranous or cartilaginous endocarp, each containing 1 or 2 seeds, though occasionally some are empty.

The genus *Pyrus* has been divided variously into sections, which some botanists treat as distinct genera. The following arrangement is perhaps the simplest:—

A. Leaf in the bud rolled inwards towards the midrib.

1. **Pyrophorum.** Flowers in corymbs on spur-like branchlets, ovary with 5 cells, styles free. Fruit pyriform or hollowed out at the base, flesh granular. Leaves simple. Pears: confined to Asia and Europe.
2. **Malus.** Flowers fascicled or umbellate on spurs, ovary with 3 to 5 cells, styles united at the base. Fruit with a cavity at the base, flesh homogeneous. Leaves simple. Apples: species in North America as well as in Europe and Asia.
3. **Aronia.** Flowers in terminal corymbs, ovary with 4 to 5 cells, styles free or united at the base. Fruit small, not hollowed at the base, endocarp very thin, flesh almost homogeneous. Leaves simple, crenate, with the midrib glandular on its upper side. Two North American shrubs.

B. Leaf folded in the bud. Flowers in terminal corymbs.

4. **Hahnia.** Ovary with 2 to 3 cells, styles united below. Fruit crowned by the calyx, and having a hard, almost bony endocarp, flesh granular. Leaves simple, lobed. *Pyrus torminalis*, the only species.

5. **Sorbus.** Ovary with 3 or 5 cells, styles free. Fruit crowned by the calyx, endocarp membranous or coriaceous. Leaves pinnate. Includes two subsections:—

Aucuparia, with 3-celled ovary and small globular fruit, and
Cormus, with 5-celled ovary and large pear- or apple-shaped fruit.

6. **Aria.** Ovary with 2 to 5 cells, styles free. Fruit crowned by the calyx, endocarp membranous, flesh granular. Leaves simple. Includes the whitebeam and its allies.
7. **Micromeles.** Ovary with 2 to 3 cells. Fruit small, globose, umbilicate, endocarp membranous or coriaceous, calyx-lobes deciduous. Leaves simple. Includes several Asiatic species.

SYNOPSIS OF THE PRINCIPAL SPECIES IN CULTIVATION EXCLUSIVE OF
PEARS AND APPLES.

(Cf. Plates 43-45, where leaves of most of the species are shown.)

- I. *Leaves regularly pinnate, the leaflets being separate and never decurrent by their bases on the rhachis.*

A. **Aucuparia.** Mountain ashes. Leaflets unequal-sided at the base. Fruit small, not exceeding $\frac{1}{3}$ inch.

(1-3) *Winter buds white-tomentose.*

1. **Pyrus Aucuparia**, Gaertner. Europe, Northern Asia, Japan. Young branchlets and leaves pubescent, adult leaves glabrous or only slightly pubescent beneath. The common mountain ash.
2. **Pyrus lanuginosa**, DC. South-eastern Europe. Only differs from the preceding in the adult leaves being densely woolly beneath.
3. **Pyrus thianschanica**, Regel. Chinese Turkestan. Young branchlets and leaves glabrous; adult leaves quite glabrous beneath and conspicuously veined on the upper surface.

(4-5) *Winter buds shining, glutinous, glabrous or sparingly pubescent, the pubescence appressed and of a rusty colour.*

4. **Pyrus americana**, Torrey and Gray. North America. Leaflets long, narrow, acuminate, glabrous beneath.
5. **Pyrus sambucifolia**, Chamisso and Schlechtendal. Manchuria, North-East Asia, Japan, North America. Leaflets broader than in No. 4, obtuse or acute (not acuminate), more or less pubescent beneath.

B. **Cormus.** True Service. Leaflets nearly equal sided at the base. Fruit large, $\frac{1}{2}$ inch diameter or more.

6. **Pyrus Sorbus**, Gaertner. Central and Southern Europe. Winter buds greenish, viscid, pubescent only at the tip; under surface of the leaves slightly pubescent in spring, soon becoming glabrous.

II. *Leaves pinnate, but upper 3 or 5 leaflets coalesced or decurrent by their bases on the rhachis.*¹

7. **Pyrus Aucuparia**, Gaertner, var. **satureifolia**, Koch. A hybrid. Differs from the common form in the coalescence into one large segment of the 3 upper leaflets; leaflets glabrous beneath.

8. **Pyrus Aucuparia**, Gaertner, var. **decurrens**, Koehne (*Pyrus lanuginosa*, Hort. non DC.) A hybrid. Upper leaflets decurrent on the rhachis by broad bases, often the upper 3 or 5 coalescing into one segment; leaflets tomentose beneath.

III. *Leaflets pinnate or deeply cut at the base, with 1-4 pairs of segments, the upper part of the leaf lobed or serrate; leaves very variable in shape.*¹

9. **Pyrus hybrida**, Moench. A shrub of hybrid origin. Main axis of the leaf glandular above, under surface of the leaf sparingly pubescent, the parents being *Pyrus aucuparia* and *Pyrus arbutifolia*.

10. **Pyrus pinnatifida**, Ehrhart. A hybrid. Axis of the leaf without glands, under surface densely grey tomentose.

IV. *Leaves simple, lobed.*

A. *Under surface of the leaf glabrous, or nearly so, light green in colour.*

11. **Pyrus torminalis**, Ehrhart. Europe, Algeria, Asia Minor, and the Caucasus.

B. *Under surface of the leaf grey tomentose.*

12. **Pyrus cratægifolia**, Savi. Italy. Leaves small, resembling those of a hawthorn, on each side 4-6 triangular-ovate toothed lobes.

13. **Pyrus latifolia**, Boswell Syme. Britain, France, Spain, Central Europe. Leaves broad-oval with a wide base; lobes decreasing from below upwards, small triangular, separated by sinuses, which form a right angle and are not narrowed. In some forms the lobes are mucronate, in others cuspidate; and, in var. *decipiens*, the outline of the leaf is like *intermedia*, but the lobing is different.

14. **Pyrus intermedia**, Ehrhart. Europe. Leaves elliptic, with a usually narrow base, lobes decreasing from below upwards, rounded, mucronate, separated by narrow sinuses, which are very acute or almost closed at their bases. This includes several forms:—

Mougeoti. Leaves with 9-12 pairs of nerves, lobes shallow.

¹ These two sections comprise hybrids, the leaves of which vary in shape, not only on different individual trees, but often also on a branch. Hybrid origin may always be suspected when such variation is observed, or when the lobing or cutting is irregular and not symmetrical.

Scandica. Leaves with 7-9 pairs of nerves, lobes deep, with sharp teeth.

Minima. Leaves with 5-7 pairs of nerves, smaller and narrower than in the preceding varieties.

Certain forms of *Pyrus pinnatifida* closely resemble *scandica*, but the lobing in these will be found always irregular and often very deep.

15. ***Pyrus lanata***, D. Don. Himalayas. Leaves large, broad oblong, woolly underneath, nerves 12-15 pairs, lobes regularly serrate.

C. *Under surface of the leaves, which are orbicular in outline, snowy-white tomentose.*

16. ***Pyrus Aria***, Ehrhart, var. *flabellifolia*. Greece. Leaves with 3-5 pairs of nerves.

17. ***Pyrus Aria***, Ehrhart, var. *græca*. Greece, Asia Minor. Leaves with 6-10 pairs of nerves.

V. *Leaves simple, not lobed, and only occasionally obscurely lobulate.*

A. **Aronia.** *Leaves finely serrate in margin, with glands on the upper surface of the midrib.* This section comprises 2 North American species and a hybrid of garden origin, small shrubs, only referred to here to prevent their being confused with other species of *Pyrus*.

18. ***Pyrus arbutifolia***, Linnæus fil. North America. Leaves beneath whitish grey tomentose, with about 6 pairs of nerves directed forwards at a very acute angle.

19. ***Pyrus alpina***, Willdenow. A hybrid between *Pyrus Aria* and the preceding species. Leaves densely grey tomentose beneath, with 9-10 pairs of nerves directed outwards at an angle of 45°.

20. ***Pyrus nigra***, Sargent. North America. Leaves glabrous beneath or very slightly pubescent.

B. *Leaves without glands on the midrib.*

(21-22) *Leaves glabrous beneath.* These 2 species, of which the first is a shrub and the other a small tree, are only referred to here to distinguish them from other species.

21. ***Pyrus Chamæmespilus***, Linnæus. Vosges, Jura, Alps, Pyrenees. Leaves sessile or nearly so, elliptic, with 6-8 pairs of nerves.

22. ***Pyrus alnifolia***, Franchet and Savatier. Japan and China. Leaves stalked, broadly ovate, with 9-12 pairs of nerves.

(23-26) *Leaves white pubescent beneath.*

23. ***Pyrus Aria***, Ehrhart. Europe, Caucasus, Siberia, Central China. Leaves oval or elliptic with very slight lobules or only doubly-toothed, the teeth or lobules diminishing in size from above downwards; nerves 7-12 pairs, very prominent on the lower surface, pubescence snowy white.

24. ***Pyrus Aria***, Ehrhart, var. *rupicola*. British Isles (Europe?) Leaves obovate-oblong (broadest above the middle), lobulate above, the lobules and teeth acute, nerves 5-9 pairs, pubescence at first as white as in the type, but ultimately becoming greyer.

25. ***Pyrus Aria***, Ehrhart, var. *Decaisneana*. Origin unknown. Leaves large, elliptic, or oblong, with margin serrated almost uniformly, nerves 12-15 pairs.

26. ***Pyrus Hostii***, Hort. A hybrid. Leaves like 23, but with very sharp, irregular teeth and tomentum *thin*, white to greyish white.

(27) *Leaves grey, densely-woolly pubescent beneath.*

27. ***Pyrus vestita***, Wallich. Himalayas. Leaves very large, elliptic, serrate, and occasionally obscurely lobulate in margin; nerves 15-18 pairs.

As many of the species mentioned above are merely shrubs or very small trees, they do not fall within the scope of our work. For this reason, *Pyrus hybrida*, *cratægifolia*, *Chamæmespilus*, *alnifolia*, and the three species of the section Aronia, will not be further referred to. *Pyrus Hostii*, a hybrid of inconstant origin, will be briefly mentioned in connection with *Pyrus Aria*.

Pyrus Aucuparia and its allies will be dealt with in a subsequent part.

The two following species are not known to us to attain timber size in cultivation in the British Isles; but Mr. H. C. Baker tells us that at Chilternhouse, near Thame, there is a specimen of *P. vestita* 50 feet by 6 feet 5 inches.

PYRUS LANATA, DON.¹

Known in gardens as *Sorbus majestica*. A tree of the eastern temperate Himalayas; leaves large, oval, oboval, or broadly oblong, with serrate lobes, glabrous above when adult except for some pubescence along the midrib, greyish woolly beneath. Flowers white in densely woolly corymbs; petals glabrous within; styles 2 to 5, free, densely tomentose. Fruit large, about an inch in diameter ($\frac{1}{2}$ to $1\frac{1}{2}$ in.), narrowed to the base, red, edible. Judging from wild specimens the foliage is very variable; and the cultivated specimen at Kew bears leaves (figured in Plate 43), which differ from those of wild trees in being less deeply lobed.

PYRUS VESTITA, WALL.²

Often known in gardens as *Sorbus nepalensis* or *Sorbus magnifica*. A tree of the temperate Himalayas from Garwhal to Sikkim. Leaves (*cf.* Plate 43) very large, ovate-acute or elliptic, lobulate-serrate, densely covered with white wool when they first appear, but later in the season becoming shining green and glabrous above, remaining densely woolly beneath. Flowers in very woolly corymbs; petals woolly within; styles 3-5, tomentose only at the base. Fruit large, about $\frac{3}{4}$ inch in diameter, globose.

¹ Don, *Prodromus*, 237 (1825). Hook., *Fl. Brit. Ind.* ii. 375 (1879).

² Wallich, *Catalogue*, 679 (1828). Hook., *Fl. Brit. Ind.* ii. 375 (1879).

PYRUS SORBUS, TRUE SERVICE¹

Pyrus Sorbus, Gaertner,² *De Fruct.* ii. 43, t. 87 (1791), Loudon, *Arb. et Frut. Brit.* ii. 921 (1838).

Pyrus domestica, Ehrhart,² "Plantag," 20, ex *Beiträge zur Naturkunde*, vi. 95 (1791); Smith, *Eng. Bot.* t. 550 (1796).

Sorbus domestica, Linnæus, *Sp. Pl.* 477 (1753).

Cormus domestica, Spach, *Hist. Vég. Phan.* ii. 97 (1834).

A tree, attaining a height of 60 to 80 feet. Bark, like that of the common pear, dark brown, fissuring longitudinally, and scaling off in narrow, rectangular plates. Leaves pinnate: 6 to 9 pairs of sessile leaflets and a terminal stalked leaflet. Leaflets linear oblong, almost equal-sided at the base, and acute at the apex, serrate with acuminate teeth, except towards the base where they are entire; dull green above, paler below, glabrous on both surfaces when mature, some pubescence often, however, remaining underneath. Flowers white, in short pubescent corymbs; styles 5, united at the base and woolly in their whole length. Fruit either pear- or apple-shaped, generally green, tinted with red on one side, 5-celled, about an inch in diameter.

The fruit apparently varies much in flavour, but in good varieties is agreeable though astringent. The French proverb, *Ils ne mangent que les cormes*, applied to destitute persons, would indicate that the fruit was poor; and this is doubtless often the case. In parts of France a perry is made from them, and they are also preserved dry like prunes. At Vevay³ in Switzerland there are avenues planted, consisting of service trees of various kinds; and the brilliancy of the fruit and of the hues of the foliage in October give a very fine effect.

VARIETIES

Two well-marked forms occur, one *maliformis*,⁴ with apple-shaped fruit, the other *pyriformis*,⁴ with pear-shaped fruit. There would seem, however, to be in France, though little known to planters in general, varieties which produce fruit of a superior kind. Two of these are strongly recommended by a writer in the Journal of the French National Horticultural Society: ⁵ one discovered on the estate of M. Dufresne, near Bordeaux, which has large pyriform fruits of a carmine yellow, produced in large bunches and excellent in flavour, as soon as they commence to mellow; the other was also found growing wild in woods belonging to M. Lafitte at Agen, which has fruit of a bright pink colour.

¹ *Service* is commonly derived from the Latin *cerevisia*, a drink said to have been formerly made of berries of the different species of Sorbus, or to have been flavoured with their leaves. C. Woolley Dod controverts this view in *Gard. Chron.* 1890, vii. 87, and holds that *service* is simply a corruption of *sorbus*, and that *cerevisia*, a drink, according to Pliny, made of cereal grain in Gaul, was ordinary malt ale.

² Gaertner's and Ehrhart's names were both published in the same year. Gaertner's preface antedates that of Ehrhart by a few days. Nothing is known for certain of the pamphlet "Plantag" cited by Ehrhart. Which name has priority of publication is uncertain.

³ *Woods and Forests*, July 16, 1884.

⁴ Loddiges, *Catalogue*, ex Loudon, *loc. cit.*

⁵ Quoted in *Garden*, 1886, xxx. 89.

IDENTIFICATION

In summer the tree is only liable to be confused with the mountain ash and its allies. The bark is, however, different, being rough, scaly, and dark-coloured in the true service tree, smooth and grey in *Pyrus Aucuparia*, etc. In *Pyrus Sorbus* the leaflets at the base are practically symmetrical, and their serration is very acute. Buds if present are the best distinction, as explained below.¹ In winter *Pyrus Sorbus* is distinguished by the following characters, shown in Plate 45:—

Twigs: long shoots glabrous, round; leaf-scars, crescentic with 5 bundle dots, set parallel to the twig on projecting cushions. Terminal buds larger, side buds coming off at an acute angle; all ovoid, densely viscid, shining, generally pubescent at the tip. Bud scales few in number, greenish, sometimes reddened, viscid, quite glabrous, the margin without cilia. Short shoots ringed, glabrous, ending in a terminal bud. The viscid greenish buds, 5-dotted leaf-scars, and rough scaly bark, distinguish this species from other kinds of Pyrus.

DISTRIBUTION

The Service tree is largely cultivated in central and southern Europe; and in many places, where it is recorded as wild, is really only an escape from cultivation. It is met with in the forests of France which rest upon limestone; but in the north and east it does not produce fruit every year, and is doubtfully wild except in the south and west. Willkomm considers it to be wild in the southern parts of the Austrian empire (Dalmatia, Croatia, Banat, Carniola, and South Tyrol), in the valley of the Moselle, in the Jura and Switzerland; also in southern Europe and Algeria. In France it is occasionally met with as a standard in coppiced woods.

Mouillefert says that the tree may live to be 500 or 600 years old, and that it was uninjured by the severe frost of 1879-80, when the thermometer fell to -25° Reaumur. He says, also, that it prefers a rich calcareous soil, but will grow on sand if not too dry. (A. H.)

REMARKABLE TREES

Pyrus Sorbus is not a native of Britain, though a single specimen which grew in a remote part of Wyre Forest in Worcestershire was long considered to give it a claim to be introduced into the British flora. This tree was mentioned in the *Philosophical Transactions*² as long ago as 1678 by Mr. Pitt, who says that he found it in the preceding year as a rarity growing wild in a forest of Worcester, and identifies it with the *Sorbus pyriformis* of L'Obelius, a tree not noticed by any preceding writer as a native of England. Pitt says nothing about the size of the tree, merely observing: "It resembles the Ornus or quicken tree, only the Ornus bears the flower

¹ The stipules of the various species of the section Sorbus differ considerably in shape, as shown in Plate 43; but they are usually quickly deciduous, and can only assist identification in spring.

² *Phil. Trans.*, abridged edition, ii. 434 (1809).

and fruit at the end, this on the sides of the branch. Next the sun, the fruit has a dark red flush, and is about the size of a small jeneting pear. In September, so rough as to be ready to strangle one. But being then gathered and kept till October, they eat as well as any medlar."

Ray's account¹ in 1724 is as follows: "The true Service or Sorb. It hath been observed to grow wild in many places in the mountainous part of Cornwall by that ingenious young gentleman, Walter Moyle, Esq., in company with Mr. Stevens of that county. I suspect this to be the tree called *Sorbus pyriformis*, found by Mr. Pitt, alderman of Worcester, in a forest of that county, and said to grow wild in many places of the morelands in Staffordshire by Dr. Plot, *Hist. Nat. Stafford*, 208." In modern times the tree has, however, never been found wild in any part of Cornwall or Stafford, and probably it was confused with *Pyrus latifolia*.²

Nash,³ in 1781, refers to the tree in the Wyre forest as occurring "in the eastern part of Aka or Rock parish, about a mile from Mopson's Cross, between that and Dowles Brook, in the middle of a thick wood belonging to Mr. Baldwyn, which I suppose to be the *Sorbus sativa pyriformis*, mentioned by Mr. Pitt in the *Philosophical Transactions for 1678*, called by the common people the Quicken pear tree." This tree was figured by Loudon,⁴ t. 644, from a drawing sent him by the Earl of Mountmorris. The Rev. Josiah Lee, rector of the Far Forest, told Mrs. Woodward that the old inhabitants of the district, where it was called the "Whitty Pear tree," used to hang pieces of the bark round their necks as a charm to cure a sore throat. Lee's *Botany of Worcestershire*, 4, gives a good figure of this tree "from a sketch taken many years ago," and another as it appeared in 1856; and says that in 1853 it was in a very decrepit state, producing a little fruit at its very summit. It was burnt down in 1862, by a fire kindled at its base by a vagrant. In a note Lees says that he thinks the tree must have been brought from Aquitaine and planted beside a hermitage in the forest, of which no trace is left but a mound of stones overgrown by brambles. He found the privet and *Prunus domestica* occurring near it, and nowhere else in the forest.

A seedling (Plate 46) from the Wyre forest tree is growing on the lawn at Arley Castle, near Bewdley, formerly the property of Lord Mountmorris, now the residence of Mr. R. Woodward. I measured it in 1903, when it was 55 feet high by 7 feet 4 inches in girth, and quite healthy, though a large hole in the trunk has been filled with cement. A few seedlings have been raised from it at Arley, but grow very slowly.

There is a large healthy tree in the park at Ribston Hall, Wetherby, the seat of Major Dent, of the pyriform variety, which in 1906 I found to be about 65 feet high by 9 feet in girth, and bearing fruit. This tree was probably brought from France by the same Sir. H. Goodricke who sowed the original Ribston pippin in 1709.

¹ Ray, *Synopsis Methodica*, ed. 3, p. 542.

² Miller, *Gard. Dict.* iii. ed. (1737), under *Sorbus sativa*, says, "The manured service was formerly said to be growing wild in England; but this I believe to be a mistake, for several curious persons have strictly searched those places where it was mentioned to grow, and could not find it; nor could they learn from the inhabitants of those countries that any such tree had ever grown there."

³ *History of Worcestershire*, i. 11.

⁴ Loudon gives the measurements in 1838 as 45 feet high, with a diameter of trunk at a foot from the ground of 1 foot 9 inches, and states that it was in a state of decay at that time.

At Croome Court, the seat of the Earl of Coventry, there are two good-sized trees in the shrubbery, one of which is 59 feet high and 6 feet 2 inches in girth. The other, with a clean stem, about 50 feet by 7, is beginning to decay.¹ Lady Coventry told me that the fruit, which is only produced in good seasons, makes excellent jam when fully ripe, but some seeds which she was good enough to send me did not germinate.

Loudon mentions a tree at Melbury Court, Dorsetshire, estimated to be 200 years old, and 82 feet high, with a diameter of 3 feet 4 inches, growing in dry loam on sand. If this was really a true sorb, it must have been the largest on record, but I learn from the gardener at Melbury that it has long been dead.

There are two good-sized trees at Painshill, and another at Syon which Henry found to be 44 feet high and 6 feet 9 inches in girth, but on this heavy soil the tree does not seem to be so long lived, and is dying at the top.

In the Botanic Gardens at Oxford are two well-shaped trees of this species, which were laden with fruit in 1905, and supposed to have been planted by Dr. John Sibthorp, who was Professor of Botany in 1784-95. The largest measures about 50 feet by 5 feet, and is of the maliform variety. Its fruit, which ripens and falls about the middle of October, is very sweet and pleasant to eat, much better than medlars, whilst the fruit of the other, which is the pyriform variety, does not turn red, is smaller, and ripens later. I have raised seedlings from both of these trees.

In the Cambridge Botanic Garden there is a tree with very upright branches, which measured, in 1906, 42 feet by 3 feet 4 inches.

At Tortworth there is a healthy, well-shaped tree, not more than 40 years planted, which is about 40 feet by 5 feet 11 inches. This is in a rather exposed situation, and it had no fruit in 1905.

At Woodstock, Co. Kilkenny, Ireland, there is a tree which seems to be the largest now living in this country. Henry measured it in 1904 and found it 77 feet high by 10 feet 8 inches in girth, with a bole dividing into three stems at 10 feet from the ground and bearing fruit.

TIMBER

A large tree was blown down at Claremont Park, Surrey, the seat of H.R.H. the Duchess of Connaught, in 1902, which I am assured by Mr. Burrell, the gardener there, was a sorb.² Its trunk was sent to Mr. Snell of Esher, to whom I am indebted for two fine planks of its wood. These show a very hard, heavy, compact surface of a pinkish brown colour with a fine wavy grain, which takes an excellent polish, and this wood has been used with beautiful effect in the framing

¹ Loudon speaks of a tree at Croome 45 years planted, and 80 feet high, which is possibly the same, but his measurements are very unreliable.

² "Among interesting trees to be found at Claremont is a good specimen of the pear-shaped service, carrying a heavy crop of fruit. It is rather over 60 feet high and 7 feet 6 inches in girth at 2 feet from the ground." Note by E. B. in *Garden*, 1883, xxiv. 422. Mr. E. Burrell gives a fuller account of the Claremont trees in the same journal, 1888, xxxiii. 154, in which he states that he thinks the variety *maliformis* does not increase in height after it gets to be about 30 feet high, whereas *pyriformis* at Claremont is close on 70 feet high.

of a brown oak chest, made for me by Messrs. Marsh, Cribb, and Co., of Leeds. Mouillefert says it is one of the hardest and most valuable woods grown in France, and is especially sought for by engravers, carvers, turners, and gun-makers. It seems to be difficult both to propagate and to grow, at least in its youth, and Loudon says that though it may be grafted on the pear or the mountain ash, it is one of the most difficult trees to graft, and that it will not layer successfully, and that it grows very slowly from seed, not attaining more than 1 foot high in four years. Seeds¹ sown in autumn germinate in the following spring. The young seedling has two oval entire-margined cotyledons, and attains about 4 inches in height in the first year's growth. Plants may be had from the French nurserymen. Mr. Weale, of Liverpool, reports as follows on a sample of this wood which I sent him:—"The wood is close and homogeneous in texture, tough, but inclined to be brittle. Rays on transverse section invisible, and rings only to be distinguished by the difference in colour of the spring and autumn wood. Harder than whitebeam, seasons well, without warping or splitting, and with little shrinkage. A reliable wood when thoroughly dry."

(H. J. E.)

¹ Mathieu, *Flore Forestière*, 184 (1897).

PYRUS TORMINALIS, WILD SERVICE

Pyrus torminalis, Ehrhart, "Plantag." xxii. ex *Beit. zur Naturkunde*, vi. 92 (1791); Loudon, *Arb. et Frut. Brit.* ii. 913 (1838); Conwentz, *Beob. über Seltene Waldbäume in West Preussen*, 3 (1895).
Crataegus torminalis, Linnæus, *Sp. Pl.* 476 (1753).
Sorbus torminalis, Crantz, *Stirp. Austr.*, ed. 2, fasc. ii. 85 (1767).
Torminaria Clusii, Roemer, *Synopsis*, iii. 130 (1847).

A tree, attaining exceptionally a height of 80 feet, but more generally only reaching 40 or 50 feet. Bark smooth and grey at first, but after fifteen or twenty years of age scaling off in thin plates, and ultimately becoming fissured. Leaves long-stalked, broadly oval, nearly as broad as long, with a cordate or truncate base and an acute apex; with 6-10 triangular acuminate serrate lobes; shining and glabrous above, obscurely pubescent beneath; nerves pinnate, 5-8 pairs. Flowers white in corymbs. Styles 2, glabrous, united for the greater part of their length. Fruit ovoid, brownish when ripe, with warty lenticels, vinous in taste when in a state of incipient decay; cut across transversely it shows a ring of white hardened tissue, forming a mesocarp around the core.

The leaves are generally described as glabrous on the under surface, but in all specimens traces of pubescence may be observed, which is much more marked on coppice shoots and epicormic branches.

VARIETIES

None have been obtained in cultivation so far as we know, and wild trees vary very little in any of their characters. A variety, *pinnatifida*, with the lobing of the leaves very deep, is described by Boissier,¹ from specimens occurring in Asia Minor and Roumelia.

IDENTIFICATION

The leaves in summer are unmistakable (see Plate 44), and can only be confounded with certain forms of *Pyrus latifolia*; but in the latter species the under surface of the leaf is always plainly grey tomentose, and the lobes are much shorter than in *P. torminalis*. In winter the following characters, shown in Plate 45, are available.

Twigs: long shoots, glabrous, shining, somewhat angled, with numerous lenticels; leaf-scar semicircular with 3 bundle traces, set parallel to the twig on a greenish cushion. Buds almost globular, terminal larger, side-buds nearly appressed to the twig; scales green with a narrow brown margin, glabrous, with the apex double-notched. Short shoots slightly ringed, glabrous, ending in a terminal bud.

(A. H.)

¹ *Flora Orientalis*, ii. 659 (1872.)

DISTRIBUTION

The most complete and recent account of the tree is a monograph cited above with maps by Prof. H. Conwentz, who describes at great length the various places where the tree is found and the conditions under which it grows. It is widely distributed throughout most of the woods and forests of Europe, but does not occur in Scandinavia, Holland, or the greater part of Russia, where it is only met with in the southern provinces. It also occurs in the Caucasus, Asia Minor, Syria, and in Algeria. It is found on most geological formations, including granite in the Vosges, gneiss in Siberia, and basalt in Austria; and it prefers a soil rich in humus. Willkomm says that on mountains it is commoner on limestone than on other soils, but the French foresters say that it is practically met with on all soils that are not very dry or very wet. It is a tree of the lowlands and hills, attaining 700 metres altitude near Zurich, 1200 in Herzegovina, and 1900 in the Caucasus. It occurs more or less rarely over all parts of Germany, especially in the north-east, and it attains its maximum size in the royal forest of Osche in West Prussia. The largest tree known to Conwentz was "25 metres high, with a clean stem of 12 metres, and a girth at 1 metre from the ground of 2 metres." The age of this tree was estimated from the rings in the broken trunk of another tree at 235 years.

The scarcity of the tree, as a rule, cannot be accounted for by any deficiency in reproductive powers, for the fruit is produced in some abundance in good years; and being eaten by many birds and animals, among which the waxwing chatterer, the nutcracker, and the fieldfare are mentioned, the seeds must be widely dispersed, while the freedom with which the roots produced suckers is remarked upon.

The timber seems to be much more highly valued in Germany than here, from 18 to 52 marks per cubic metre being given for it, according to quality, in places where hornbeam is only worth 11 marks. It is very hard and durable, and takes a fine polish like that of maple.

In the Hartz mountains and Thuringia it is known as "Atlasholz," and is much used and valued for furniture making.

The fruit is not so much valued as formerly, when it was sold in Prague and Vienna in the winter at the market, and also in Wurtemberg, under the names of Häspele, Arlesbeere, or Adlsbeere.

Conwentz says that the Latin name *torminalis* was derived from the Latin word *tormina*, and given on account of the properties of the fruit, to which one of its names in England, "gripping service tree," also has reference.

In Upper Alsace a spirit is distilled from the fruit, which tastes something like Kirschwasser.

DISTRIBUTION AND REMARKABLE TREES IN ENGLAND

Pyrus torminalis does not occur as a wild tree, and is rarely planted in Ireland, Scotland, or the North of England. Its range is from Anglesea and Nottingham southwards. It is known as the service or gripping service tree; and in Kent and

Sussex the fruit is called chequers. It is found in woods, copses, and hedgerows, usually on loam or clay, but does not seem to grow on sandy soils. It attains its greatest size in the Midland counties, where it reaches a height of from 50 to 70 feet. It never seems to be gregarious, and though it reproduces itself by seed or suckers, yet being usually looked on as underwood and not allowed to grow up to its full size, does not attract notice, and is unknown except to the most observant woodmen, even in districts where it occurs. In the vale of Gloucester, on the Earl of Ducie's property, there are probably thirty or forty trees of it scattered over a considerable area. The tallest of these, though not the thickest, is in Daniel's Wood, and is figured (Plate 47). This tree was 62 feet by 5 feet 1 inch in 1904, and is still growing vigorously among other trees and underwood. Not far off is another which may grow to as fine a tree.

In the Cotswold Hills the tree is very rare. I only know a single decaying specimen of moderate size in Chedworth Wood, close to the road leading from Withington to Chedworth Downs.

On Ashampstead Common, in Berks, I found one about 65 feet high and 8 feet in girth, crowded among other trees, which had produced a few suckers. At Rickmansworth Park, Herts, are two fine trees growing together by a pond, which are probably planted (Plate 48), and which Henry measured in 1904, when they were 65 feet by 8 feet 3 inches, and 63 feet by 9 feet 1 inch respectively. The largest specimen known to me is at Walcot, Shropshire, growing on a bank in good soil with a wych elm crowding it on one side, but probably planted. It measures as nearly as I could estimate about 80 feet high, and is no less than 8 feet 9 inches in girth.

At Cobham Hall, Kent, a tree planted beside a pond measured 55 feet high by 4½ feet in 1906.

In the woods in Worcestershire, as I am informed by Mr. Woodward, it is not uncommon, but is not looked upon as of any value. There is a tree at Arley 5 feet 1 inch in girth. In Wychwood Forest, Oxon, now nearly all destroyed, I am informed by Mr. R. Claridge Druce, of Oxford, the tree was formerly common enough for its fruit to be collected and sold in Witney market under the name of service berries.

In Cornbury Park, and in the remains of the forest outside it, there are at least six good-sized trees surviving. Of these the largest, just outside the park wall on the south side, is 65 to 70 feet high by 6 feet 6 inches in girth, a well-shaped, vigorous tree, which on 16th October 1905 was covered with unripe fruit. Another, also outside the park, is about 50 feet by 6 feet 10 inches, with a fine clean bole 12 to 14 feet long. I saw no suckers or seedlings near these trees.

In the woods and coppices north and north-east of London, and in Herts, the tree is not unfrequent on clay soil, and Pryor¹ gives several localities for it.

In Epping Forest, Mr. E. N. Buxton tells me that he does not know of more than thirty trees on an area of 3000 acres, growing on heavy gravelly clay. The largest in his grounds is 40 to 50 feet high.

¹ *Flora of Hertfordshire*, 154 (1887).

In Sussex, Sir E. Loder knows it as an uncommon hedgerow tree of no great size, and Mr. Stephenson Clarke, of Borde Hill, also tells me that it occurs there, and more commonly in the Isle of Wight, where, in Bridlesford Copse, Woolton, a wood of about 200 acres, are perhaps two dozen old trees, which differ in appearance from the Sussex ones in assuming a somewhat pendulous habit of branching when well grown. I find no mention of the occurrence of the tree in the New Forest, and the Hon. G. W. Lascelles does not know it there.

We have no record of *Pyrus torminalis* as a planted tree in Scotland, except that the Rev. Dr. Landsborough¹ notes a tree in vigorous health in Bellfield Avenue, Kilmarnock, which was 2 feet 9 inches in girth in 1893. He calls it the English service tree or table rowan, and adds that, in spite of its Latin name, the fruit is pleasant. In Ireland the tree is very rare. Henry saw, however, a fine specimen in 1903, at Adare, Limerick, which measured 53 feet by 5 feet 10 inches.

The fruit is ripe late in October, when it falls, if not previously eaten by birds, and the seeds, which only seem to mature in warm summers, should be sown at once, or kept in sand exposed to the weather and sown in spring, when they will germinate the next year. Seedlings raised by me from seed gathered at Les Barres, France, which were sown 7th July 1902, germinated 9th March 1903, and were on 14th October 1904 1 to 2 feet high. The leaves turn a reddish yellow in autumn, when the tree is decidedly ornamental, though, on account of its slow growth, it does not seem to have any value as a forest tree, and is rarely procurable from nurserymen in this country.

TIMBER

Pyrus torminalis is unknown as a timber tree in the trade owing to its scarcity, and is mentioned by Boulger² only as "a small tree, sometimes 30 feet high, with wood practically identical in character and uses with that of the rowan." Stone does not mention it at all, and Marshall Ward, in his edition of Laslett, says nothing worth quoting.

I am indebted to Mr. Stephenson Clarke for a log of the timber, which resembles that of the whitebeam tree, being hard, heavy, and, according to Loudon, weighing, when dry, 48 lbs. per cubic foot.

Mr. Weale, of Liverpool, reports as follows on a sample of this wood which I sent him:—"Of a hardness between true service tree and whitebeam. Rays on transverse section just visible, a little narrower than sycamore, but wood generally exhibits similar characters. Takes a good finish, but this is not lasting, the ring boundaries rising after exposure. Seasons fairly well, shrinks a little, and rather inclined to twist."

Evelyn says that "the timber of the sorb is useful to the joiner, of which I have seen a room curiously wainscotted; also to the engraver of woodcuts, and for most that the wild pear tree serves." (H. J. E.)

¹ *Annals of Kilmarnock Glenfield Ramblers' Society*, 1894, p. 11.

² *Woods of Commerce*, 312.

PYRUS LATIFOLIA, SERVICE TREE OF FONTAINEBLEAU

Pyrus latifolia, Boswell Syme, *Bot. Exchange Club Report*, 1872-1874, p. 19 (1875).

Pyrus rotundifolia, Bechstein, N. E. Brown in *Eng. Bot.* iii. ed. Suppl. 164 (1892).

Crataegus latifolia, Lamarck, *Flore Française*, ed. i. 486 (1778).

Sorbus latifolia, Persoon, *Syn. Pl.* ii. 38 (1807).

A tree, attaining a height of 60 feet in France, with smooth, grey bark, which becomes fissured at the base in old trees. Leaves broadly oval, with a broad, rounded, or truncate base and an acute apex; margin with small triangular lobes, decreasing in size from the base of the leaf upwards, dentate and mucronate, the sinuses opening between the lobes almost at a right angle. The leaves are firm in texture, shining and glabrous above, tomentose and greyish green beneath, with 6 to 10 pairs of lateral nerves prominent underneath. Flowers in moderate-sized corymbs, never long peduncled. Fruit globular, $\frac{1}{2}$ inch diameter, smooth, reddish, marked with brown dots, flesh edible; containing two cells, one seed in each cell, or more often one cell with one seed, the other cell containing two aborted ovules.

The description just given is drawn up from Fontainebleau specimens; and trees absolutely identical are said to occur in various forests in Seine-et-Oise, Seine-et-Marne, Marne, Aube, and Yonne.

A series of forms,¹ however, occur in the forests of the east of France, in Alsace-Lorraine, Spain, Switzerland, Austria-Hungary, and Bosnia, which differ slightly in the general outline of the leaf and in the colour and marking of the fruit; and these are supposed to be hybrids between *Pyrus Aria* and *Pyrus torminalis*, between which species they oscillate in the characters of the foliage and fruit; whereas, according to French botanists, the tree of Fontainebleau is a true species, as it reproduces itself naturally by seed; and, moreover, one of the supposed parents, *Pyrus Aria*, is not, according to Fliche, wild in the forest of Fontainebleau.² However, the differences are trifling; and it is convenient, in the present state of our knowledge, to treat these supposed hybrids as varieties of *Pyrus latifolia*.

VARIETIES

Var. *rotundifolia* (Bechstein).³ Leaves broadly oval or suborbicular, sometimes even broader than long, truncate or rounded at the base, sub-obtuse at the apex; lobes obtusely cuspidate.

Var. *decipiens* (Bechstein).⁴ Leaves elongated with acute bases, much resembling

¹ These may be called, if their hybridity is considered to be established, *Pyrus Ario-torminalis*, Garcke, *Flora von Deutschland*, ed. 17, 207 (1895). Fliche, in Mathieu, *Flore Forestière*, 177 (1897), sums up the question thus:—Fontainebleau tree not a hybrid, near to *Pyrus Aria*, a true species, seed germinating readily and producing natural seedlings; Lorraine tree nearer to *Pyrus torminalis* than to *Pyrus Aria*, a true hybrid, seeds rarely perfect. Rouy et Fourcaud, *Flore de France*, vii. 22 (1901), suggest that the Fontainebleau tree is a hybrid fixed and behaving as a true species. See also Irmisch in *Bot. Zeitung*, 1859, p. 277.

² Cf., however, p. 156, note 2.

³ *Pyrus rotundifolia*, Bechstein, *Forstbotanik*, 152 and 316, t. 5, 1843.

⁴ *Pyrus decipiens*, Bechstein, *loc. cit.* 152 and 321, t. 7.

those of *Pyrus intermedia*, except that the lobes are triangular pointed, and not rounded as in that species, the sinuses never being acute at their bases.

Var. *semilobata* (Bechstein).¹ Leaves oval or elliptic oval, acute at the apex, narrowed at the base, lobes sharply cuspidate.

IDENTIFICATION

In summer the leaves are distinguishable from those of *Pyrus intermedia* by the characters of the lobes and sinuses; while broad-leaved forms differ from *Pyrus torminalis* in being tomentose beneath, the lobes never being so long as in that species. The tomentum wears off the under surface of the leaf towards the end of the season, and is never so dense or so persistent as in *intermedia*. On Plate 44 figures are given of leaves from wild trees occurring at Symond's Yat (Fig. 9) and Minehead (Fig. 11), and from a cultivated tree at Kew (Fig. 12). In winter a tree cultivated at Kew showed the following characters, represented in Plate 45.

Twigs: long shoots, shining, round, glabrous, except for a little pubescence near the tip; lenticels numerous as oval prominent warts; leaf-scars set somewhat obliquely on prominent, often greenish cushions; crescentic with three bundle dots, of which the central one is the largest. Terminal bud oval, much larger than the side buds, which come off the twigs at a very acute angle, with their apices bent inwards. All the buds are viscid, pubescent at the tip, and composed of oval scales, which are keeled on the back, ciliate in margin, and short-pointed at the tip. Short shoots ringed, slightly pubescent, ending in a terminal bud. In the specimens examined the leaf-scar at the base of the terminal bud had acute lateral lobes not observed in other species of *Pyrus*; but these are probably not always present.

DISTRIBUTION

The tree was first discovered in the forest of Fontainebleau,² and was described by Valliant³ as "*Cratægus folio subrotundo, serrato, et laciniato.*" Duhamel du Monceau gave a figure of the leaf in his classic work.⁴ The distribution on the Continent of the type, and of the forms allied to it, has been given above.

In England a small tree, of somewhat rare occurrence, grows wild in woods

¹ *Pyrus semilobata*, Bechstein, *loc. cit.* 152 and 317, t. 6.

² I visited Fontainebleau in 1905 on purpose to see this tree at home, and found only small trees of it in full flower on 14th May. I was informed by M. Reuss, Inspector of Forests at Fontainebleau, that the tree grows scattered only in the part which is called Montenflamé and Mont Merle, where the sand is covered by the calcareous strata of Beaune, so that the tree is evidently peculiar to calcareous formations. Formerly the trees were cut with the underwood, but are now reserved on account of their rarity, as well as the whitebeam and *P. torminalis*, which M. Reuss considers to be indigenous at Fontainebleau, and therefore admits the possibility of their hybridising. The largest tree known to him is on Mont Merle, at the corner of the roads d'Anvers et de l'Echo in the 16th série, and is 40 centimetres in diameter, or about 4 feet in girth at 5 feet from the ground. It is known to the peasants at Fontainebleau as *baguenaudier* or *elorsier*, but is generally termed by French botanists *alisier de Fontainebleau*.—(H. J. E.)

³ *Botanicon Parisiense*, ed. 3, p. 63 (1727).

⁴ *Traité des Arbres*, i. 194, t. 80, fig. 2 (1755).

in Cornwall, South Devon, and Gloucestershire,¹ which is very near to, if not absolutely identical with, the Fontainebleau tree, as some of the specimens have leaves which resemble rather those of the varieties *rotundifolia* and *semilobata*. The South Devon tree produces fertile seed,² which has been planted, and the offspring differs in no respect from the wild trees. In English trees the flowers are reported to have a disagreeable odour,³ and the fruit ripens in the end of October or November. When fully grown, but still hard, it is olivaceous brown in colour, with numerous scattered small brown or grey dots; but when quite mature it becomes reddish. At Minehead in Somerset, the Nightingale Valley and Leigh Woods near Bristol, and at Castle Dinas Bran, Denbigh, the variety *decipiens* occurs.⁴ Mr. E. S. Marshall observed a remarkably fine specimen with good fruit on the Conan river in East Ross-shire; but as no other specimen was seen this tree is probably not wild in that locality. The tree in Earl Bathurst's woods near Cirencester has given rise to some difference of opinion. It was identified at Kew as *Pyrus intermedia*; but in the specimens which I have seen the leaves have the triangular lobing and tomentum of *Pyrus latifolia*, and I have no doubt that it is this species.⁵ Its foliage is very variable, some leaves being broad, with rounded bases like the type, whilst others have narrowed bases, and approximate in outline to the *decipiens* variety.

REMARKABLE TREES

Pyrus latifolia is seldom planted except in botanical gardens, as at Kew, Edinburgh, and Glasnevin. There are several fine trees at Edinburgh, one of which was figured in the *Gardeners' Chronicle*⁶ for 1882, when it was 45 feet high by 5 feet 3 inches in girth. Professor Balfour had the tree measured again in January 1904, when it was 45 feet high by 6 feet 6 inches in girth. A year or two before it was considerably pruned on the top branches, and this probably accounts for it not being higher in 1904 than it was in 1882. Professor Balfour kindly sent me specimens of the Edinburgh trees, which, though they differ slightly, are all referable to *Pyrus latifolia*. He informed me that while the birds eat the fruit off one tree as soon as it is ripe, in another the fruit remains on the tree untouched. The variability of the fruit in this species is remarkable, and points undoubtedly to hybrid origin.

A tree exists at Oakleigh House,⁷ near Keynsham in Somerset, which was planted many years ago. (A. H.)

¹ "Occurs at Bicknor, Coldwell, and Symond's Yat, which form a single range of wooded limestone rock in West Gloucestershire, about $\frac{3}{4}$ mile in length."—Rev. A. Ley, *Bot. Exchg. Club Report*, 1893, p. 415. "French Hales" is the name given to this species in Devon, according to Britten and Holland, *Dict. Eng. Plant Names*, p. 194 (1886). They state that the fruits are sold in Barnstaple market. These authors call the tree *Pyrus scandica*, as, at the time they were writing, its identity with the Fontainebleau tree was not established.

² Briggs, *Jour. Bot.* 1887, p. 209, and 1888, p. 236.

³ Briggs, *Flora of Plymouth*, 144 (1880); and Boswell, *Bot. Exchg. Club Report*, 1872-74, p. 20.

⁴ Cf. N. E. Brown, *loc. cit.* 165. Mr. J. White reports a tree 30 feet high in Leigh Wood (*Bot. Exchg. Club Report*, 1902, p. 45).

⁵ Mr. Hickel, Inspecteur des eaux et forêts, who knows the Fontainebleau tree well, and to whom I sent specimens, is of my opinion.

⁶ Vol. xviii. 749.

⁷ *Jour. Bot.* 1899, p. 488.

My attention was called by Mr. R. Anderson of Cirencester to a very remarkable tree growing in a part of Earl Bathurst's woods about two miles from Cirencester, known as the Dear Bit. The tree, though it has lost some of its principal branches, is still, as our illustration shows (Plate 49), a very handsome one, and in size exceeds any other of the kind of which we have a record, either in this country or on the Continent. It is, as nearly as I can measure it, about 75 feet high by 11 feet in girth. It grows on dry shallow soil of the Oolite formation, and is close to a ride, which leads me to suppose that it was planted perhaps at the time when the park was laid out. It is near the north-east edge of the wood, and open to the south-west. I have never seen the flowers of this tree, which bears fruit only in favourable seasons near the ends of its uppermost branches, and as the birds are fond of it, and even in good years many of the seeds are immature, I have not until 1904 been able to procure any. A few of these have now produced small plants.

I have been unable to find any self-sown seedlings near this tree, and though there are one or two good-sized *P. torminalis* in another part of the park, probably planted, none of them approach it in size. As to the possible age of this tree, I can only say that the drive on the edge of which it grows has, as I am told by Mr. Anderson, certainly been in existence over 100 years, and the bank was covered with old beech, which were cut in 1892. The tree has become one-sided from the pressure of a beech which until then closed it in on the south-west side, where it is now open. As these beeches were 150 years old or more, the tree may be now from 150 to 200 years old, and it seems very probable that the person who designed this park had seen the tree at Fontainebleau, and introduced it when Oakley Park was planted by the ancestor of the present Earl Bathurst in Queen Anne's reign.

(H. J. E.)

PYRUS INTERMEDIA, SWEDISH WHITEBEAM

- Pyrus intermedia*, Ehrhart, *Beiträge zur Naturkunde*, iv. 20 (1789); Loudon, *Arb. et Frut. Brit.* ii. 915 (1838).
Pyrus scandica, Ascherson, *Fl. des Prov. Brandenburg*, i. 207 (1864).
Pyrus suecica, Garcke, *Fl. Deutschland*, ed. ix. 140 (1869); Conwentz, *Beob. über Seltene Wald-bäume in West Preussen*, 81 (1895).
Sorbus scandica, Fries, *Flora Hollandica*, 83 (1818).
Sorbus intermedia, Persoon, *Syn. Pl.* ii. 38 (1807).
Sorbus Mougeoti, Soyer-Willemet et Godron, *Bull. Soc. Bot. de France*, v. 447 (1858).
Cratægus Aria scandica, Linnæus, *Amœn. Acad.* 190 (1751).
Cratægus Aria suecica, Linnæus, *Sp. Pl.* 476 (1753).

A shrub or small tree attaining a height of 20 to 50 feet. Leaves stalked, oval or elliptic, rounded or cuneate at the base, pointed at the apex; margin lobed, lobes diminishing in size from the base upwards, rounded, toothed, shortly acuminate, separated by sinuses which are very acute or almost closed at their bases; upper surface green, shining, glabrous when adult, lower surface greyish tomentose. Flowers in branching corymbs, with pleasant odour; petals spreading, tomentose; styles 2, free, tomentose at the base. Fruit oval, red, sweet-flavoured, smooth or slightly dotted.

VARIETIES

1. *Scandica*.¹ Leaves less narrowed and almost rounded at the base, deeply lobed, with numerous sharp teeth; 6-8 pairs of nerves. Fruits large, surmounted by the curved and outwardly-reflected calyx teeth.
2. *Mougeoti*.² Leaves narrowed at the base, slightly lobed, with few short teeth; nerves 9-12 pairs. Fruit very small, surmounted by erect and inwardly-curved calyx teeth.
3. *Minima*.³ Leaves linear-oblong, with 3-4 pairs of lobes, variable in size, but generally deepest at the middle part of the leaf; nerves 6-8 pairs. Flowers—early in June—in loose corymbs, not flat-topped, small, and resembling those of *Pyrus Aucuparia*. Fruit small, globose, bright red, surmounted by erect calyx lobes.

In Plate 44 figures are given of the leaves of var. *scandica* from Bergen (Fig. 19), of the variety from Great Doward in Hereford (Fig. 10), and of var. *minima* from Breconshire (Fig. 17).

IDENTIFICATION

In summer the greyish tomentum of the leaves underneath, and the rounded lobes, with sharp sinuses which are almost closed at their bases, will distinguish the

¹ *Sorbus scandica*, Fries, *loc. cit.*

² *Sorbus Mougeoti*, Soy.-Will. et God. *loc. cit.*

³ *Pyrus minima*, Ley, *Jour. of Bot.* 1895, p. 84, and 1897, p. 289, t. 372; *Sorbus minima*, Hedlund, *Kon. Sv. Vetén. Akad. Handl.* (1901-2) 60.

tree from *Pyrus Aria* and *Pyrus latifolia*, the species nearly allied. In winter the following characters are available, as shown in Plate 45:—

Twigs: long shoots, round, glabrous, often with waxy patches; lenticels long, numerous. Leaf-scars: crescentic, with 3 equal-sized bundle dots, obliquely set on a brownish projecting cushion. Buds glistening, pubescent at the tip; terminal much the largest; side-buds arising at an acute angle with their apices directed inwards. The bud-scales have a dark-coloured rim to the ciliate margin, and their apex is scalloped with a central projection ending in a tuft of long hairs. The short shoots are ringed, pubescent, with a terminal bud.

DISTRIBUTION

The variety *minima* occurs only in Breconshire, on the limestone mountain cliff Craig Cille, near Crickhowell, and at Blaen Onnen, two miles to the west of Craig Cille, and is a small shrub clothing the cliffs up to 2000 feet altitude. The flowers and fruit are very similar to those of the mountain ash; and Koehne supposes it to be a hybrid between *Pyrus intermedia* and *Pyrus Aucuparia*, which occur in the same locality.

The form *Mougeoti*, which is considered by many botanists to be a distinct species, occurs in Lorraine, the Vosges, Jura, Suabian and Western Alps, and in the Carpathians. It never attains a great size, being either a low bush or a small tree 15 to 30 feet in height. In Piercefield Park, Monmouth, Great Doward in Hereford, and a few other localities in the west of England, a shrub or small tree has been found which is near this form.¹

Var. *scandica* has been found in Britain, in a few localities in Denbighshire and Breconshire,² and also at Chepstow³ in Monmouthshire, always growing on limestone rocks. It was supposed to grow also in Arran, but Koehne,⁴ as will be seen in our account of the peculiar forms of that island under *Pyrus pinnatifida*, denies its occurrence there.

(A. H.)

This variety is widely spread in Northern Europe. The best account we know of this tree is by Conwentz, who calls it "*Pirus Suecica*." He says that most authors speak of it as a small tree or shrub—Koehne only gives it as 7 metres high. It grows on granite, gneiss, chalk, and alluvium, and extends from the island of Åland, South-east Sweden, South Norway, and Denmark, to North-east Germany, where, however, it seems to be quite a rare tree and only recently discovered.

It is represented in France, Switzerland, Austria, and Bosnia by *P. Mougeoti*, which many botanical authors have mistaken for it, and which, according to Conwentz, can only be distinguished in some varieties by the fruit.

In the island of Oesel, in the Baltic, it is much planted, and often attains 2 metres in girth. Conwentz, however, found wild specimens at Soëginina near Karral, at Pajumois near Keilkond, at Wita Jahn, and in other places—mostly small trees, but

¹ It is called *Pyrus intermedia*, Ehrh., by the Rev. Augustin Ley. Briggs and Boswell think it is perhaps a form of *Aria* or *rupicola*. See *Jour. Bot.* 1884, p. 216. It is certainly quite distinct, in my opinion, from *scandica* or *latifolia*.

² *Jour. Bot.* 1903, p. 215.

³ Specimen at Kew.

⁴ *Jour. Bot.* 1897, p. 99.

in some places attaining 10 metres in height. In the Finnish islands of Åland it is found truly wild, in a few places only, sometimes in company with an allied species, *P. fennica*. Conwentz identified it at Bergö, Skarpnåtö, Labnäs, and elsewhere. The finest specimen he saw at Östergeta, being 12 metres high and 2 metres in girth.

In south-eastern Sweden it is more abundant, but does not occur in any of the provinces north of Wermland, about lat. 60° N. In the neighbourhood of Stockholm it grows at Stockby to 12 metres in height. In Södermanland and the island of Gothland it is more common.

In Denmark the tree has been found in many places, and is undoubtedly wild near Aarhus in Jutland, in the forests of Adslev, Kolden, and Jexen. I believe that I also saw it in the forest of Roldskov near Aalborg, though I did not at that time distinguish it from *Pyrus Aria*. In the island of Bornholm it is known under the name of "Axelbar."

In Germany it is confined to a limited area on the coasts of West Prussia and Pomerania, where Conwentz has found it living in six places only—Koliebken, Hoch Redlau, Oxhöft, Karthaus, Gr. Podel, and Markuhle near Kolberg. He gives maps showing the position of the trees in these places, and says that whilst *P. torminalis* grows in the interior, where the hornbeam is predominant, *P. intermedia* grows in the country along the coast, where the beech is the prevailing tree. It occurs most commonly in a shrubby condition, the tallest wild one being only 13 metres high by 1 metre in girth, but one tree at Gross Podel in Pomerania is 1.90 metre in girth, and at Wernigerode, in the Harz, a cultivated tree has attained 17 by 3.17 metres, which is the largest known to Conwentz. He thinks that the scarcity of the tree in Germany arises from its not being indigenous, as no geological evidence exists of its having been formerly commoner, and suggests that it has been introduced from Sweden by birds of passage, such as the waxwing or thrushes, which are fond of the fruit, and may have voided the seeds after migration from the north.

The Swedish name is *Oxel*, and this name being found in many place and family names in Sweden, shows that the tree was probably more common formerly than at present.

In Norway, Schübeler¹ says that it is wild only in the most southern parts, as at Porsgrund, Grimstad, and Dalen in Eidsborg, in lat. 59° 42' N. There are large trees at Lunde in Stavanger district growing near the church. In the Botanic Gardens at Christiania I have seen a tree which is about 12 metres high and over 2 in girth. It has been planted and grows well at Stenkjær, at the north end of the Trondhjem Fjord. The Norsk name is *Maave*.

Dr. Brunchorst, Director of the Bergen Museum, informed the Earl of Ducie that *Pyrus intermedia*, as well as *P. pinnatifida* (*P. fennica*), were found on the south-west coast of Norway, and that a hybrid which he calls *Pyrus Meinickii*, *P. fennica* × *Aucuparia*, has also been recently discovered in the "Mosterö Bommel Fjord." Dr. Brunchorst, who has paid much attention to this genus, says that three species which he cultivates at Bergen vary much, and perhaps pass into one another.

¹ Schübeler, *Viridarium norvegicum*, vol. ii. 477 (1888).

Lord Ducie has brought plants of these to Tortworth, where he grows them under the name of *Pyrus hybrida*.

REMARKABLE TREES

This species appears to be now rarely planted, except in botanical gardens. The best specimen which we have seen occurs at Syon (var. *scandica*). In 1904 it measured 48 feet in height by 7 feet 10 inches in girth, with a bole of 7 feet, dividing into 8 large branches, and forming a wide-spreading crown of foliage, about 50 yards in circumference (Plate 50). Another fine tree is growing at Livermere Park, Bury St. Edmunds, Suffolk, specimens and particulars of which have been kindly sent to us by Mr. Stiling. It is now (1905) 45 feet high by 8 feet 5 inches in girth, with a bole of 8 feet dividing into 12 main branches, the diameter of the spread of foliage being 45 feet. This tree was reported¹ in 1889 to have been 42 feet high by 8 feet 3 inches in girth. In August 1905 it was covered with fruit. (H. J. E.)

There is a fine specimen at Stowe, near Buckingham, growing near the bridge over the lake in sandy soil, which measures about 45 feet high by 7 feet 9 in. in girth, with a 7 feet bole. It was loaded with fruit in August 1905.

At Wykeham Abbey, the Yorkshire seat of Viscount Downe, there is a fine tree on the lawn, about 40 feet high, spreading from the ground, where it measures 10 feet 8 inches in girth, into a large and well-shaped head.

This tree is planted in some of the parks and gardens in London, and grows well at the Botanic Gardens in Regent's Park. I am informed by Mr. A. Stratford, Superintendent of the Corporation Park of Blackburn, that it makes a good shade tree in that smoky town.

¹ *Garden*, 1889, xxxvi. 342. Note by J. C. Tallack, who named the tree *Pyrus pinnatifida*.

PYRUS PINNATIFIDA, BASTARD MOUNTAIN ASH

Pyrus pinnatifida, Ehrhart, "Plantag." 22, ex *Beiträge zur Naturkunde*, vi. 93 (1791); Loudon, *Arb. et Frut. Brit.* ii. 915 (1838); N. E. Brown, in *Eng. Bot.* iii. cd. Suppl. 168 (1892); *Gard. Chron.* xx. 493, fig. 78 (1883).

Pyrus semipinnata, Roth, *En. Pl. Phæn. in Germ.* i. sect. post. 438 (1827).

Pyrus fennica, Babington, *Man. Eng. Bot.* ed. 3, p. 111 (1851).

Sorbus hybrida, Linnæus, *Sp. Pl.* 684 (1762); Schübel, *Viridarium norvegicum*, ii. p. 476.

Sorbus fennica, Fries, *Summa Veg. Scand.* 42 (1846).

A species of hybrid origin, occurring as a small tree, which may attain 50 feet in height, with smooth, grey bark. Leaves variable in shape, mostly pinnate or deeply cut at the base, with 1-4 pairs of segments more or less separate; the upper part cut into deep sharp-toothed lobes; green and glabrous above, grey tomentose below. Flowers white in loose corymbs; styles 3, woolly at the base; fruit small, globular, coral red, and resembling that of *Pyrus Aucuparia*.

VARIETIES

This form, the parents of which are *P. Aucuparia* and *P. intermedia*, must be carefully distinguished (see p. 143) from *Pyrus hybrida*, Moench, a shrub of different origin.

Pyrus Thuringiaca, Ilse,¹ a cross between *P. Aucuparia* and *P. Aria*, is generally included under *P. pinnatifida*, from which it differs only in the leaf, whiter beneath, having its upper part lobulate or dentate and not deeply lobed.

Sorbus arranensis, Hedlund,² is the name given to a form occurring in the Isle of Arran, which is intermediate between *P. pinnatifida* and *P. intermedia*, and closely resembles the latter, differing only in the deeper and more irregular lobing of the leaf.

The hybrid forms, which are intermediate between *P. pinnatifida* and *P. Aucuparia*, are generally regarded as varieties (var. *satureifolia*³ and var. *decurrens*⁴) of the latter species, and will be mentioned in our account of the mountain ash.

IDENTIFICATION

Pyrus pinnatifida and the intermediate hybrids are variable and inconstant in the shape of the leaf. There is no difficulty, however, in their identification, if it be noted that hybridity may be suspected in all cases where the leaves vary on the one hand from the regularly pinnate separate leaflets of *Pyrus Aucuparia*, and on the other from the regular uniform lobing or serration of *Pyrus intermedia* or *Pyrus*

¹ In *Jahresh. Bot. Gart. u. Mus. Berlin*, i. 232 (1881).

² In *Kon. Sv. Vetén. Akad. Handl.* 1901-2, p. 60.

³ Koch, *Dendrologie*, i. 189 (1869).

⁴ Koehne, *Deutsche Dendrologie*, 248 (1893). This variety is commonly known as *Pyrus lanuginosa*, Hort.

Aria. In winter, specimens of cultivated *Sorbus fennica* show the following characters represented in Plate 45 :—

Twigs: long shoots glabrous, shining, dark brown, with a few scattered lenticels. Leaf-scar crescentic, very narrow, set obliquely on a reddish brown, slightly projecting cushion; it shows a varying number of bundle traces,¹ 3, 4, or 5, and may thus be distinguished from other species of *Sorbus*, as *Pyrus Aucuparia* has 5 dots on the scar, while *Pyrus Aria*, *intermedia*, and *latifolia* have only 3. Terminal bud large, conic, tomentose, especially at the apex. Lateral buds small, either appressed to the stem or diverging from it at an acute angle. Bud-scales few, densely pubescent on the outer surface, and ciliate in margin. Short shoots ringed, pubescent, bearing a terminal bud.²

DISTRIBUTION

The form *fennica* occurs plentifully in Scandinavia, where it grows wild, reproducing itself naturally by seed, and behaving as a true species. It extends in Norway, according to Schübeler, up to lat. 66° 14' on the west coast as a wild plant, and in Sweden up to 60° wild and 62° planted; it also occurs in Finland, but is not recorded from other parts of Russian territory. In Central Europe it only occurs sporadically, and apparently always in company with the parent species; it is recorded from various mountain stations in France, Switzerland, Germany, and Austria.

The hybrids which occur in the Isle of Arran have attracted much attention and discussion. Formerly it was believed that *Pyrus Aucuparia*, *Pyrus intermedia* (var. *scandica*), and *Pyrus fennica*, all occurred in a wild state. Koehne,³ however, considers that (excepting *Aucuparia*) all the plants in question on the island are hybrids, there being two sets, one typical *fennica*, while the other set comprises forms between that and *scandica*. This view, which excludes one of the parents (viz. *scandica*), implies that these hybrids, once established, may under favourable conditions reproduce themselves naturally and behave generally as true species.

N. E. Brown says of this species that it is "rare and perhaps not indigenous except in Scotland"; but he has seen specimens from Kent, Sussex, Hants, Somerset, Gloucester, Leicester, Stafford, Cumberland, Roxburgh, Arran, and Dumbarton. He thinks that Arran seems to be the only truly native locality for this tree in the British Isles, and believes that the Arran plant placed under *intermedia* is a form of it. Watson, however, states in his *Compendium*, p. 510, that Borrer held it to be wild in North Hants between Farnham and Farnborough, where it was observed sparingly along with *Aria* and *Aucuparia*, both more plentifully. A specimen picked by James M'Nab in Darent Wood, Kent, is, according to Watson, identical with Arran specimens.

There is a fine tree on the edge of a shrubbery close to Wilton House, Wilts, the seat of the Earl of Pembroke, about 50 feet by 5.

¹ If the dots are not plainly visible externally, they can be seen clearly on paring off the epidermis of the scar.

² The twigs in winter described above clearly show the hybrid origin of this species; the varying number of dots on the scar, the pubescence and shape of the scales, etc. show the influence of *Pyrus Aucuparia*.

³ Koehne, *Jour. of Bot.* 1897, p. 99. See also Rev. Dr. Landsborough's account of the Arran hybrids in *Trans. Bot. Soc. Edin.* xxi. 56 (1897).

There is a tree at Williamstrip Park, Fairford, the seat of Lord St. Aldwyn, which is in a decaying condition. It consists of a large stool measuring 8 feet at the ground, with four stems about a foot in diameter by about 60 feet high. There is also a tree at Arley Castle 50 feet high by 3 feet 5 inches in girth in 1905. One at Bayfordbury is 40 feet by 5 feet 2 inches, branching at 4 feet into four stems, with numerous ascending branches. At Aldenham Cottage, Letchmore Heath, Herts, is a fine tree 44 feet by 6 feet 2 inches, with a bole of 6 feet. At Danson Park, Welling, Kent, the residence of Mr. Bean, there is said to be a tree about 30 feet high, with a girth of 12 feet 4 inches at 1½ feet above the ground, described to be like a large bush with seven main branches. (A. H.)

PYRUS ARIA, WHITEBEAM

Pyrus Aria, Ehrhart, *Beiträge zur Naturkunde*, iv. 20 (1789); Loudon, *Arb. et Frut. Brit.* ii. 910 (1838).

Crataegus Aria, Linnæus, *Sp. Pl.* 475 (1753).

Sorbus Aria, Crantz, *Stirp. Aust.* ii. t. 2, f. 2 (1762).

Aria nivea, Host, *Fl. Aust.* ii. 8 (1813).

A tree in woods and on good soil attaining a height of 40 to 50 feet, and rarely 70 feet in height; but in rocky and mountainous situations usually remaining shrubby. Bark smooth and grey, becoming slightly fissured in old trees. Leaves stalked, oval or obovate, rounded, cordate, or cuneate at the base, sharp or obtuse at the apex, biserrate or slightly lobulate with teeth, the lobules largest towards the apex of the leaf; green and glabrous when adult above, but always snowy-white tomentose beneath; nerves, 8-12 pairs, very prominent on both surfaces. Flowers with an unpleasant odour, white, in loose corymbs; the peduncle, receptacle, calyx, and corolla, white tomentose; styles 2, free, pubescent at the base. Fruit globose or ovoid, $\frac{1}{2}$ inch in diameter, shining red with a few brown dots, tomentose at the base and apex; flesh scanty, sweetish acid in flavour.

IDENTIFICATION

In summer the leaves, snowy white underneath and with prominent nerves, are a sure guide. The leaves of *Aria* from a wild specimen growing at Gosford, Kent (Fig. 18); of var. *rupicola* from a wild specimen from north-west Lancashire (Fig. 13); of var. *salicifolia* (Fig. 16) and var. *Decaisneana* (Fig. 8), both from specimens cultivated at Kew, are shown on Plates 43 and 44. In winter the following characters are available, as shown in Plate 45:—

Twigs: long shoots round, shining brown, glabrous except for a little pubescence near the tip, marked with scattered wart-like lenticels. Leaf-scars set obliquely on prominent leaf-cushions, crescentic, with three bundle traces. Buds ovoid, conical-pointed, shining, and somewhat viscid; terminal larger, side-buds coming off at an acute angle. Bud-scales glued together, strongly keeled, glabrous on the surface, densely long ciliate in margin. Short shoots ringed, generally glabrous, and ending in a terminal bud. Viscid buds occur also in *Pyrus Sorbus*, which is, however, very distinct in its five-dotted scars and glabrous scales.

VARIETIES

Some authors take *Pyrus Aria* in a wide sense, and under it group *Aria* proper, *rupicola*, *latifolia*, *scandica*, etc. as sub-species. Most of these, as being readily distinguishable by many characters, have been considered by us as distinct species. Taking *Pyrus Aria* in a narrow sense, as comprising forms with leaves

snowy white beneath, it exhibits a great variety of forms in the wild state, explained by its wide geographical distribution and its occurrence on different soils and in different situations. Moreover, various horticultural varieties have been produced. The type has been described above; the following is a list of the most important varieties:—

1. Var. *rupicola*.¹ Differs from the type in the leaves having fewer nerves, generally 7 (5-9) pairs, less prominent; obovate-oblong in shape, widest above the middle, lobulate above, with the tomentum ultimately becoming slightly grey. Fruit smaller, $\frac{3}{8}$ inch diameter, carmine-scarlet. This variety occurs always on limestone rocks, and is recorded from many stations in the British Isles. It is probably a form due to poor soil and exposure to wind, and other uncongenial conditions.

2. Var. *græca*, Boissier.² A shrub occurring in Spain, Albania, Greece, Syria, and Asia Minor. Leaves round, thick, almost leathery in consistence, nerves 6-10 pairs, broad, cuneate at the base, lobulate, with large teeth in the upper two-thirds. This form is also known as *Sorbus cretica*, Fritsch, and *Aria græca*, Decaisne.

3. Var. *flabellifolia*.³ Leaves orbicular, cuneate, or rounder at the base, margin with large incisions, sharply toothed, nerves 3-5 pairs. South-eastern Europe and Asia Minor.

4. Var. *Decaisneana*, Rehder.⁴ Leaves large, 4-6 inches long by 2-3 $\frac{1}{2}$ broad, elliptic or oblong, narrow or acuminate at the apex, rounded or subcordate at the base, serrate in almost the whole margin with sharp teeth; nerves 12-14 pairs; petiole channelled above, nearly an inch long. Flowers first white, then becoming pinkish; styles glabrous. Fruit purplish, ellipsoid, crowned by the persistent hairy sepals. This tree is of unknown origin; it has been said to be Himalayan, but I am not aware on what authority. It closely resembles *Pyrus lanata* from that region.

5. Var. *sinensis*. Leaves narrow, lanceolate or ovate, with acuminate apex and cuneate base; crenately serrate. A series of forms occur in the mountains of Hupeh in China, where the trees are common at high elevations, and vary in size from 10 to 40 feet in height. Seeds were sent home by Wilson to Messrs. Veitch in 1901, and seedlings, very beautiful in foliage and vigorous in growth, are now growing at Coombe Wood.

6. Var. *salicifolia*. Leaves narrow, ovate-lanceolate, doubly serrate in margin, with long petioles. Origin unknown.

7. Certain horticultural varieties occur in which the leaves are variously coloured, as *lutescens*, *chrysophylla*, *sulphurea*.

8. Var. *quercooides*. Leaves regularly lobed with their edges bent upwards.

PYRUS HOSTII,⁵ Hort., may here be mentioned, as it occurs in cultivation and

¹ *Pyrus rupicola*, Boswell Syme, *Eng. Bot.* ed. 3, t. 483.

² *Flora Orientalis*, ii. 658. There is a form in south-east Europe called *meridionalis*, which differs only slightly from this variety.

³ *Crataegus flabellifolia*, Spach, *Hist. Vég. Phan.* ii. 103.

⁴ Rehder in *Cyclop. Am. Hort.* iv. 1689 (1902). *Aria Decaisneana*, Lavallée, *Arbor. Segrez.* p. 51, t. 18. *Pyrus Decaisneana*, Nicholson, *Kew Hand-list of Trees and Shrubs*, 187 (1894). *Sorbus Decaisneana*, Zabel, *Handbuch Laubholz-Benennung*, 199 (1903).

⁵ Figured in *Garden*, 1881, xx. 376.

resembles *Pyrus Aria*. It is of hybrid origin, one parent being either that species or *Pyrus intermedia*, while the other is *Pyrus Chamæespilus*. It is distinguished from *Pyrus Aria* by the larger and more irregular teeth of the leaves (*cf.* Plate 44), and its flowers are pinkish white, borne in loose corymbs. Various intermediate forms have been distinguished, as—

Sorbus ambigua, Michalet. Exactly intermediate between *Pyrus Aria* and *Pyrus Chamæespilus*, with the leaves larger than in the second, and smaller than in the first, and the margins having a tendency to lobing. Tomentum whitish.

Sorbus arioides, Michalet. A form intermediate between *ambigua* and *Aria*.

Chamæespilus × *Mougeoti*. Leaf large, with lobes well marked and rounded; tomentum greyish. These hybrids are common in the Jura and the Alps.

DISTRIBUTION

The whitebeam is a wide-spread species. It occurs throughout Europe generally, reaching in Norway as far north as lat. 63° 52', and in Sweden to lat. 59°. It is met with also in Algeria, Asia Minor, the Caucasus, Armenia, Siberia, and Central China, assuming in some of these regions remarkable varietal forms. It is replaced in the Himalayas and Japan by *Pyrus lanata*, Don, an allied species.

While it occurs on all soils except those which are wet, it has a decided preference for limestone. In woods and hedges it grows to be a small tree; but in exposed situations on rocky mountains, etc. it dwindles to a mere bush. On the Alps it ascends to 4800 feet.

In the British Isles its distribution has not been accurately made out, as many supposed records refer rather to *intermedia* or *latifolia*. Apparently, however, as a wild tree, the typical form is almost entirely confined to the southern and midland counties of England and to south Wales. Variety *rupicola* is recorded from nearly every county from Devon to Sutherland, and is widely spread on the littoral range between Lancaster and Humphrey Head, ascending in Banffshire to 1200 or 1400 feet, where it has been found by Dr. Shoolbred of Chepstow on limestone cliffs near Inchroy in upper Banffshire. In Ireland the whitebeam is rare and local, and both the type and *rupicola* occur. (A. H.)

REMARKABLE TREES

By far the finest specimen that we know of in England or elsewhere grows on the edge of Camp Wood, near Henley on Thames, on Sir Walter Phillimore's property, where Henry saw it in 1905. It measures 75 feet high by 4 feet 9 inches in girth, with a bole about 35 feet long, and has very smooth beech-like bark (Plate 51).

There is a large and very well shaped tree at Walcot, Shropshire, which in 1906 Elwes found to be 56 feet high and 6½ feet in girth, with a clean bole about 20 feet long.

There is a handsome tree on the lawn at Belton Park, which measures 41 feet by 6 feet 7 inches.

A very spreading, ill-shaped tree in a thicket at Mount Meadow, near Cobham, Kent, is 9 feet 3 inches in girth.

At Stowe, near Buckingham, there are several fine trees near the Queen's Temple, which are about 50 feet high, but the tree when growing wild on the Cotswold Hills, where it is common, rarely exceeds 30 feet with a stem 2 to 3 feet in girth, and is more usually seen as a bush with many stems.

The whitebeam, like the mountain ash, is occasionally found as an epiphyte growing on other trees, where its seeds have been dropped by birds. Though this is more common in the damp climate of the west of England, yet we know of two cases which are remarkable on account of their situation. One is in the Yew Tree Vale in Surrey, where a whitebeam is growing near the top of a yew tree;¹ the other is near Colesborne in the Cotswold Hills. In this case a large limb has been torn by the wind from a Scots pine, and in the crevice on the east side of the tree, where but very little vegetable matter has yet had time to form, a healthy young whitebeam, now about 3 feet high, grew for seven or eight years, when it began to lose vigour.

Though it is well known that the decaying mossy trunk of a fallen tree is one of the most favourable situations for the seeds of many conifers to germinate and grow, yet in this case the roots of the whitebeam must derive their nourishment almost entirely from the air, the case being very different from those so often seen in the Himalayas and other countries, where a large quantity of moss, ferns, and decaying vegetable matter accumulate in the forks of large old trees.

The whitebeam is easily propagated by seed, which, if sown in autumn, will germinate partly in the following spring and partly in the second year after sowing. The seedlings grow slowly at first, and require five or six years in the nursery before they are large enough to plant out. When planted on good soil the whitebeam is a very ornamental tree, both on account of its leaves and fruit, which is larger and more abundant than when wild. It is, however, so much liked by birds that it is soon eaten up.

TIMBER

The wood is hard, heavy, and even in the grain, and is white in colour, with some dark spots, and in old trees becomes occasionally tinged with red. It is used on the Continent in turnery and in making tools.

Loudon says that it was used for the axletrees, naves, and felloes of wheels, carpenters' tools, and walking-sticks, but that the greatest use of its wood, until iron superseded it, was for the cogs of small wheels. I have felled a tree 18 inches in diameter, which when cut through was perfectly sound at heart, and was considered to be well suited for chair-making.

¹ *Garden*, 1882, xxii. 164.

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In Hampshire¹ the wood is used for making whip-handles, and the tree is known there on that account as "whip-crop."

Mr. Weale, of Liverpool, reports as follows on a sample of this wood which I sent him:—"The wood is of a medium hardness, good length of fibre, and takes a clean finish. Not tough. Rays invisible on transverse section. Grain moderately close and even. Warps badly in drying, and is liable to split."

In a little book on English timber by "Acorn" (Rider and Son, London, 1904), I find the following note on the whitebeam, though the author does not notice either of the service trees:—"In a green state whitebeam has a strong smell, and even after seasoning this is retained to a certain extent. A great many handles for cutlery are made from it, and its hardness is admirably adapted for these, as it is capable of taking a very high polish from the extreme closeness of its grain. It is also used in the manufacture of musical instruments, and the tops and small pieces are always appreciated by the turner." As it is usually available only in small pieces, these would probably, when thoroughly seasoned, be very useful to introduce as blocks in parquet flooring. (H. J. E.)

¹ Townsend, *Flora of Hampshire*, 125 (1883).

TAXODIUM

Taxodium, Richard, *Ann. Mus. Par.* xvi. 298 (1810); Bentham et Hooker, *Gen. Pl.* iii. 429 (1880); Masters, *Jour. Linn. Soc. (Bot.)* xxx. 24 (1893).
Schubertia, Mirbel, *Nouv. Bull. Soc. Philom.* iii. 123 (1812).
Glyptostrobus, Endlicher, *Syn. Conif.* 30 (1847).

DECIDUOUS or subevergreen trees, several extinct species and a series of living forms, which have been variously considered to constitute one, two, or three species, belonging to the tribe Taxodineæ of the order Coniferæ.

Branchlets of two kinds, those at the apex of the shoot persistent, and bearing axillary buds, those lower down on the shoot deciduous and without buds. Buds of two kinds: those near the apex of the shoot, two in number, sub-terminal, globose, composed of imbricated, ovate, acute, keeled scales; these buds continue the growth of the persistent shoot. The lateral buds, situated lower on the shoot, are minute globose swellings, enclosed in two transverse, broadly oval, concave, membranous scales, which do not meet. These buds produce the deciduous branchlets, and are developed both on older and current year's shoots, in the latter case arising in the axils of primary leaves.

Leaves inserted spirally on the branchlets; on the persistent shoots, spreading more or less radially; on the deciduous shoots, in the usual forms of the species, thrown by a twisting of their bases into two lateral ranks, thus assuming a pseudo-distichous arrangement; linear, acute, channelled along the median line above, keeled and bearing stomata below. In var. *imbricaria* the leaves are not pseudo-distichously arranged, but are appressed around the twig and spreading at their free apex; they are narrow, long-pointed, concave above.

Flowers monœcious. Male flowers in panicles, 3 to 5 inches long, arising at the end of the preceding year's shoot. Each flower is minute, sub-sessile, and consists of a stalk surrounded at its base by ovate scales, and bearing 6 to 8 distichously opposite stamens. Female flowers, scattered near the ends of branchlets of the preceding year, solitary, globular, consisting of numerous imbricated pointed bracts, adnate below to the thickened fleshy scales, each of which bears two ovules.

Fruit, a globular or ellipsoidal, short-stalked, woody cone, an inch or more in diameter, ripening in the first year, composed of thick coriaceous peltate scales, the stipes of which are slender and spring off at right angles from the axis of the cone; the discs, rhomboidal in shape, show a triangular scar at the base, above which they are irregularly crenulate and rugose. The bract having almost entirely coalesced

with the scale, its apex appears on the upper part of the scar as a minute reflexed point. Some of the scales are sterile; the others bear each two erect unequally three-angled seeds.

Taxodium is readily distinguishable in winter from other deciduous trees by the peculiar buds and branchlet scars which mark the twigs. The latter are very slender, terete, glabrous, and brown in colour, and bear at their apex the two pseudo-terminal buds described above, one of which, however, is often aborted in trees growing in England. Scattered over the twigs appear the branchlet scars and the lateral buds. The former are small circular depressions, surrounded by a slightly raised rim, and having a single dot or a minute protuberance in their centre. The lateral buds, also previously described, are smaller than the branchlet scars, and on twigs of one year arise just above the minute scars left by the primary leaves, in which a single dot may be made out with difficulty. Single-dotted leaf-scars occur in *Larix* and *Pseudolarix*; but in these genera branchlet scars are absent, and the twigs show spurs or short shoots, which are wanting in *Taxodium*.

The genus *Taxodium* was once common and widely distributed over the Holarctic region. During Miocene and Pliocene times it was spread over the interior of North America, throughout Europe, and in north-eastern Siberia. In the present day it is restricted to the Southern United States and Mexico.

The genus can only be confounded with *Glyptostrobus*, now represented by one living species, *G. heterophyllus*, Endlicher,¹ a native of the province of Canton, in Southern China, where it occurs as a small tree along the banks of rivers and streams. Like *Taxodium*, it has deciduous foliage and branchlets. The leaves assume two forms—on ordinary branchlets long and linear and arranged in three rows, on fruiting branchlets closely imbricated, scale-like, concave internally and carinate externally. The cone, pyriform in shape, is composed of scales, which are not peltate, but elongated and arising from its base. The bract coalesces with the scale below; but above the middle is free and recurved, leaving bare the 5 to 7 lobed summit of the scale. The seeds, oblong or obovate, often short-spurred at the base, are narrowly winged on the sides and prolonged at the base into a flat, lancet-shaped wing. *Glyptostrobus heterophyllus* is not hardy at Kew, where specimens may be seen in the temperate house. A plant of it is reported to be growing in the open air at Castlewellan.

¹ *Glyptostrobus heterophyllus*, Endlicher, *Syn. Conif.* 70 (1847); Masters, *Jour. Bot.* 1900, p. 37, and *Gard. Chron.* xxvi. 489 (1899); *Thuja pensilis*, Staunton, *Embassy to China*, ii. 436 (1798); Lambert, *Pinus*, ed. 2, ii. 115, f. 51.

TAXODIUM DISTICHUM, DECIDUOUS CYPRESS

Taxodium distichum, Richard, *Ann. Mus. Par.* xvi. 298 (1810); Loudon, *Arb. et Frut. Brit.* iv. 2481 (1838); Sargent, *Silva N. America*, x. 151, t. 537 (1896); Kent, in Veitch's *Man. Conifera*, 281 (1900).

Cupressus disticha, Linnæus, *Sp. Pl.* 1003 (1753).

Schubertia disticha, Mirbel, *Mém. Mus. Par.* xiii. 75 (1825).

Three well-marked forms of *Taxodium* occur in the wild state, which differ in certain characters, such as the form of the foliage, its partial persistence or complete deciduousness, and the time of flowering; and in the present state of our knowledge these may be considered as constituting one species, the peculiarities mentioned appearing to depend on conditions of soil and climate, and to be by no means constant.

1. Var. *typica*. A tall tree, with a gradually tapering stem, which has an enlarged base, usually hollow internally and buttressed externally. When young it is strictly pyramidal in form; but in older trees the crown becomes wide and flattened, often 100 feet across, according to Sargent. The bark is dull reddish brown, 1 to 2 inches thick, fissured and separating into long fibrous scales. The leaves in this form are arranged pseudo-distichously on horizontally spreading branchlets, and are linear in shape (see generic description). This form is the one which occurs generally in the alluvial swamps of the south-eastern United States.

2. Var. *imbricaria*.

Taxodium distichum, var. *imbricaria*, Sargent, *l.c.* 152.

Taxodium distichum pendulum, Carrière, *Conif.* 182 (1867).

Taxodium imbricarium, Harper, *Bull. Torrey Bot. Club*, xxix. 383 (1902), and xxxii. 105 (1905).

Taxodium sinense, Gordon, *Pinetum*, 309 (1858).

Cupressus disticha, β *imbricaria*, Nuttall, *Gen.* ii. 224 (1818).

Glyptostrobus pendulus, Endlicher, *Syn. Conif.* 71 (1847); Hooker fil., *Bot. Mag.* t. 5603 (1886).

A tree, generally smaller in size than the type, with branchlets normally erect, but occasionally somewhat spreading and very rarely pendulous. Leaves appressed on the branchlets and acicular-acuminate (see generic description).

According to Mohr,¹ this is the "upland Cypress" which occurs on the shallow ponds of the pine-barrens and in semi-swampy woods on poor sandy soil. He considers it to be greatly inferior to the typical cypress of the alluvial swamps in regard to the size and quality of the wood; and states that in the earlier stages of its growth and on vigorous adventitious shoots it produces leaves of the ordinary form. It passes readily, according to his observations, into the type, where the soil conditions are favourable. He considers the peculiarity of the foliage to be an adaptation to check excessive transpiration during the time of drought when the sandy soil is laid bare to the sun and the supply of water diminishes.

¹ *Contrib. U.S. Nat. Herbarium*, vi, 117 and 325 (1901).

Harper considers this variety to be a distinct species, and in support of this opinion alleges that certain differences which he has observed in the two forms are constant. The bark in var. *imbricaria*, both in cultivated and wild specimens, is considerably thicker and more coarsely ridged than in the typical form. The enlargement of the base of the trunk is abrupt in the former, conical in the latter. Knees are formed more abundantly in trees of the type, and are usually slender and acute, sometimes reaching a height of 6 feet. In var. *imbricaria* the knees are short and rounded, often almost hemispherical in shape. The type is a lover of limestone, the variety just the opposite. The distribution of the two forms is different, dependent upon the geological nature of the soil, var. *imbricaria* always growing on the Lafayette formation, which is a deposit of sandy clay, while the type always occurs on other formations. Harper admits the occurrence of intermediate forms, but states that they are rare. He has records of 300 to 400 stations in Georgia for var. *imbricaria*, at each of which there may be from ten to several thousand trees, while he has only seen intermediate forms about twenty times, and never more than 100 trees at one station. In the intermediate forms branchlets with distichous leaves occur on young shoots. Harper has seen in Georgia specimens of var. *imbricaria* as large as the ordinary form; but it is generally admitted to be a smaller tree. The two forms often grow close together, but in different situations. On the Savilla river in Camden County, Georgia, he noticed the type growing along the water's edge below the Lafayette formation, while a hundred yards or so away var. *imbricaria* was flourishing in moist pine-barrens.

Var. *imbricaria* is possibly a juvenile form, analogous to *Cryptomeria elegans*. The generally smaller size of the trees and the various differences noted by Harper are probably the result of poor soil, and do not, in my opinion, entitle this form to rank as a distinct species.

This variety was early introduced into England, as it was in cultivation, according to Aiton,¹ at Kew in 1789. The original tree at Kew, now dead, was living in 1886, when it was described by Sir Joseph Hooker² as 40 feet in height and of remarkable habit, on account of its slender twisted stem with decurved branches and pectinately-disposed branchlets. A small tree, 20 feet in height, is now growing in Kew Gardens.

A tree of the Mexican kind was reported³ to be growing at Penrhyn Castle, North Wales; but Elwes saw it in 1906, and confirms the opinion I had formed from specimens sent by Mr. Richards, that it is var. *imbricaria*. It is 44 feet high and 4 in girth, and comes into leaf later than the ordinary form growing near it.

At Pencarrow,⁴ Cornwall, there is a fine specimen, which was planted about 1841 by Sir W. Molesworth. It had attained in 1899 a height of over 30 feet, with a girth of stem of 2 feet 9½ inches at 5 feet from the ground.

¹ *Hortus Kewensis*, iii. 372. Described as "Cupressus disticha, var. nutans; foliis remotioribus subsparis: long-leaved deciduous cypress." This varietal name was kept up by Loudon, *loc. cit.* 2481, who considered it to be identical with the *Taxodium sinense* of cultivators of his time.

² *Bot. Mag.* t. 5603 (1886), where it is described as *Glyptostrobus pendulus*, Endlicher.

³ A. D. Webster, *Hardy Coniferous Trees*, 115 (1896). This tree is described in *Garden*, 1887, xxxi. 480.

⁴ Figured in *Gard. Chron.* 1899, xxvi. 489, fig. 161.

As ordinarily seen in cultivation it is a small tree of slow growth, and is quite distinct from the Chinese *Glyptostrobus heterophyllus*, with which it has been occasionally confused.

3. Var. *mucronatum*.

Taxodium mucronatum, Tenore, *Ann. Sc. Nat. sér.* 3, xix. 355 (1853).

Taxodium mucronulatum, Sargent, *Silva N. Am.* x. 150, note 2 (1896).

Taxodium Montezumæ, Decaisne, *Bull. Soc. Bot. de France*, i. 71 (1854).

Taxodium mexicanum, Carrière, *Traité Conif.* 147 (1855).

Taxodium distichum mexicanum, Gordon, *Pinetum*, 307 (1858).

This differs from the type in the foliage being more persistent, generally lasting two years on the tree, and in the time of flowering, which is in autumn. The panicles of male flowers are generally more elongated than those of the United States tree. The leaves are usually shorter, lighter green in colour, and blunter at the apex.

These differences scarcely entitle this form, which occurs in Mexico, to separate specific rank. Specimens¹ of the type, occurring at high elevations (1600 to 2000 feet) in Texas, approach it in character of the foliage; and in some Florida specimens the panicles of flowers are as large as any occurring on Mexican trees. The cones vary greatly in size and form in trees of *Taxodium*, occurring both in Mexico and the United States. Sargent, who has seen the tree in Mexico, was unable to distinguish it, by either foliage or habit, from the type.

It is evidently a geographical form in which certain differences of foliage have been brought about by climatic influence. One is led by a study of the specimens from many different regions to see in *Taxodium* a single species very variable in the wild state, rather than a number of distinct species.

Taxodium does not produce knees, so far as we can learn, in Mexico, where trees generally stand upon dry ground. According to Seeman,² the tree is known in Mexico as *Sabino*, and is diffused over the whole tableland of that country. There are reported to be extensive forests of it at altitudes varying from 4500 to 7500 feet. Concerning, however, the character and distribution of these forests our information is very scanty. Much more is known about the remarkable isolated examples of very old and enormous trees, which have always attracted the attention of travellers in Mexico. The most noted of these is the tree of Santa Maria del Tule, about eighteen miles south-east of the city of Oaxaca, which was measured by Baron Thielmann³ in 1886, when its height was between 160 and 170 feet. Its

¹ Specimens collected by Hillier in Keir County, Texas, are in the Kew Herbarium.

² *Botany of Voyage of H.M.S. "Herald"* (1852-1857), p. 335.

³ *Garden and Forest*, 1897, p. 123; figured on p. 125. The tree is also depicted in *Gard. Chron.* 1892, xii. 646, fig. 100. According to a correspondent, the girth was 139 feet in 1886; 25 years previously it had been 136½ feet. Various and conflicting measurements of this tree, taken by Exter, Baron von Karwinski, and Galeotti, in the early part of the nineteenth century, are given by Zuccarini in *Ray Society, Reports on Botany* (1846), p. 19. The latest measurements of this tree I know of are on a very fine photograph given me by the late Hon. Charles Ellis, as follows:—

TAXODIUM DISTICHUM AT MITLA, NEAR OAXACA.—Reported dimensions—

Girth at 4 feet from ground,	132 feet.
" " 6 " " "	154 "
" higher up . . .	198 "
Height, 100 to 120 feet.	

(H. J. E.)

actual girth at 5 feet from the ground, following all sinuosities, was 146 feet, the longest diameter being 42 feet. The cypress of Montezuma, which is the largest of the great trees in the gardens of Chapultepec, near Mexico, is about 48 feet in girth, according to Elwes, who saw it in 1888. Its height is about 170 feet.¹

Taxodium mucronatum was first described² from a specimen growing in the Botanic Garden at Naples, said to have been introduced into Europe in 1838. Elwes saw this tree in April 1903, when the old leaves were partly persistent. A tree at Palermo has borne fruit. There are specimens at Kew labelled "Hort. Cusinati," collected by J. Ball, which bear very large cones, $1\frac{1}{2}$ inches long by an inch in breadth.

Two seedlings were raised by Elwes from seeds brought by Mr. Marlborough Pryor from Oaxaca in 1904, one of which is to be planted out in a sheltered dell at Tregothnan in Cornwall, the other in the Temperate House at Kew. The larger of these, which grew slowly in a greenhouse through the winter of 1904-5, was about 18 inches high at one year old.

The typical form is the one commonly cultivated in England. In summer the foliage is decidedly ornamental, being of a delicate green colour. In autumn the leaves, before they fall, become reddish brown in colour.

Sub-varieties.—About a dozen sub-varieties are enumerated by Beissner,³ pyramidal, pendulous, fastigiate, dwarf forms, etc. The tree is very variable in habit.

Taxodium distichum rarely produces flowers or fruit in England. It first bore fruit about the year 1752. A tree⁴ at Ryton-on-Dunsmore, which was forty years old, produced flowers, apparently all males and in great abundance, in 1868. Fruiting specimens were sent to Dr. Masters⁵ from Menabilly in Cornwall in 1893; the cones were smaller than native-grown ones. One of these was prolific, the cone terminating in a branch bearing leaves and male flowers; and from the sides of the cone leaf-bearing branches also emerged, which on examination proved to form no part of either bract or scale, but were separate outgrowths from the axis of the cone. On a tree at Gwydyr Castle, North Wales, fruit is borne about every third year, but Mr. Macintyre informed me that it never was fully matured, and no seedlings were ever raised. According to Webster,⁶ this tree was profusely covered with cones in 1884, but had none when Elwes saw it in 1906. Bunbury⁷ states that at Abergwynant, in Wales, a tree produced oval cones.

Gay⁸ says that though often cultivated in wet places in several old parks at Paris, he has only seen fruit at the Trianon on a tree growing in very dry ground.

¹ *Garden and Forest*, 1890, p. 150, fig. 28.

² Carrière, *Traité Conif.* 147 (1855).

³ *Nadelholzkunde*, 152 (1891).

⁴ *Gard. Chron.* 1868, p. 1016.

⁵ *Ibid.* 1893, xiv. 659, fig. 105, showing fruiting branch, scales, and seeds. In the same journal, 1886, xxvi. 148, fig. 28, are represented abnormal flowers of this species, from a tree growing in England; also, in *Gard. Chron.* 1888, iii. 565, fig. 77, is depicted a remarkable gnaw on a *Taxodium*.

⁶ *Woods and Forests*, 1885, p. 25.

⁷ *Arboretum Notes*, 161.

⁸ Note in Kew Herbarium.

Seedling.—There are 5 or 6 cotyledons, borne in a whorl at the summit of a purplish brown caulicle, about 2 inches long, ending in a tiny curved rootlet, which subsequently develops a few lateral fibres. The cotyledons are linear, 1 to $1\frac{1}{4}$ inch long, $\frac{1}{16}$ inch broad, sessile on a broad base, gradually diminishing to an acute apex, upper surface dark green, bearing stomata in lines with a raised midrib; lower surface pale green and uniform. On the stem above the cotyledons are borne about 3 false whorls of leaves, $\frac{1}{2}$ inch long, those below resembling the cotyledons, but bearing stomata on both surfaces; those above having decurrent bases. In the axils of the uppermost leaves lateral branchlets are given off, bearing needles in two rows and forming short shoots, which fall off in autumn.

The preceding description is taken from seedlings raised at Colesborne from cones gathered by Elwes in September 1904 at Mt. Carmel, Illinois. (A. H.)

DISTRIBUTION

This remarkable tree occurs in North America from southern Delaware, where, according to Sargent, it formerly attained almost its largest size, all along the coast region as far as the Devil's River in Texas, and up the Mississippi valley as far as southern Illinois and south-western Indiana. In these regions it inhabits river bottoms usually submerged during several months, and swampy places. On the Edwards Plateau of Texas,¹ several hundred miles west of the great cypress swamps of eastern Texas, it occurs at 1000 to 1750 feet above sea-level, and attains an enormous size at the edges of the deeper holes near the heads of the permanent water of the Pedernales and other streams. This highland form in certain respects resembles the Mexican variety. In some parts of Louisiana, Texas, and the Gulf States, it occurs as pure forest, and in places so continuously flooded that the seed cannot germinate. I have passed on the railway, built on trestles for miles, through cypress swamps where the soil was submerged to a depth of 5 or 6 feet, and where few other trees could live. In drier places, such as the Wabash valley in southern Indiana, near Mount Carmel, where the cypress is evidently not so happy, it was associated with ash, liquidambar, and maple. In this locality also, although the trees were covered with fruit, I could find no seedlings; and as the accessible trees are in most places being rapidly cut for their timber, they seem likely to become scarcer unless protected. As far as I know it does not grow from the stool or from suckers.²

In Arkansas and Missouri there are swamps³ in which both *Taxodium* and *Nyssa uniflora* grow together, the latter with a peculiar dome-shaped base,

¹ *Ann. Report U.S. Geol. Survey*, xviii. 210, 211 (1898). There are specimens from this locality at Kew.

² R. Ridgway describes this locality as being in 1873 heavily timbered with cypress over an area of about 20,000 acres, in which the best trees had even then been cut and floated out into the river. The largest stump he measured was 38 feet in girth at the ground and 22 feet at 8 feet high. The largest standing tree measured was 27 feet in girth above the swollen base, and the tallest 146 and 147 feet high. Their average height, however, was not above 100 feet, and even the finest of them would not compare for symmetry and length with the sweet gums (liquidambar) and ashes (*Fraxinus americana*) with which they were associated.—*Proc. U.S. Nat. Mus.* 1882, p. 87. An excellent photograph taken here is published in *Garden and Forest*, iii. p. 7, and shows the knees remarkably well.

³ Coulter, *Missouri Bot. Garden Report*, 1903, p. 58.

analogous to the cone-shaped base of the former; and from Coulter's observations it would appear that seedlings of *Taxodium* are also rare here, and that it is being beaten in the struggle by the *Nyssa*, the seedlings of which are very abundant.

A disease¹ due to a fungus has attacked many of the trees in the Mississippi valley; the heartwood is found when the trees are cut down to be full of holes $\frac{1}{4}$ to $\frac{3}{4}$ inch in diameter.

Taxodium is one of the most striking and characteristic trees in the Gulf States, having its branches often covered with *Tillandsia usneoides*, the "Spanish moss" of the inhabitants, the long grey masses of which wave in the wind and give it a strange appearance. The trunk takes many curious forms, which seem to be induced by the nature of the soil and the depth of the water, sometimes branching low and surrounded by buttresses, sometimes growing straight up to a considerable height (Plates 52-53).² From the stout wide-spreading roots arise woody cylindrical projections, sometimes above a foot in diameter and 5 to 7 feet high, which are called "cypress knees." The growth and functions of these have been the source of much discussion.³ Berkeley⁴ supposed that they serve to aerate the submerged roots; others have thought that they help to anchor the roots in soft muddy soil. As the knees, however, occur to some extent even on ground which is never flooded, as in the trees at Syon, these suppositions, though highly probable, must remain somewhat doubtful.

The knees are hollow inside, and smooth externally, being covered with a reddish, soft, and spongy bark. They never show any sign of vegetation, and will not put forth shoots, even if wounded and covered with earth.

CULTIVATION

In England the *Taxodium* grows much better than might be expected considering how much colder and shorter are our summers than those of its native country. It was introduced by John Tradescant about 1640, and described by Parkinson⁵ as *Cupressus americana*.

For some unexplained reason it has lost the popularity it once enjoyed, and is now seldom planted, though it grows well in the southern and western counties. I have raised it from American seed, which, however, must be soaked in warm water for some time, and placed in a warm house to get good results. It grows rapidly at first, but as the young wood is not ripened, and no terminal bud formed (which

¹ Coulter, *Missouri Bot. Garden Report*, 1899, p. 23.

² For the negatives of the first of these photographs I am indebted to Miss E. Cummings of Brookline, Mass., a lady who is second to none in her love of and knowledge of trees. The second, which was sent by Mr. W. Ashe, represents a typical cypress swamp on the Roanoke river, North Carolina, which has never been cut for timber.

³ Sargent, *loc. cit.* 152, note 1; Coulter, *loc. cit.* The best review I know of the literature on this subject is in a letter by R. H. Lamborn in *Garden and Forest*, iii. p. 21, which should be consulted by those interested, and which is illustrated by a very curious photograph, taken at Lake Monroe in Central Florida, of the denuded roots of the tree, showing that in some cases, at least, the anchor theory is proved.

⁴ *Gard. Chron.* 1857, p. 549.

⁵ Parkinson, *Theatr.* 1477, fig. In *Catalogue of Trees*, London, 1730, p. 25, it is stated that the first tree, raised in Tradescant's garden near Lambeth, was then still living, being 40 feet high by 2 fathoms in girth.

Sargent says is also the case in America), the young plant must be kept under glass for the first two or three winters in order to develop a straight leader.

Many of the old trees which are to be found in England have evidently suffered from spring and autumn frosts when young, and have become stunted in consequence, but when the wood is ripe the tree will stand as much as 30° to 40° of frost, and I have seen it existing in the open air as far north as Copenhagen.

It should be planted in deep, moist loam, and the most sheltered situation that can be found, and may then be expected in the south and south-west to grow into a very fine and ornamental tree.

REMARKABLE TREES

The trees at Syon have been frequently described and figured. They are planted in damp soil by the side of a sheet of water, and one of them has produced knees of 1 to 2 feet high. This tree, which is shown in Plate 54, measured, in 1903, 90 feet by 12, but there is a much taller one on the other side of the water, which, when we saw it last in 1905, was 110 feet high, and is the tallest we know of in Europe. Another in the Duke's walk is 85 feet by 10 feet 3 inches.

But those at Whitton, near Hounslow, are even more remarkable, and are believed to have been planted by the Duke of Argyll between 1720 and 1762. They grow on gravelly soil, which, though apparently dry, is probably underlaid by damp alluvium. There are five trees standing in a group, of which the largest, carefully measured by us both in 1905, was 98 to 100 feet high by 13 feet 6 inches in girth; the others are all large, healthy, and growing trees (Plate 55).

At Pain's Hill, Surrey, there are two good trees: one,¹ measured by Henry in 1904, is 90 feet by 10 feet 9 inches, the other is 80 feet by 8 feet 6 inches.

At Parkside Gardens, Wimbledon, a tree is growing which is remarkably like the Ginkgo at Kew in habit. The bole at 7 feet divides into two stems, which give off seven or eight ascending branches. In 1904, measured by Henry, it was 65 feet by 11 feet 2 inches.

At Gothic Lodge, Wimbledon, the residence of Sir William Preece, there is a tree with a fine bole of 20 feet, dividing into several upright stems. In 1904, measured by Henry, it was 90 feet by 11 feet. This is perhaps the tree mentioned by Miller,² who says that a "tree at Wimbledon in the garden of Sir A. Janssen, Bart., bore cones for some years past and seeds which have been as good as those brought from America."

At White Knights, Reading, there are several trees, but none of large size, the biggest measuring, in 1904, 67 feet by 7 feet 10 inches. They are remarkable, however, for variety of habit. One is a tall, narrow tree with upright branches, almost fastigiate. In another tree the stem is twisted, as often occurs in the chestnut, and most of the branches are twisted also in the direction against the sun. Loudon mentions these as young trees of peculiar habits.

¹ This is probably the tree, reported in *Woods and Forests*, February 4, 1885, to be 83 feet in height by 10 feet in girth at 3 feet above the ground.

² Miller, *Gard. Dict.*, ed. 8, sub *Cupressus disticha* (1768).

At Barton, Suffolk, there are three trees, which measured in 1903, (*a*) in the Arboretum, 50 feet by 5 feet 5 inches, dying; (*b*) a smaller tree beside it, in a worse condition; (*c*) on the lawn, 56 feet by 4 feet 3 inches. The latter tree¹ was planted in 1826, the other two in 1831. It is evident that the dry though deep soil at Barton is not favourable to the growth of this species.

At Frogmore, Windsor, there are two specimens very different in habit. One, a clean-stemmed tree, growing near water, but without knees, is 80 feet by 8 feet 6 inches. The other, not so large, has a weeping habit, and is branched to the ground.

At Strathfieldsaye there is a tree, mentioned by Loudon as being 46 feet in height by 3 feet 4 inches in diameter, which I found in 1903 to be 63 feet high by 9 feet in girth. It is growing in stiff clay soil and has no knees; the stem is deeply furrowed.

At Dropmore there is a tree beside a pond, planted in 1843, and now measuring 60 feet by 5 feet 9 inches.

At South Lodge, Enfield, a tree is growing near water, with small knees, which, measured by Henry in 1904, was 77 feet by 11 feet 10 inches.

At Combe Abbey, Warwickshire, Mr. W. Miller² reports that a tree, mentioned by Loudon as 47 feet by 2 feet 3 inches in 1843, had attained, in 1887, 75 feet by 11 feet 6 inches at 3 feet from the ground.

At Longford Castle,³ Salisbury, there are two trees, growing within a few yards of the river Avon. One, very tall, has a straight trunk free from branches for about 30 feet, and a girth of 8 feet 10 inches at 4 feet from the ground. The other is 6 feet in girth, and branches at 7 feet up.

At Brockett's Park, near Hatfield, the residence of Lord Mountstephen, there are many trees planted along a walk on the banks of the Lee, and forming an irregular line in which the trees vary very much in size. In the sheltered part of the valley, where the soil and situation are very favourable, they average 70 to 80 feet high, the best I measured being 80 feet by 10 feet and 86 feet by 9 feet. But lower down the stream, where the valley is more exposed to the wind, they are stunted, and not more than half the height of those above. There are knees on some of the trees overgrown with moss and meadowsweet, but not so large as those at Syon.

At Upper Nutwell, near Exeter, there is a tree which Mr. G. H. Hodgkinson informed me in June 1904 was 84 feet high by 11 feet 9 inches in girth.

Large trees have been reported at many other places, especially in the south of England, viz. :—

Connington Castle,⁴ Huntingdonshire, a tree 70 feet by 7 feet in 1877; Watford,⁵ Herts, 85 feet by 14 feet in 1884; Stanwell,⁶ Surrey, a tree 13 feet in girth in 1904; Embley,⁷ near Romsey, Hampshire, a tree 8½ feet in girth in 1872, standing on the top of a hill.

¹ Bunbury, *Arboretum Notes*, 161.

² *Gard. Chron.* 1905, xxxvii. 12.

³ *Garden*, 1890, xxxvii. 538.

⁴ *Ibid.* 1877, xii. 405.

⁵ *Woods and Forests*, 1884, p. 546.

⁶ Reported by Sir Hugh Beevor.

⁷ Bunbury, *Arboretum Notes*, 161.

I have seen no trees in Scotland of any size, and Henry has heard of none in Ireland, but there is one in the Edinburgh Botanic Gardens 31 feet by 3 feet in 1905.

TIMBER

According to Sargent the timber is light and soft, close, straight grained, not strong, easily worked, and very durable in contact with the soil. It is largely used for building, most of the houses in Louisiana and the Gulf States being built from it, and large quantities are also now exported to the North, where it is found a most valuable wood for doors, sashes, balustrades, and greenhouses.

The Stearns Lumber Company of Boston, U.S.A., are making a speciality of it, and from a pamphlet published by this firm I take the following particulars :—

The timber varies considerably in different localities, and they consider, after long experience, that the so-called Gulf Cypress, grown in Florida, is better than the Louisiana Red Cypress, or that from the Atlantic coast of Georgia. Farther north it is apt to be more shaly and of coarser grain; and it is claimed that the seasoning is better done in the South than in the Northern States, from one to five years being required to do this properly, according to the dimensions of the timber, and that the longer in reason that it is kept in the pile before using the better.

It is said to be more durable, and to shrink and swell less than spruce or pine, to take paint well, and, as it contains no pitch, to resist fire longer than other coniferous woods.

It is quoted from the *Richmond Despatch* that a house, built by Michael Braun in 1776, and still owned and occupied by his descendants, was covered with cypress shingles, which were only removed in 1880.

Such shingles are now made by machinery at a very low price, and would be well worth trying for roofing houses in England, as they are very light in weight and inexpensive, and though I have no evidence that they are better than shingles made from English oak, their much greater size makes them easier to lay, and they can be cut to fancy patterns, which makes them very ornamental for roofing.

This wood is also highly recommended for doors, sashes, tanks, and other purposes where a great power of enduring damp is required.

It occasionally produces very ornamental wood, which is mottled and grained with red and brown, and some doors made of this wood, two of which I now possess, are extremely handsome.

Whether the wood grown in England will prove equally good I cannot say, as large trees are so seldom cut down in England that I have been unable to try it, but would certainly advise anyone who may have the opportunity to do so.

(H. J. E.)

THUYA

Thuya,¹ Linnæus, *Gen. Pl.* 378 (1737); R. Brown, *Trans. Edin. Bot. Soc.* ix. 358 (1868); Bentham et Hooker, *Gen. Pl.* iii. 426 (*ex parte*) (1880); Masters, *Jour. Linn. Soc. (Bot.)* xxx. 19 (1893). *Biota*, Endlicher, *Syn. Conif.* 47 (1847).

EVERGREEN trees of pyramidal habit and aromatic odour, belonging to the tribe Cupressineæ of the order Coniferae. Branches spreading and much ramified, terminating in so-called "branch-systems," which are flattened in one plane and are 2-, 3-, or 4- pinnately divided, their primary and other axes being densely clothed with scale-like leaves. These branch-systems² when they fall are cast off as a whole, the leaves not falling separately. The leaves, which are minute, are more or less coalesced with the axes, on which they stand in 4 ranks in 2 decussate pairs, those of the lateral ranks being conduplicate or boat-shaped, those placed dorsally and ventrally being flattened. In the seedling stage and certain horticultural varieties,³ the foliage is different, the leaves being acicular, spreading, and uniform; all 4 ranks in this case are alike.

Flowers monœcious, all solitary and terminal on the ultimate short branchlets of the preceding year, the male and female flowers on different branchlets, the former on the branchlets near the base of the shoot, the latter on those near its summit. Male flowers cylindrical or globular, consisting of 3 to 6 pairs of stamens placed decussately on an axis, each with an orbicular connective bearing 2 to 4 pollen sacs. Female flowers minute cones, composed of opposite scales in which no distinction of ovular scale and bract is visible, continuous in series with the leaves at the end of the branchlet, 2 to 4 pairs in *Biota*, 4 to 6 pairs in *Euthuya*, mucronate at the apex, some sterile, the others fertile and bearing 2 to 3 ovules.

Cones solitary, ultimately deflected, except in *Biota*, in which they retain the erect position, oblong, ovoid, or almost globose, composed of 3 to 6 pairs of decussate scales, which are not peltate, some fertile, the others sterile, the uppermost often united together. Seeds 2 to 3 on each fertile scale. Cotyledons 2.

The genus *Thuya*, as understood here, does not include *Chamaecyparis* and

¹ *Thuya* has been written *Thuja* in Linnæus, *Hort. Cliff.* 449 (1737), and *Sp. Pl.* 1002 (1753); and *Thuia* in Scopoli, *Introd.* 353 (1777).

² The branchlets become brown in colour before they fall. See Masters, *Gard. Chron.* 1883, xx. 596.

³ In addition to the varieties, in which the foliage retains permanently the seedling character, other forms occur in cultivation, in which the leaves are intermediate in shape between those of the seedling and of the adult plant. These varieties resemble the so-called *Retinospora* forms of the genus *Cupressus*, and were formerly considered, like them, to belong to a distinct genus.

Thujopsis, which were united with it by Bentham and Hooker. So limited, it comprises 5 species, and is divided into the two following sections:—

I. *Euthuya*. Cones with thin, coriaceous mucronulate scales, those of the 2 or 3 middle ranks being fertile. Seed thin, with lateral wings and a minute hilum. This section comprises 4 species, *Thuya occidentalis* and *Thuya plicata* of North America, *Thuya sutchuenensis* of central China, and *Thuya japonica* of Japan.

II. *Biota*. Cones with thickened, conspicuously umbonate scales, which are fleshy when young, almost ligneous when ripe; those of the lowest two ranks fertile. Seed thick, without wings, the hilum being large and oblong. This section includes one species, *Thuya orientalis* of north China.

The Thuyas resemble considerably in foliage and habit the flat-leaved cypresses. The latter are best distinguished by their fruit, which consists of peltate scales fitting closely by their edges. In a subsequent part, the peculiarities, as regards the branch systems and leaves, of these cypresses (*Cupressus Lawsoniana*, *nootkatensis*, *thyoides*, *obtusa*, and *pisifera*) will be described, and may then be compared with those now given below for the four species of *Thuya* in cultivation.

In the discrimination of the Thuyas, in addition to the characters shown by the bark, mode of branching, and fruit, the primary and secondary axes of the branch-systems give good marks of distinction. These axes are markedly flattened in *Thuya occidentalis*, terete in the other species. In *Thuya orientalis* the branch-systems stand in vertical planes, the inner edges of which are directed towards the stem of the tree. In ordinary forms of the other three species they are arranged in horizontal planes. The leaves on the main axes in each species differ as follows:—

1. *Thuya plicata*:¹ widely spaced, long, ending in long, fine, free points, which are parallel to the axis; glands inconspicuous or absent. Under surface of the foliage usually marked with white streaks.

2. *Thuya japonica*: placed closely together, shoots ending in short, rigid, thick, triangular points, directed outwards at an acute angle; glands absent. Under surface of the foliage conspicuously marked with broad white streaks.

3. *Thuya occidentalis*: widely spaced, ending in long, fine points, which are parallel to the axis; glands raised, large and conspicuous on the flat leaves. Under surface of the foliage pale green; white streaks inconspicuous or absent.

4. *Thuya orientalis*: widely spaced, ending in short triangular free points, which are not rigid, and are directed slightly outwards at an acute angle: flat leaves marked by longitudinal glandular depressions. Under surface of the foliage pale green, without white streaks.

Thuya sutchuenensis, Franchet,² is a small tree occurring in north-east Szechuan in central China, where it was discovered by Père Farges growing at an altitude of 1400 feet. The branchlets are much flattened, thin in texture, and practically glandless. Cones composed of 8 obovate scales, the apices of which are slightly thickened. This species has not been introduced into cultivation.

¹ This species exhales a peculiar aromatic odour, which is different from that of the other Thuyas.

² *Jour. de Bot.* 1899, p. 262. See also Masters in *Jour. Linn. Soc. (Bot.)* xxvi. 540.

THUYA PLICATA, GIANT THUYA

Thuja plicata, D. Don in Lambert, *Pinus*, ed. 1, ii. 19 (1824); Masters, *Gard. Chron.* xxi. 214; figs. 69, 70, 71 (1897); Sudworth, *Check List Forest Trees U.S.* 31 (1898); Sargent, *Manual Trees N. America*, 75 (1905).

Thuja gigantea, Nuttall, *Jour. Philad. Acad.* vii. 52 (1834); Sargent, *Silva N. America*, x. 129, t. 533 (1896); Kent, in Veitch's *Man. Coniferae*, 239 (1900).

Thuja Menziesii, Douglas, ex Carrière, *Traité Gén. Conif.* 107 (1867).

Thuja Lobbi, Hort.

Thuja Craigiana, Hort. [*non* A. Murray, *Bot. Exped. Oregon*, 2 (1853)].

A lofty tree, attaining a height of 200 feet, with a trunk remarkably conical, the base being broad and buttressed, sometimes girthing as much as 40 to 50 feet near the ground.

Bark of the trunk fissuring longitudinally in narrow thick plates, which scale off, leaving exposed the reddish brown cortex beneath. On the branches, the bark only begins to scale when they become old and thick. Branches horizontal, ascending towards their ends, forming in England a dense, narrow, pyramidal tree, usually clothed to the base.

The 3-4 pinnate branch-systems, disposed in horizontal planes, have their main axes terete and covered with long leaves ending in acute points which keep parallel to the axes. The glands on these leaves are inconspicuous or absent. On the ultimate axes the leaves are smaller, the flat ones scarcely glandular, and ending in mucronate points; the lateral ones keeled on the back, slightly curved, and ending in sharp cartilaginous points. On the lower surface of most branchlets the foliage is streaked with white, some branchlets usually remaining uniformly green.

The male flowers are dark red in colour, cylindrical, and composed of about 6 decussate pairs of stamens.

The cones when ripe do not remain erect, but are deflected out of the plane of the branchlets. They are oblong, light brown in colour, and composed of 5 to 6 pairs of scales, of which the 2nd, 3rd, and 4th pairs are larger than the others, and fertile. The scales are oval or spatulate, with a rounded apex, from immediately below which externally a small deltoid process is given off. The seeds, 2 or 3 on each fertile scale, are brown in colour, two-thirds the length of the scale, and surrounded laterally by a scarious wing, which is deeply notched at its summit.

Seedling.¹—The 2 cotyledons are linear, flat, acute at the apex, and slightly tapering towards the base, supported on a terete caulicle, about $\frac{3}{8}$ inch long, which ends in a long brown flexuose primary root giving off a few fibres. The stem, terete and smooth near the base, becomes ridged above by the decurrent leaf-bases. The first 4 true leaves are in opposite pairs, decussate with the cotyledons. Above these the stem gives off a number of whorls or pseudo-whorls of longer ($\frac{1}{2}$ inch) sharply pointed leaves, dark green above and pale beneath, with markedly decurrent

¹ Figured in Lubbock, *Seedlings*, ii. 551, fig. 676 (1892), and Sargent, *loc. cit.* t. 533, fig. 12.

bases. After a few of these whorls lateral branches are given off, which sometimes bear a few acicular leaves at their bases. The lateral branches ramify and approach in character those of the adult plant, as the leaves are arranged decussately in 4 ranks. These leaves are variable, being acicular and loosely imbricated, or scale-like and closely imbricate. The branches are ascending, horizontal, or drooping, and are more or less flattened from above downwards.

HISTORY¹

This tree was discovered by Née, who accompanied Malaspina in his voyage round the world during the years 1789 to 1794; and his specimen, gathered at Nootka Sound, is preserved in the Natural History Museum at South Kensington. It was referred to by James Donn, in *Hortus Cantab.* ed. 4 (1807), as *Thuja plicata*, without any description; and subsequently D. Don drew up from it the oldest description of the species under the same name. The *Thuja plicata* of gardens, which was early in cultivation, is a variety of *Thuja occidentalis*, and has no connection with the plant of Née.

Archibald Menzies, who accompanied Vancouver's expedition as botanist, gathered specimens also at Nootka Sound in 1795. Nuttall received specimens later from the Flathead river, on which he founded his description of the species as *Thuja gigantea*. It was introduced into cultivation² in 1853 by W. Lobb, and distributed from Veitch's nursery at Exeter as *Thuja Lobbi*, as at that time Nuttall's name *Thuja gigantea* was wrongly applied to *Libocedrus decurrens*, and Don's name, *Thuja plicata*, in a similar erroneous way, had gone into common use for a variety of *Thuja occidentalis*. Afterwards the tree became generally known in England as *Thuja gigantea*; and it is unfortunate that Don's name, *Thuja plicata*, must, following the law of priority, be substituted for a name so well known and so established as *gigantea*. This change of name has, however, been adopted in the *Kew Hand List of Conifers*, and by Sudworth and Sargent in North America, and on the whole it is now most convenient to adopt the name *Thuja plicata*.

(A. H.)

DISTRIBUTION

This tree is, next to the Douglas fir, the most important from an economic point of view in northern Oregon, Washington, and British Columbia.

It extends in the north as far as southern Alaska, in the east to the Cœur d'Alène Mountains in Idaho and to north-western Montana, and in the south to Mendocino County in northern California. It is known as Cedar, or Red Cedar, and is found most abundantly on wet soils and in wet climates, ascending from sea level to an elevation, according to Sargent, of 6000 feet, where it becomes a low shrub.

¹ See Masters, in *Gard. Chron. loc. cit.*

² At the Royal Botanic Gardens, Edinburgh, there were in 1884 five trees of supposed *Thuja gigantea*, which were raised, it was said, from seed sent to Edinburgh by Jeffrey in 1851, while collecting for the Oregon Association. Three of these trees, according to Nicholson, were true *gigantea*, the other two being what is now known as *Thuja occidentalis*, var. *plicata*. See *Woods and Forests*, Feb. 27, and Mar. 19, 1884. These trees cannot now be identified.

It is scarce in the dry belt of country east of the Cascade Mountains, but common in the Selkirk and Gold ranges, though, so far as I know, it never extends to the eastern side of the Rocky Mountains.

On the coast and in Vancouver Island it attains an immense size. I have never measured trees more than 200 to 220 feet high, but Prof. Sheldon says that it attains 250 feet in Oregon, though no actual measurements are given.¹ As regards their girth, I have measured two trees which may have grown from the same root, so close do they stand together, one of which was 39, the other 25 feet at 5 feet from the ground. These stand on Mr. Barkley's farm in Vancouver Island, in swampy land near sea level, and are figured in Plate 56.² At over 2000 feet elevation in Oregon I measured another, also a twin tree, which was 30 feet in girth. Mr. Anderson states that he has seen Indian canoes 6 feet and more from the level of the gunwale to the bottom, hewn out of a log of this tree, such canoes being often 50 feet and more long. A hewn plank 5 feet wide by 15 feet long is in the museum at Victoria, B.C., and split boards, quite straight, 12 feet long and 15 inches wide, are made from it without difficulty.

The natural reproduction by seed was, wherever I saw it, very good, though in the densest shade the western hemlock seemed to have the advantage.

CULTIVATION

Wherever I have seen this tree growing in England and Scotland it is a vigorous, healthy tree of great beauty and promise, and one that I think is likely in fifty years or so to become a more valuable timber tree than the silver fir or spruce.

It has been stated in a report by Herr Bohm, in the March number of the *Zeitschrift für Forst. u. Jagdwesen* for 1896,³ that the parasitic fungus *Pestalozzia funerea* has done serious damage to the tree in North Germany, and statements to the same effect have been made elsewhere; but I can say that out of the thousands of this tree that I have raised from English seed and planted out in a bad soil and climate, I have never had any die from any disease whatever, and have found it an easier tree both to raise and to transplant than any other conifer. It will grow on almost any soil at the rate of at least one foot per annum, as in damp, cold bottoms where the spruce will hardly thrive, on the poor dry oolite soil of the Cotswold hills, and seems equally indifferent to wind, damp, and spring frosts.⁴ It seldom loses its leader, is rarely blown down, endures heavy shade, and transplants both in

¹ In the Canadian Court of the Colonial Exhibition of 1886, there was shown a portion of a bole of this species, which was taken from a tree girthing 21 feet, and having a length of 250 feet. It came from British Columbia.—*Gard. Chron.* 1886, xxvi. 207.

² An illustration of a tree growing near Snoqualmie Falls on the Seattle and International Railway, Washington, was given in *The Pacific Rural Press* in 1897. This is said to have been 107 feet 7 inches round at the base, and was supposed to have been over 1000 years old, but we know of no good evidence that it ever attains so great an age as this.

³ Cf. A. C. Forbes, *Gard. Chron.* 1896, xix. 554.

⁴ The very severe frost on May 20-21, 1905, when 10°-15° of frost were registered in many places, which killed many young beech trees in low situations at Colesborne, and checked the young growth considerably, killed none except a few of the weakest Thuyas which were freshly transplanted; but the autumn frost of the following October, when the trees were still in growth, seems to have done more harm, though the young trees did not die till the following spring.

early autumn and late spring with great readiness. It has, therefore, every good quality a forest tree can have, except the as yet unproved one of cleaning its trunk from branches without pruning.

And as this has not yet been properly tested by thick planting, I venture to say that there is no conifer better worthy of an extensive trial as a timber tree for such purposes as the larch is now used, and especially for fencing posts, for which its remarkable durability in the ground seems to make it most valuable.¹

I should therefore recommend that this tree should be planted at distances of 6 to 8 feet apart in situations where larch will not thrive, and not thinned as long as the trees keep healthy.

In the New England states it is not hardy enough to live in many places, but Professor Sargent tells me that a variety raised from seed from the Coeur d'Alène mountains in northern Idaho is hardy at Boston, where the form from the Pacific coast is tender, just as in the case of the Douglas fir.

No reliable tests, so far as I know, have yet been made in England or America as to the breaking strain and strength of this wood, but Sheldon states that it is used for telegraph posts in Oregon, and though its branches die off so slowly that the home-grown timber may probably be knotty, it is certainly not worse in this respect than spruce, to which I should consider it in every respect a superior forest tree.

The seed usually ripens about the end of October, and is very freely produced in most seasons. It soon sheds when ripe, and should be sown in boxes or in the open ground in early spring. I have tried both plans with great success, and find it best to plant the seedlings at two years old in nursery lines, and plant out the trees finally either in the early autumn or spring, when the deaths will be very small if the roots are not allowed to dry before planting.

There is very little variation among the seedlings, which grow rapidly in moist soil, and are less liable to suffer from spring frost than most trees, though if planted in mid-winter the tops are liable to die back.

There is no reason why this tree should not be sold in nurseries at the price of spruce except the absence of a regular demand, as it can be got up to a proper size for planting in two years less time.

The tree seeds itself very rapidly on sandy soil in many parts of the west and south of England, though liable to be thrown out of the ground by frost during the first year, and often destroyed by rabbits. On the lower greensand at Blackmoor, Hants, self-sown seedlings were quite numerous, both of this tree and of many other conifers, but rabbits are not allowed here, and both Lord and Lady Selborne take great interest in self-sown seedlings.

REMARKABLE TREES

The giant Thuya has not been long enough in cultivation to show whether it

¹ I have recently been shown by Mr. Molyneux a plantation of *Thuya gigantea* and larch called Mays hill, made by him in 1888 on poor, heavy wheat land overlying chalk at Swanmore Park, Hants, the seat of W. H. Myers, Esq., M.P. Here the Thuyas have completely outgrown the larch, and in many cases suppressed them, and are 15 to 20 feet high, and quite healthy; whereas where the larch were planted alone in the same place they are diseased and sickly.

will attain the same dimensions that it does in America, but there are many trees which are already 60 to 70 feet in height at less than fifty years from seed.

By far the finest that I have seen or heard of are at Fonthill Abbey, Wilts, the residence of Lady Octavia Shaw-Stewart, which were raised in the late Duke of Westminster's gardens at Eaton Hall from seeds collected for Lord Stalbridge in 1860. Here, on a bed of greensand at an elevation of 400 to 500 feet, well sheltered from wind, are growing some of the finest and best grown conifers in Great Britain. In a group of three *Thuyas*, the middle one measured in 1906, as nearly as I could ascertain, not less than 90 and probably 95 feet in height by 10 feet in girth, and already began to show the buttressed trunk which is so characteristic in its native country. The other two trees were not much less in size, and all were a picture of health and symmetry (Plate 57).

The next tallest that we know of is a tree at Albury Park, the Surrey seat of the Duke of Northumberland. This was measured by Henry in 1904, and by myself in 1905, but owing to the way in which it is shut in by other trees it is difficult to measure accurately, and though the late Mr. Leach, the head gardener at Albury, and Dr. Henry both considered it about 90 feet high, I should not like to say that it is over 80, with a girth of 7 feet 6 inches. It is, however, a very healthy and vigorous tree, and growing fast, and the Duke's agent and gardener both hold a very high opinion of the probable value of the tree for timber, and are planting it largely on the estate. See *Gard. Chron.* Jan. 30, 1892, where an account is given of the trees at Albury in which Mr. Leach is quoted as saying: "If I had 1000 acres to plant with trees that would give the most remunerative return in a given time, the above would be my mainstay."

Sir Charles Strickland, one of the oldest and most experienced planters in England, also has a high opinion of this tree, and is quoted as follows by Mr. A. D. Webster in an article on this tree in *Trans. Scottish Arb. Soc.* vol. xii. p. 343:—"There is a hillside here (Hildenley, Yorkshire), with a thin soil upon limestone rock, which I planted two or three times over with very small success—chiefly, I believe, on account of the extreme dryness of the site. The *Thuya* grows there with great vigour, and I have scarcely lost one of those planted. Among the other merits of this *Thuya* is the ease with which it may be transplanted, owing to its having bushy, fibrous roots, instead of the long tangles which larch and many other conifers have." I saw this plantation in 1905, and though the situation is too dry for *Thuya* to grow to any size, it bears out Sir Charles's good opinion. He has continued to raise the tree largely from his own seed, and is planting them largely at 5 feet apart, without mixture.

At Castlehill, North Devon, the seat of Earl Fortescue, there are also very fine specimens of *Thuya plicata*. The best is growing in a quarry in a well-sheltered place, but on dry, rocky ground. It measured in April 1905 about 74 feet high by 5 feet 11 inches in girth, and bids fair to become a noble tree.

At Fulmodestone, Norfolk, there are two trees, planted in 1863, which measured in 1905, 67 feet by 7 feet, and 61 feet by 6 feet 8 inches, and have natural seedlings around them.

At Coolhurst, near Horsham, Mr. C. Scrace Dickens showed me a very fine and symmetrical tree 75½ feet high by 5½ in girth, and only 8 yards in the spread of its branches.

At many places in the south-west of England trees of from 65 to 70 feet are growing of which the following are the best we have measured ourselves:—Linton Park, Kent, 70 feet by 7 feet 1 inch in 1902; Dropmore, Bucks, 68 feet by 6 feet 10 inches in 1905; Killerton, Devonshire, 68 feet by 7 feet 10 inches in 1905; Bicton, Devonshire, 70 feet by 8 feet 2 inches in 1902; Blackmoor, Hants, 60 feet by 6 feet.

In Wales a tree at Hafodunos measured 65 feet 6 inches by 9 feet 7 inches in 1904, with natural seedlings a few feet from its base on the stump of an old tree; at Welfield, near Builth, the seat of E. D. Thomas, Esq., a tree 68 feet high and 6½ feet in girth was flourishing on the Llandilo slate formation; and at Penrhyn Castle Mr. Richards showed me a well-shaped and healthy young tree about 50 feet high, one of fifty which had been transplanted when about 18 feet high, only one of which died after being moved.

In Scotland *Thuya plicata* flourishes in the south and west, as well as in England. At Inverary Castle a tree only 25 feet high in 1892 is now over 60. At Poltalloch there are many, of which one in 1905 was 65 feet by 7 feet 2 inches. As far north as Gordon Castle it grows well, and at most of the places from which reports were sent to the Conifer conference in 1892 it is spoken of as healthy and vigorous. At Murthly, Scone, and Castle Menzies, I have seen fine trees, but have not measured any of remarkable size.

At Monreith, Dumfriesshire, the seat of Sir Herbert Maxwell, Bart., who has a high opinion of this tree, a large number have been raised from seed and planted out, but are as yet too young to measure.

At Benmore, near Dunoon in Argyllshire, the property of H. J. Younger, Esq., where there are very interesting plantations of several kinds of exotic conifers made in the winter of 1878-79, *Thuya*, when mixed with the common larch and Douglas fir on a steep hillside at 250 to 500 feet above sea-level, is now being suppressed by these species, which grow more vigorously. However, in one part of the plantation, near Ardbeg, at only 50 feet above sea-level and in fairly good soil, the *Thuya* was holding its own fairly well with the Douglas, and had attained, at twenty-four years old, 50 feet in height with clean stems varying from 25 to 38 inches in girth at 5 feet from the ground. Near Kilmun, on the same property, there is now, according to the forester, about 1½ acres of *Thuya*, which has been planted mixed with larch. The larch has been cut out, and the whole area is now pure *Thuya*, with clean stems larger in size than in the other parts of the plantations where it occurs mixed with Douglas fir.¹

In Ireland the best trees we know of are at Castlewella, co. Down, 65 feet in 1903; Hamwood, co. Meath, 71 feet by 6 feet 3 inches in 1904; Churchill, co. Armagh, 68 feet by 5 feet 10 inches in 1904; Adare, co. Limerick, 71 feet by 7 feet 7 inches in 1903.

¹ We are indebted to Mr. Angus Cameron, factor for the property, and to Mr. J. M. Stewart, forester, for further particulars of these plantations, for which we cannot now find space.

At Dartrey, in co. Monaghan, the Earl of Dartrey planted in 1882 a considerable area of slightly hilly ground with a mixture of larch, spruce, Douglas fir, and Thuya. In 1904, twenty-two years after planting, of the four species, all grown densely under the same conditions, the Thuya had made the most timber, the trees averaging 40 to 50 feet in height by $4\frac{1}{2}$ feet in girth. The Douglas fir was slightly taller, but not so stout in the stem, averaging about $3\frac{1}{2}$ feet in girth. The Earl of Dartrey speaks very highly of the timber of Thuya, which he considers to be superior to that of the best larch.

At Brockley Park, Queen's Co., the residence of Mr. Wm. Young, there are trees growing on light soil on limestone, which have made 40 cubic feet of timber in 30 years, and 50 feet in 35 years. The tallest tree, 30 years old, was in 1906 64 feet high by 7 feet 9 inches at a foot from the ground, and $3\frac{1}{2}$ feet girth at 24 feet up; and its branches were 105 feet in circumference.

TIMBER

Sargent says, *Garden and Forest*, iv. p. 109: "The wood is very valuable; it is light, soft, and easily worked, and so durable in contact with the ground, or when exposed to the elements, that no one has ever known it long enough to see it decay."

The great value of the cedar for shingle-making has long been known, and several instances were mentioned by reliable people in Vancouver Island of hand-made shingles, or "shakes" as they are called, remaining good 40 to 50 years on roofs without decaying in the wet climate of this island.

They are now manufactured on a very large scale by machinery in all the Puget Sound mills, and exported largely to the middle and eastern states in neat bundles, and I have no doubt that, if carefully selected and laid, such shingles would be very suitable for roofing in England. Sargent says, *Garden and Forest*, iv. p. 242, "that nearly 100 mills were in 1891 exclusively devoted to making Red Cedar shingles, and that the combined output of half of these operated by one company was 3,500,000 per diem. They are now supplanting the Pine shingle of Michigan, the Cypress shingle of the south, and the Redwood shingle of California."

As a rule in the American forests, they begin to decay at the heart long before they attain their full growth, and the trunk seems to continue growing round the hollow centre for an almost indefinite time, as in the case of the yew. On drier land it keeps sound longer, and if cut when 2 to 3 feet in diameter the wood is probably at its best. It resists decay for an immense time when fallen.

For inside finish the wood is excellent, though not hard enough for flooring and wainscot, or strong enough for joists. For ceiling and panelling it is most ornamental when well cut, as I saw in the Hotel at Duncan's, Vancouver Island.

Mr. Stewart has found at Benmore that it is very suitable for all estate purposes, and prefers it to larch for planking and fencing, as he finds it less liable to warp and crack.

(H. J. E.)

THUYA OCCIDENTALIS, WESTERN ARBOR VITÆ

Thuya occidentalis, Linnæus, *Sp. Pl.* 1002 (1753); Loudon, *Arb. et Frut. Brit.* iv. 2454 (1838); Sargent, *Silva N. America*, x. 126, t. 532 (1896), and *Manual Trees N. America*, 74 (1905); Masters, *Gard. Chron.* xxi. 213, figs. 67, 68, and 258, fig. 86 (1897); Kent, in Veitch's *Man. Conif.* 244 (1900).
Thuya plicata, Hort. (*non* Don).

A tree, attaining a height of 50 to 60 feet, with a stout and buttressed trunk, sometimes 6 feet in diameter. It often divides near the base into two or three stems. In England the branches, short and spreading, form a tree pyramidal in outline, which is not so dense in foliage as *Thuya plicata*. Bark of the trunk scaling off in thin papery rolls, but not so freely or so finely as in *Thuya japonica*. The branches when of no great size begin to show scaly bark.

The branch systems are disposed in horizontal planes, resembling those of *Thuya plicata*; but their main axes are flattened, being compressed from below upwards, while the leaves are shorter than in that species, ending in similar long points. The flat leaves on the main axes are studded with conspicuous large circular elevated glands. The smaller leaves on the ultimate branchlets vary as regards the presence or absence of glands; the lateral pairs are shorter than and not so acutely pointed as in *Thuya plicata*. The foliage is dark green above, pale green and not marked with white streaks below.

The male flowers, minute and globose, are composed of three decussate pairs of stamens. The female flowers are yellow.

The cones become deflected when ripe, as in *Thuya plicata*. They are oblong, light brown, and composed of 4 to 5 pairs of scales, of which the 2nd and 3rd pairs are larger than the others, and fertile. The scales are ovate or spatulate, ending in a rounded or acute apex, with a minute external process, which is generally much less developed than is the case in *Thuya plicata*. The seeds, usually two on each fertile scale, are scarcely distinguishable from those of the last-named species.

Seedling.¹—Cotyledons as in *Thuya plicata*. The caulicle and stem are quadrangular. The first two true leaves are opposite, spreading, and similar to the cotyledons, though smaller. These are followed by 5 or more whorls or pseudo-whorls, each of three similar leaves, linear, acute, and sessile. The ultimate leaves are opposite, decussate, and adnate for the greater part of their length to branchlets, which are flattened from above downwards.

VARIETIES

Few trees, except *Cupressus Lawsoniana*, show a greater tendency to variation in the seed-bed. Sargent says that if anyone will sow a quantity of seed he will be sure to find forms among the seedlings as novel and as interesting

¹ See Lubbock, *Seedlings*, ii. 548, 560 (1892).

as any now in cultivation. Many of the varieties only show their distinctive characteristics when young, and soon grow up into the normal form. Beissner gives as many as forty varieties; but it is doubtful if all these are recognisable. Those commonly met with in cultivation in this country are enumerated below:—

1. Var. *ericoides*.¹

Retinospora dubia, Carrière, *Conif.* ed. 2, p. 141.

A form in which the seedling foliage is fixed and preserved. It is a dwarf, compact, rounded, or somewhat pyramidal shrub, with slender branchlets, on which the leaves, heath-like in appearance, are borne in distant decussate pairs. They are spreading, linear, and soft in texture, becoming brown in winter. This shrub resembles *Cupressus pisifera*, var. *squarrosa*; but in the latter the leaves are much whiter on both surfaces, and do not brown in winter. The latter also attains a much larger size, and often becomes a large shrub or small tree.

2. Var. *Ellwangeriana*.

Retinospora Ellwangeriana, Carrière, *Rev. Hort.* 1869, p. 349.

This is a transition form, in which both kinds of foliage, seedling and adult, appear on the shrub, which may attain a considerable size. There is no regularity in the distribution of the two kinds of leaves; but in shrubs at Kew of this variety the juvenile foliage persists on branchlets in the interior shaded parts, the external branchlets having adult foliage.

It was probably this form which M'Nab² mentions as having seen in 1866 in quantity in the nursery of Messrs. P. Lawson and Sons, who had received it from Messrs. Ellwanger and Barry of America under the name of Tom-Thumb Arbor Vitæ. M'Nab states that the heath-like leaves have a slight smell of juniper, while the other foliage has the odour of ordinary *Thuya occidentalis*.

3. Var. *plicata*, Masters, *Gard. Chron.* xxi. 258, fig. 86 (1897).

Thuya plicata, Parlatores, *D.C. Prod.* xvi. 457.

A tree differing from the type in the branch-systems tending to assume the vertical plane, being curved so that the ultimate branchlets lie in different planes. The foliage is conspicuously glandular, the lateral leaves being flattened, so that they become almost like the median ones in appearance. According to Kent the foliage shows a brownish tint.

This variety was long considered to be a distinct species; but it is only a seedling of *Thuya occidentalis*, with which it agrees in cones and in general character of the leaves.

4. Var. *Wareana*. This only differs from the last in the colour of the foliage, which is a deep green without any brown tinge. It was raised by Mr. Ware of Coventry.³ According to Masters⁴ it has larger leaves than var. *plicata*, and corresponds very closely with native specimens of *Thuya occidentalis* gathered at Niagara.

¹ A plant of this variety growing into the mature form at Meehan's nursery, Germantown, U.S., showed that it was only a juvenile state of *Thuya occidentalis*.—*Garden and Forest*, 1893, p. 378.

² *Trans. Edin. Bot. Soc.* ix. 61, fig. (1868).

³ Gordon, *Pinetum*, ed. 2, p. 409.

⁴ *Gard. Chron.* xxi. 258 (1897).

5. Var. *dumosa*. A dwarf shrub, with the foliage and branchlets of var. *plicata*.

6. Var. *pendula*. A shrub with pendulous branches and branchlets.

7. Var. *erecta*. Branches slender and erect. In var. *erecta viridis* the foliage is dark green and shining on the upper surface. It originated in Messrs. Paul's nurseries at Cheshunt.¹

8. Var. *Späthi*. A monstrous form, with seedling foliage on the younger branchlets, older branchlets being tetragonal, and clothed with sharp-pointed adult leaves.

9. Various forms occur with coloured foliage, as *lutea*, *aurea*, *vervæneana*, etc.

Thuya occidentalis was probably the first American tree cultivated in Europe. Belon² describes it as occurring in a garden at Paris about the middle of the sixteenth century. It was introduced into England prior to 1597, as it is mentioned by Gerard in his *Herball* published in that year. (A. H.)

DISTRIBUTION, ETC.

According to Sargent, *Thuya occidentalis* frequently forms nearly impenetrable forests on swampy ground, or occupies the rocky banks of streams from Nova Scotia and New Brunswick, north-westward to Cedar Lake at the mouth of the Saskatchewan, and southward through the northern states to southern New Hampshire, central Massachusetts and New York, northern Pennsylvania, central Michigan, northern Illinois, and central Minnesota, and along the high Alleghany mountains to southern Virginia and north-eastern Tennessee; very common in the north, less abundant and of smaller size southward; on the southern Alleghany mountains only at high elevations.

Mr. James M. Macoun says of this tree in his excellent pamphlet, *The Forest Wealth of Canada* (Ottawa, 1904), that the white cedar, as it is there usually called—though in New England this name is always given to *Cupressus thyoides*—is very rare in Nova Scotia, but abundant throughout New Brunswick and Ontario. It grows to a considerable height, but seldom exceeds 2 feet in diameter. The wood is soft and not strong, and has never been much used for timber, but is unexcelled for shingles. It is chiefly used for fence rails and posts, railway ties, and telegraph posts. No other wood is used in any quantity for telegraph poles in Ontario and Quebec. It is very durable in contact with the soil or when exposed to the weather.

I saw the tree abundantly in wet swamps and also on dry ground near Ottawa, where, in Rockcliff Park, good though not large trees of it may be seen, the best having all been cut out for telegraph poles. On dry, rocky ground the tree grows freely from the stool, and in wet places in the woods reproduces abundantly from seed, which was ripe at the end of September, and, as usual in the forests of Canada, germinates and grows best when it falls on a rotten log.

¹ *Gard. Chron.* xiv. 213 (1880).

² Belon, *De Arboribus Coniferis*, p. 13 (1553).

REMARKABLE TREES

Thuja occidentalis never attains to a considerable size when planted in this country. There is a specimen at White Knights, near Reading, of great age, which is now dying at the top. According to the gardener there it has not made any growth for the last thirty-five years. It measured in 1904, 41 feet in height by 4 feet in girth. At Stratton Strawless, Norfolk, there is also a specimen of considerable age, remarkable for the pendulous habit of the branches, which is 35 feet in height. There are more large specimens at Belton Park than at any other place I know in England, the largest I have measured being 41 feet by 3 feet 9 inches. Henry, however, in 1904 measured one at Arley Castle as tall, which divides into three stems near the ground, where it measures 7 feet 6 inches in girth. At Auchendrane, Ayrshire, Renwick measured a tree in 1902—which, according to a specimen procured by him in 1906, was *Thuja occidentalis*—as 42 feet high by 6 feet 8 inches in girth, with a bole of 12 feet.

It seems to be one of the best conifers for making shelter hedges in gardens, as it stands clipping well, and for this purpose may be relied on to attain 15 to 20 feet in height in any fair soil. As it grows slowly at first when raised from seed, it is usually propagated by cuttings. (H. J. E.)

THUYA JAPONICA, JAPANESE THUYA

Thuja japonica, Maximowicz, *Mél. Biol.* i. 26 (1866); Masters, *Jour. Linn. Soc. (Bot.)* xviii. 486 (1881), and *Gard. Chron.* xxi. 258, fig. 87 (1897); *Revue Horticole*, 1896, p. 160; Kent, in Veitch's *Man. Coniferae*, 244 (1900); Shirasawa, *Icon. des Essences forestières du Japon*, 28, t. xi. 18-34 (1900).

Thuja Standishii, Carrière, *Traité Gén. Conif.* 108 (1867).

Thuja gigantea, var. *japonica*, Franchet et Savatier, *Enum. Pl. Jap.* i. 469 (1875).

Thujopsis Standishii, Gordon, *Pin. Suppl.* 100 (1862).

A tree attaining, according to Shirasawa, a height of 90 feet in Japan, with a tapering stem, open in habit as cultivated in England, and not forming such a dense pyramid as *Thuja plicata*. Bark of the trunk scaling off in very narrow longitudinal papery strips. The bark commences to scale on young branches of less than a half inch in diameter. The branches curve upwards towards their extremities.

The branch-systems, 3-4 pinnate, are disposed in horizontal planes, which droop at their outer extremities. Primary axes terete, with leaves densely crowded, all the four sets ending in short, rigid, thick, free points, glands being absent. The leaves on the ultimate branchlets are obtuse, and not acutely pointed as in *Thuja plicata*; and glands may be present or absent on the flat leaves. The foliage is light green above, while on the under surface there are whitish streaks, somewhat triangular in outline, which exceed in area the greener parts.

Male flowers cylindrical, with 6 decussate pairs of stamens. The cones are deflected, ovoid, and composed of 5 to 6 pairs of scales, of which the second and third pairs are larger than the others and fertile. The scales are broadly oval, with a rounded apex, from below which externally is given off a short, broad, triangular process, projecting from the scale at right angles or nearly so. The seeds, three to each fertile scale, and nearly equal to it in length, differ considerably from those of *Thuja plicata* and *Thuja occidentalis*, the wing being narrow, not so scarious in texture, entire, and not notched at the summit.

Fortune discovered *Thuja japonica* in cultivation around Tokyo in 1860, and sent home seeds of it to the nursery of Mr. Standish at Ascot, who distributed plants under the name of *Thujopsis Standishii*. Maximowicz, who had also seen it cultivated at Tokyo, gave the species its first authoritative name in 1861. Maries found it growing wild on the mountains of Nikko, in central Japan, in 1877. Sargent,¹ who, in company with James H. Veitch, met with a few solitary specimens on the shores of Lake Yumoto in these mountains, at 4000 feet altitude, describes it as a small pyramidal tree of 20 to 30 feet high, of open and graceful habit, with pale green foliage and bright red bark. Shirasawa, however, states that it attains a height of 90 feet, with a diameter of stem of nearly 6 feet; and that it grows in the central chain of Hondo, in the mountains of Kaga, Hida, and Shinano, at elevations of 2000 to 6600 feet. The stem, according to Shirasawa, is often twisted, and gives off great wide-spreading branches. (A. H.)

¹ *Garden and Forest*, 1893, p. 442, and 1897, p. 441.

According to Komaror, *Flora Manchurica*, i. 206 (1901), *Thuya japonica* grows wild abundantly in northern Corea in the Samsu district, but was not observed by him in Manchuria or elsewhere on the mainland.

This tree is not, so far as I saw, as common in Japan, where it is called Nezuko, as *Cupressus obtusa* or *C. pisifera*, though it is said by Goto¹ to be found in the provinces of Yamato, Bungo, Satsuma, Omi, Iwashiro, Shimotsuke, and Uzen, at an elevation of from about 3000 to 6000 feet.

The only place where I saw it wild was at Yumoto, above Nikko, where it was scattered in mixed forest with Tsuga, Thujopsis, birches, and other deciduous trees, and it is said to be never found in unmixed woods. At Koyasan I found small trees of it, perhaps planted, and brought away a seedling, which is now living at Colesborne.

At Atera, in the Kisogawa district, the forester told me that it grows best as a young tree in shade, and that where *Cupressus obtusa* has been felled it often comes up from seed. It does not attain very large dimensions, so far as I could learn, and is not considered a tree of much economic importance.

The timber is light and used for carpentry. It sometimes has a very pretty figure, and in old trees is of a pale grey colour, though perhaps this is only assumed by trees which were dead before cutting. It is cut into thin boards, and used for ceilings and other inside work, and is said to cost about 2d. per square foot in the board at Tokyo, and to make very durable shingles.

In Great Britain the tree seems to grow slowly, and is not common in gardens. The largest I have seen is a grafted and very spreading tree in Mr. W. H. Griffiths' garden at Campden, Gloucestershire, which is about 25 feet by 2½ feet, and probably one of the oldest in England. It has produced fertile seeds from which plants have been raised. The largest recorded at the Conifer Conference was at Dalkeith Palace, where it was 15 feet high in 1891. A tree at Kilmacurragh, co. Wicklow, Ireland, was 24 feet by 2 feet 4 inches in 1906, and bears fruit. Another at Castlewellan measured 25 feet high in the same year. (H. J. E.)

¹ *Forestry of Japan* (1904).

THUYA ORIENTALIS, CHINESE ARBOR VITÆ

Thuya orientalis, Linnæus, *Sp. Pl.* 1002 (1753); Loudon, *Arb. et Frut. Brit.* iv. 2459 (1838); Masters, *Jour. Linn. Soc. (Bot.)* xviii. 488; Kent, in Veitch's *Man. Coniferae*, 248 (1900).
Biota orientalis, Endlicher, *Syn. Conif.* 47 (1847).

A tree or dense shrub, with the trunk often branching into several stems from near the base. Bark of trunk thin, reddish brown, and separating in longitudinal papery scales. The bark begins to scale on branches which are about a half inch in thickness. The branches are ascending, becoming tortuose at their extremities, and giving off more or less equal-sided branch-systems, which are disposed in vertical planes, with their inner edge directed towards the stem of the tree. These are finer and more closely ramified than in the preceding species. Their main axes are terete; bearing median leaves, marked by a glandular longitudinal depression, and ending in triangular free points (not appressed to the axis); and lateral leaves, ending in similar but longer free points, which are thickened at the part where they become free and reflected away from the axis. The leaves on the ultimate branchlets are closely imbricated, appressed to the stem, and marked with longitudinal depressions.

The male flowers are globose and composed of 4 decussate pairs of stamens.

The cones¹ are erect and ovoid, fleshy and bluish before ripening, but ultimately becoming dry and woody, the scales gaping widely. Scales, usually 3 pairs (occasionally a fourth pair, sterile and much reduced, appears at the base), the two lowest fertile, the uppermost pair aborted and sterile: ovate, obtuse, thick, and ligneous, bearing externally below the apex a hooked process. The seeds, 2 on each scale, are large, ovoid, without wings, brown in colour, with a white, large, oblong hilum.

The seedling² resembles that of the other species of *Thuya*, except that the cotyledons are much larger, about an inch in length.

VARIETIES

A great number of varieties of this species have been obtained. The most remarkable of these are:—

1. Var. *pendula*, Masters, *Jour. R. Hort. Soc.* xiv. 252.

Thuya pendula, Lambert, *Genus Pinus*, ed. 2, ii. 115 t. 52; Siebold et Zuccarini, *Fl. Jap.* ii. 30 t. 117.

Thuya filiformis, Lindley, *Bot. Reg.* xxviii. t. 20 (1842).

Biota pendula, Endlicher, *Syn. Conif.* 49.

Cupressus pendula, Thunberg, *Fl. Jap.* 265.

¹ The cones ripen in one year, but frequently in England retain their seed till the spring of the following year.

² Tubeuf, *Samen, Früchte, u. Keimlinge*, 104, fig. 144 (1891).

A shrub, with a straight trunk, bare of branches below. The branchlets, numerous, long, flexile, cord-like, unbranched or only slightly branched, are produced in irregular fascicles of 5 to 20 or more at irregular intervals along the branches. They are slender and pendent, and bear leaves distantly placed in 4 rows in decussate pairs. The leaves, broadly decurrent at the base and long acuminate at the apex, spread out from the branchlets at an acute angle. Cones are occasionally borne, which are like those of the type.¹ There is a specimen at Kew of a plant raised from seed of this variety, which is ordinary *Thuya orientalis*. It was sent from the Botanic Garden at Turin by Mr. Hanbury in 1860.

There are several forms of this variety, differing in habit and length of leaves; in one the branchlets are tetragonal.

This shrub was first observed by Thunberg in Japan, and specimens were collected near Yokohama by Maximowicz. It was also met with by Fortune in China, and has been raised in Europe.

2. *Var. decussata.*

Retinospora juniperoides, Carrière, *Conif.* ed. 2, p. 140.

A low shrub, with erect stems and branches, bearing foliage like that of the seedling. The leaves are in 4 rows in decussate pairs, spreading, and resembling those of a juniper, except that the points are not prickly. They are greyish green in summer, changing to brown in winter.

3. *Var. Meldensis.*

Biota Meldensis, Lawson, in Gordon, *Pinetum*, 37.

A small tree with ascending flexible branches. It is a transition form, bearing acute acicular spreading leaves like that of the seedling, and occasionally leaves of the adult character. The leaves are bluish green, changing to brown in the winter. This plant was raised from seeds of *Thuya orientalis* gathered in the cemetery of Trilbardoux near Meaux in France; and for a long time was supposed to be a cross between *Thuya orientalis* and *Juniperus virginiana*.

4. *Var. intermedia.*

Biota orientalis intermedia, Carrière, *Man. des Pl.* iv. 322.

This is also a transition form. It is a shrub with elongated pendent branchlets, the ramifications of which arise from all sides of the axis, not remaining in one plane. There are two kinds of leaves, those towards the ends of the branchlets resembling the adult foliage of *Thuya orientalis*, while those on older parts are spreading, arranged in decussate pairs, oval-lanceolate, decurrent at the base, and acute at the apex. In *Var. funiculata*, if it is in reality distinguishable, there appears to be a larger proportion of adult foliage.

Many other varieties have been described: some of peculiar habit, as *gracilis* and *pyramidalis*, which are fastigate; others with coloured or variegated foliage, as *aurea*, *argenteo-variegata*, *aureo-variegata*. *Var. ericoides* of this species closely

¹ At Barton, a shrub of this variety produced cones, which had very long hooked processes on the scales (Bunbury, *Arboretum Notes*, 153).

resembles the variety of the same name belonging to *Thuya occidentalis*; the latter is slightly whiter on both surfaces of the leaves.

DISTRIBUTION, ETC.

Thuya orientalis occurs wild in the mountains of north China. It is common in the hills west of Peking, where Fortune¹ observed trees of a large size, 50 or 60 feet in height. Elsewhere in China it is only met with planted in cemeteries and temple grounds. It has been known to the Chinese from the earliest times as the *Poh* or *Peh* tree, and is mentioned in their classical books; it was planted around the graves of feudal princes, and its wood was used for making the coffins of great officials. The tree was introduced into Japan from China at an early period, probably like so many other Chinese plants, by the Buddhist missionaries. Japanese botanists are all agreed that it is not indigenous in Japan. Various other regions have been mentioned as being the home of *Thuya orientalis*, as Siberia, Turkestan, Himalayas, etc.; but specimens collected in these countries are undoubtedly from cultivated trees. The tree is mentioned by Gmelin in his *Flora Siberica*, i. 182 (1747); but only as occurring between Kiachta and Peking. Ledebour² denies its existence in any part of Siberia.

Thuya orientalis was first grown in Europe at Leyden, some time before 1737, when Linnæus³ described the plant as *Thuya strobilis uncinatis squamis reflexa acuminatis*. Royen, who sent a specimen to Linnæus, mentions the species with considerable details in his account⁴ of the plants that were cultivated at that time in the Botanic Garden at Leyden; but his promised account of the history of its introduction apparently never was published. It is possible that it was raised from seed sent home by the Dutch from Japan, as Kaempfer, who travelled in that country from 1690 to 1692, collected specimens of *Thuya orientalis* which are still preserved in the Natural History Museum at South Kensington.⁵ Seeds were also soon afterwards sent to Paris by the missionaries in north China.⁶ The earliest account of it in England occurs in a letter dated February 1, 1743, from the Duke of Richmond to Collinson, as follows:—"I am sorry to find by Miller that I am not likely to have the Chinese Thuya. I own, if it belonged to anybody that would sell it, I should be foolish enough to offer ten guineas for it, because it is the only one in England that can match that which I have already." It was cultivated early by Miller⁷ in the Physic Garden at Chelsea.

Thuya orientalis never attains in this country any considerable dimensions. It ripens good seed; and at Kew, on a wall near the Director's office, may be seen a

¹ *Yedo and Peking*, 307, 382 (1863). Fortune supposed that the wild tree in north China was distinct from that cultivated near Shanghai; but there is no doubt that the trees, which attain a great size in the hills west of Peking, are ordinary *Thuya orientalis*.

² *Comment. in Gmelini Fl. Sibericam*, 60 (1841).

³ *Hort. Cliff.* 449 (1737).

⁴ *Flora Leydensis Prodrromus*, 87 (1740).

⁵ I have seen these specimens. See Salisbury, *Coniferous Plants of Kaempfer*, in *Jour. Science and Arts*, ii. 313 (1817). Kaempfer does not mention the plant in his *Amenitates Exotica*.

⁶ See Miller, *Gard. Dict.* ed. 6 (1752), and ed. 8 (1768), sub "Thuya."

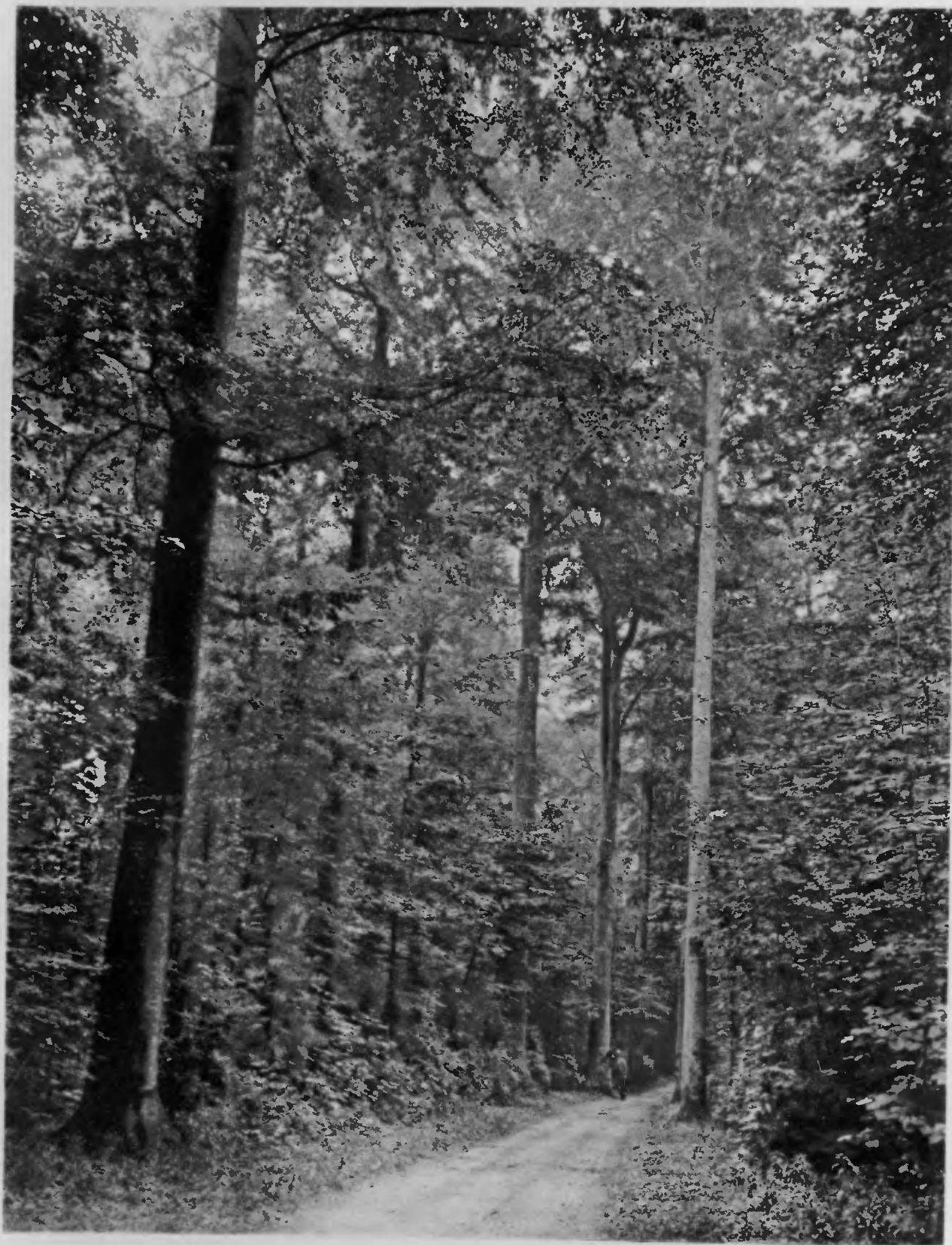
⁷ Cf. Aiton, *Hort. Kew.* iii. 371 (1789).

200 The Trees of Great Britain and Ireland

young tree which originated from a seed probably carried there by a bird from a tree in the gardens.

In the garden at Hampton Court, Herefordshire, there are a pair of fine specimens about 40 feet high, and about 7 feet round at the base, where they divide into several stems which have been formed into an arch over the path, and in most old gardens trees of 25 to 35 feet may be found, but, like *T. japonica* and *T. occidentalis*, it must be looked on as an ornamental shrub rather than a timber tree.

(A. H.)



BEECH DRIVE AT CIRENCESTER

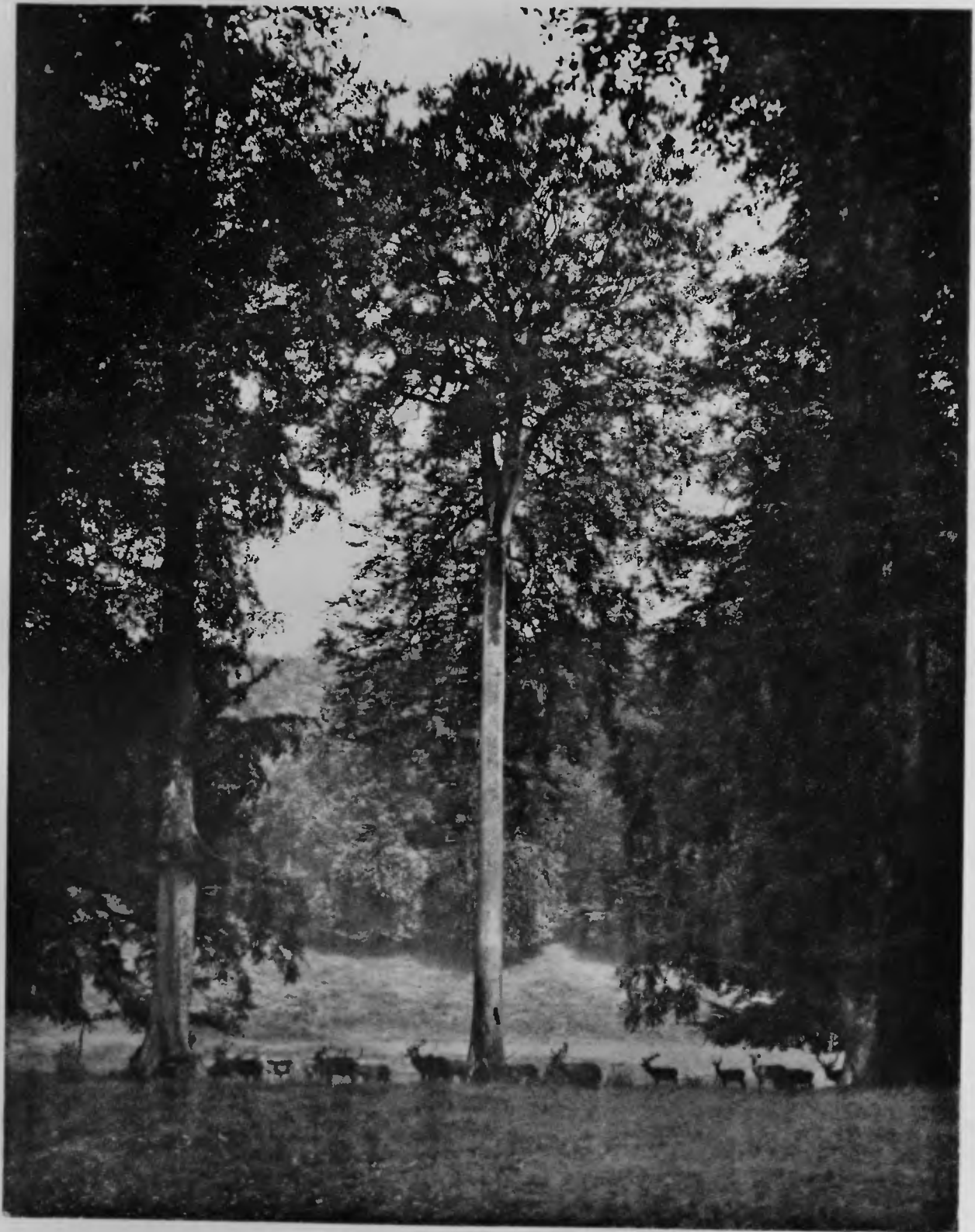
PLATE I.



BEECH AVENUE AT WATFORD

PLATE 2.

69-12129



QUEEN BEECH AT ASHRIDGE

PLATE 3.



INARCHED BEECH AT ASHRIDGE

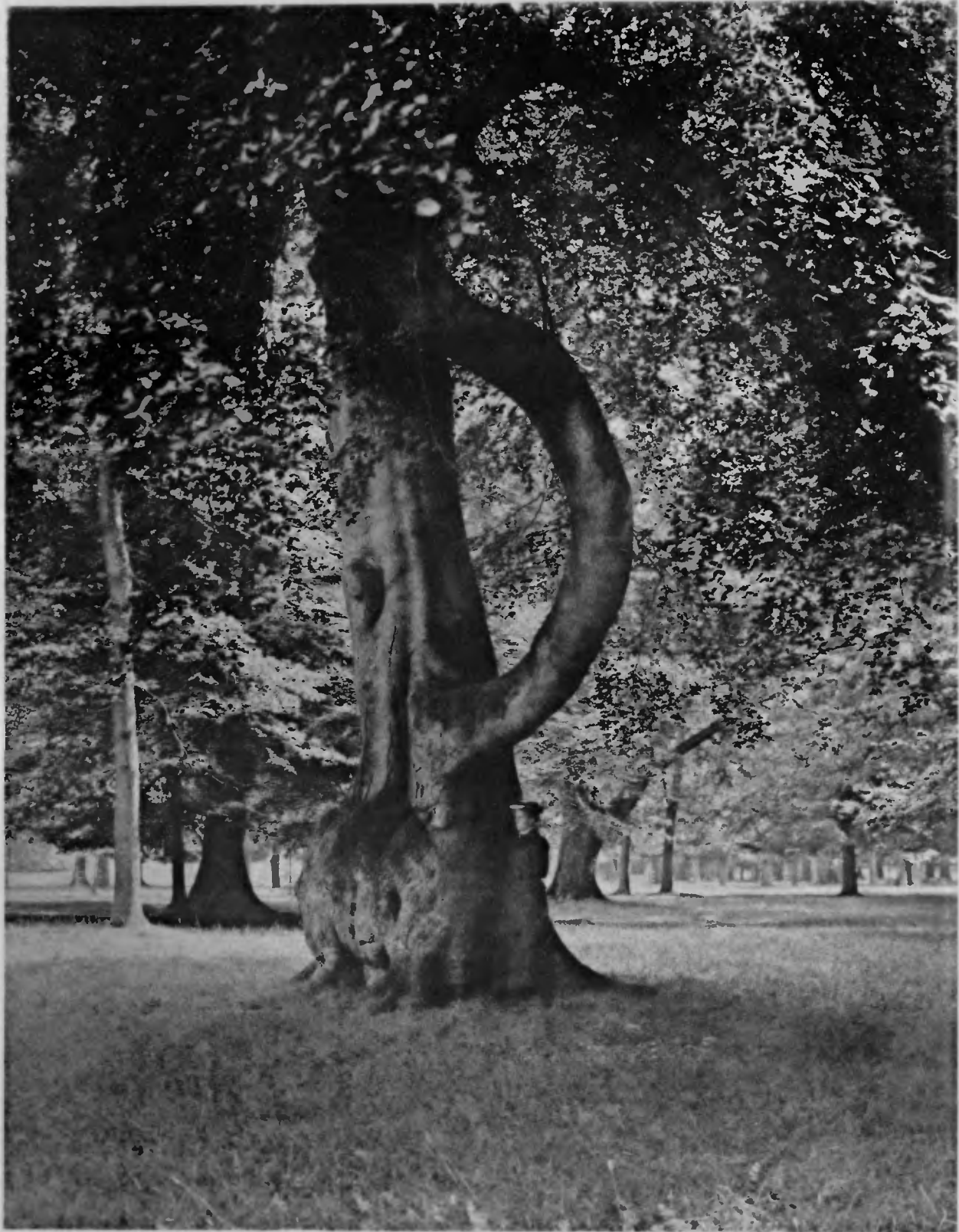


PLATE 5.

BEECH, WITH BURR, AT ASHRIDGE



BEECH WOOD AT SLINDON

PLATE 6.



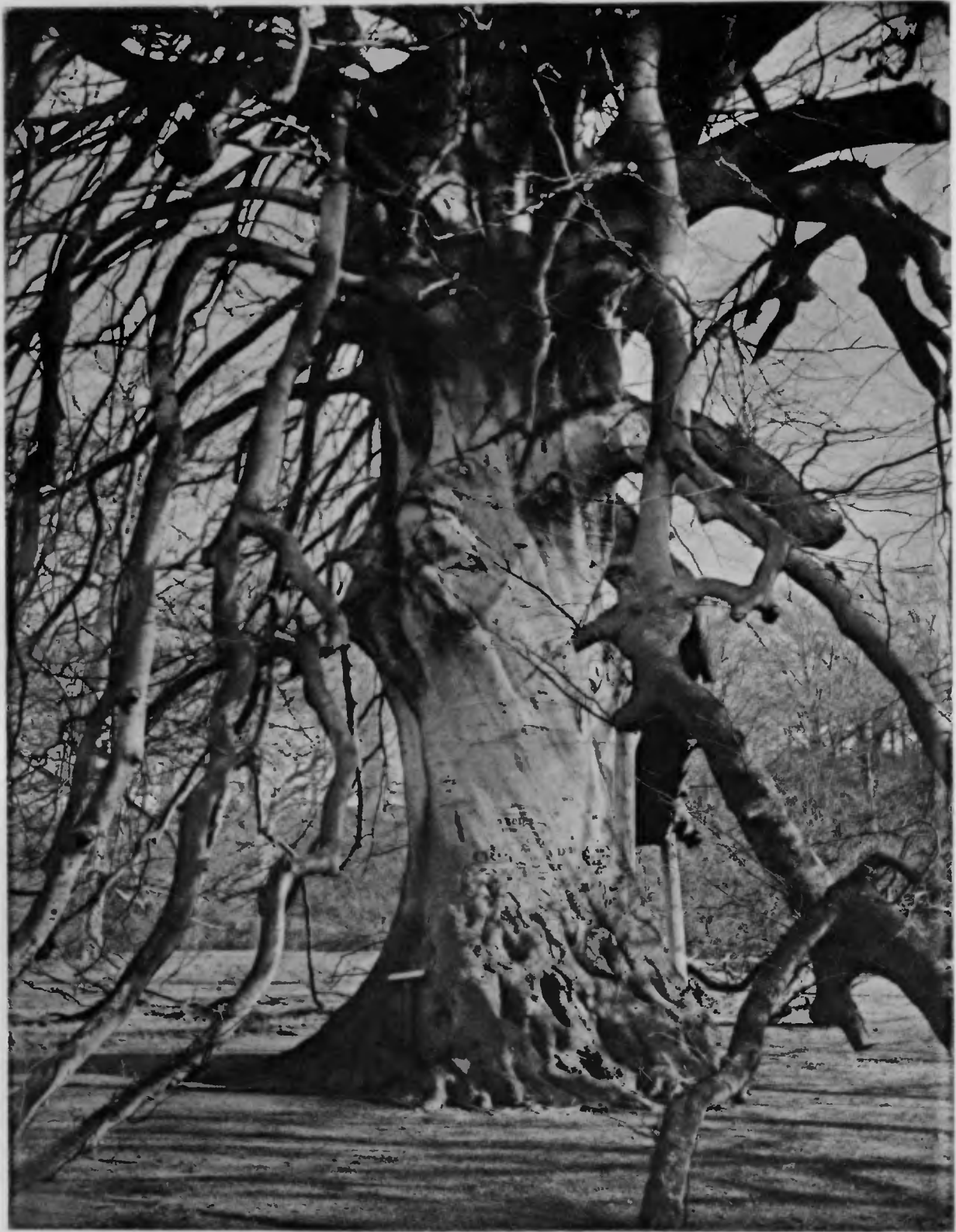
PLATE 7.

GIANT BEECH AT CORNBURY



BEECH AT NEWBATTLE

PLATE 8.



TRUNK OF NEWBATTLE BEECH

PLATE 9.



BEECH AT GORDON CASTLE

PLATE 10.



BEECH HEDGE AT MEIKLEOUR

PLATE II.



KING BEECH AT KNOLE

PLATE 12.



AILANTHUS AT BROOM HOUSE



AILANTHUS AT BELTON

PLATE 14.



A



B



C



D



E



F

PLATE 15.

SEEDLINGS

A B, AILANTHUS.

C D, GINKGO.

E F, ARAUCARIA.



SOPHORA AT CAMBRIDGE



ARAUCARIAS IN CHILE



ARAUCARIA FOREST IN CHILE

PLATE 18.



ARAUCARIA AT DROMORE

PLATE 19.



ARAUCARIAS AT BEAUPORT



MAIDENHAIR TREE AT KEW

PLATE 21.



MAIDENHAIR TREE AT FROGMORE

PLATE 22.



PLATE 23.

MAIDENHAIR TREE IN CHINA



TULIP TREE IN NORTH CAROLINA



TULIP TREE AT WOOLBEDING



TULIP TREE AT KILLERTON



PLATE 28.

*In consequence of an accident Plate 27 cannot be ready for
the present Volume, but will be issued with a later one.*

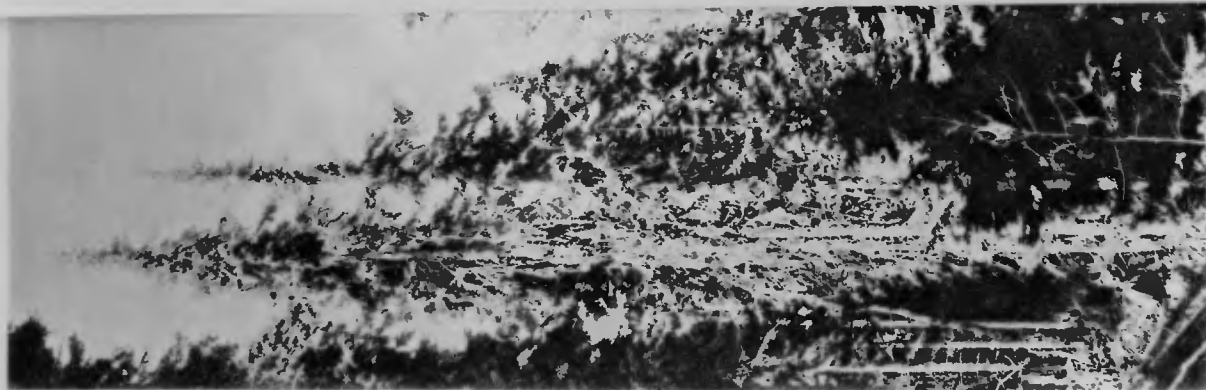




PLATE 28.

SERVIAN SPRUCE IN BOSNIA



BREWER'S SPRUCE IN AMERICA

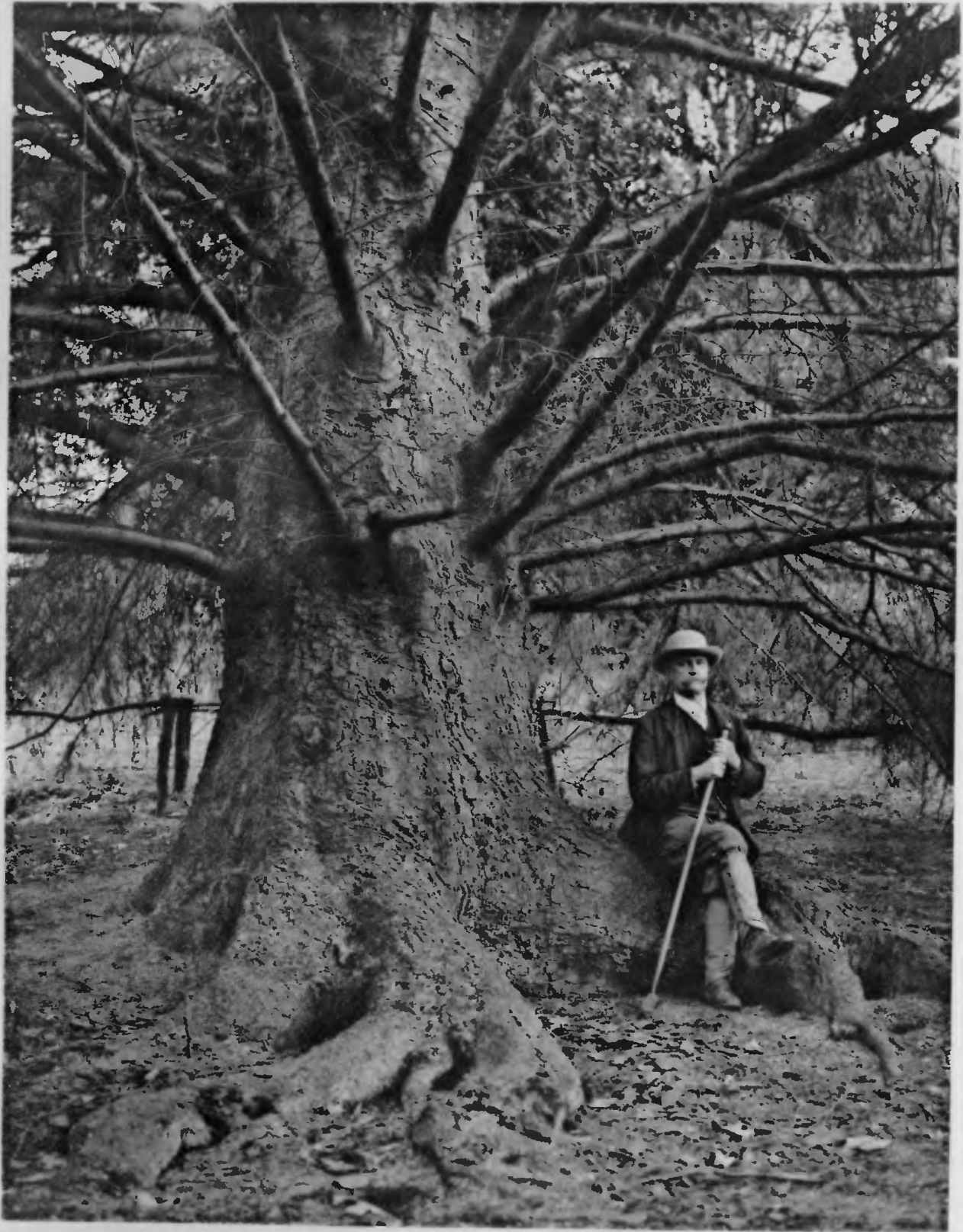


PLATE 30.

MENZIES' SPRUCE AT BEAUPORT



JAPANESE YEW AT NIKKO



YEW AVENUE AT MIDHURST



YEW GROVE AT MIDHURST



IRISH YEW AT SEAFORDE

PLATE 34.



YEW AT TISBURY



YEW AT WHITTINGHAME



CRYPTOMERIA ELEGANS AT TREGOTHNAN

PLATE 37.



CRYPTOMERIA FOREST IN NORTH JAPAN



A



B

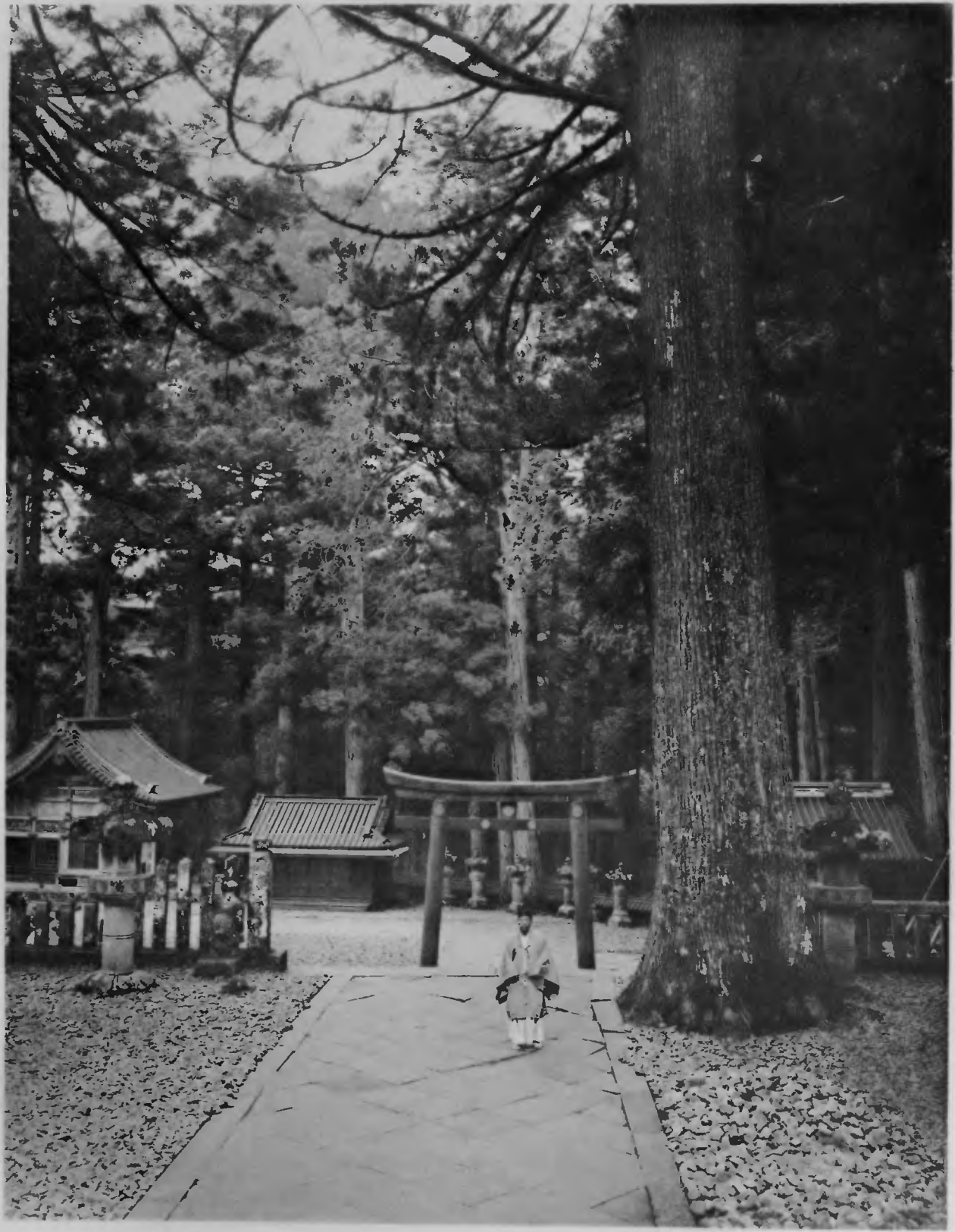
PLATE 39.

CRYPTOMERIAS IN JAPAN



PLATE 40.

CRYPTOMERIAS AT IMAICHI

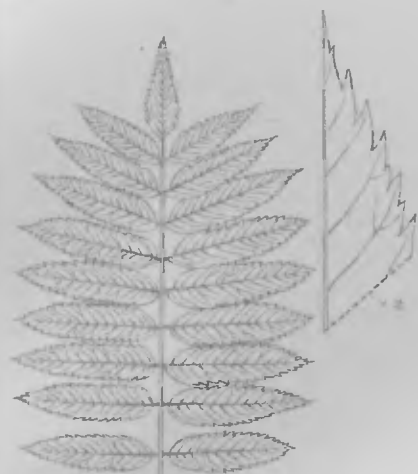


CRYPTOMERIAS AT NIKKO

PLATE 41.



CRYPTOMERIA AT HEMSTED



1.

americana



2.

Aucuparia



3.

Sorbus



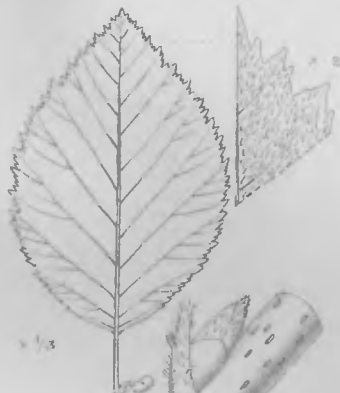
4.

Aucuparia decurrens



5.

pinnatifida



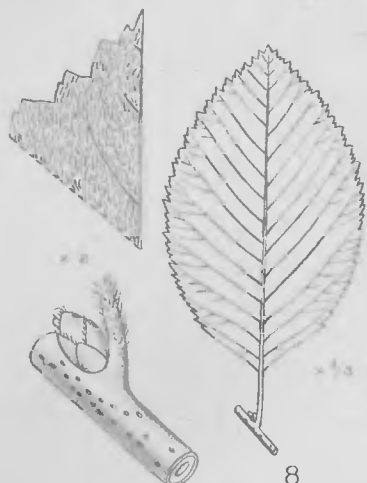
6.

lanata



7.

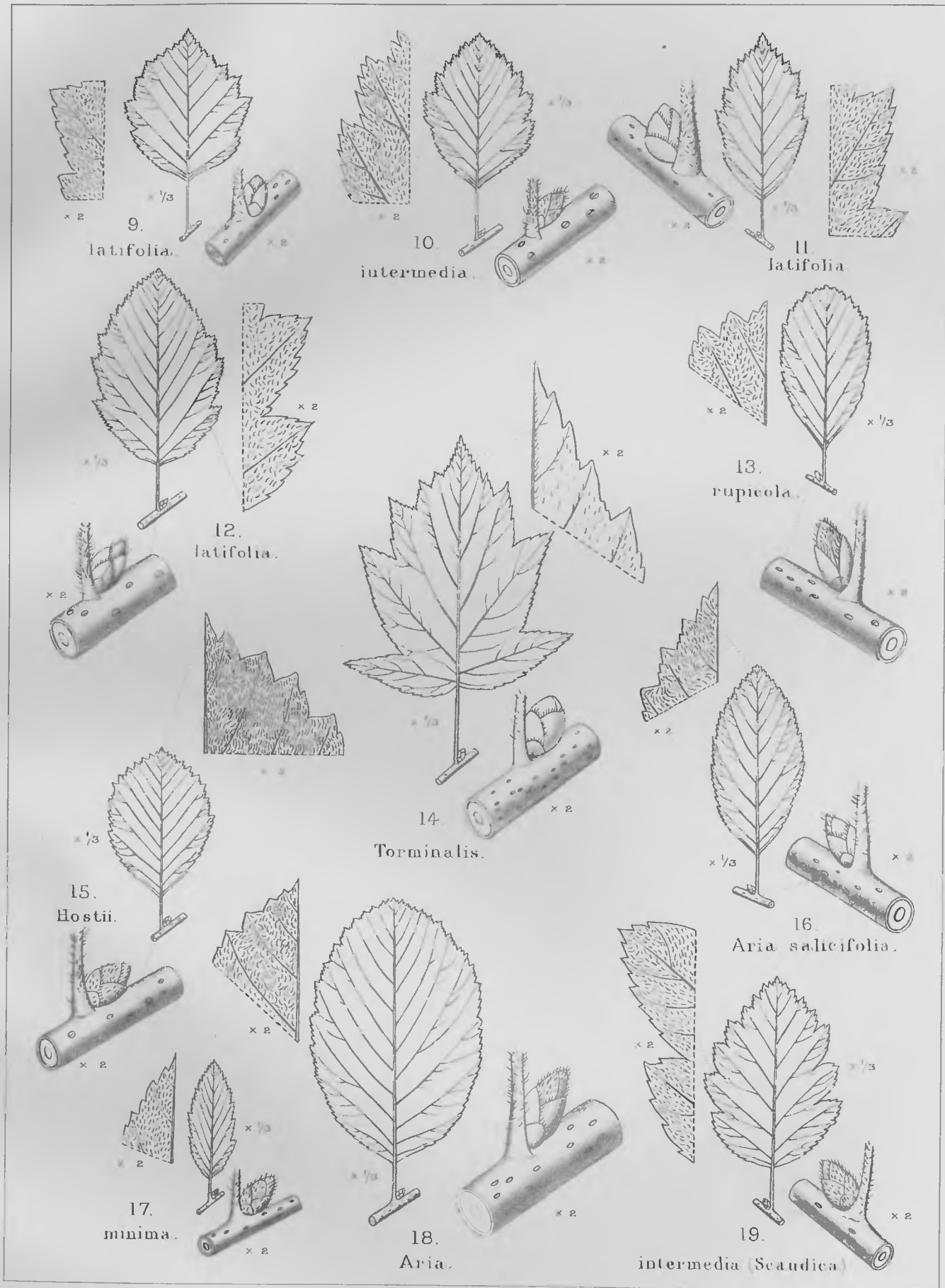
vestita



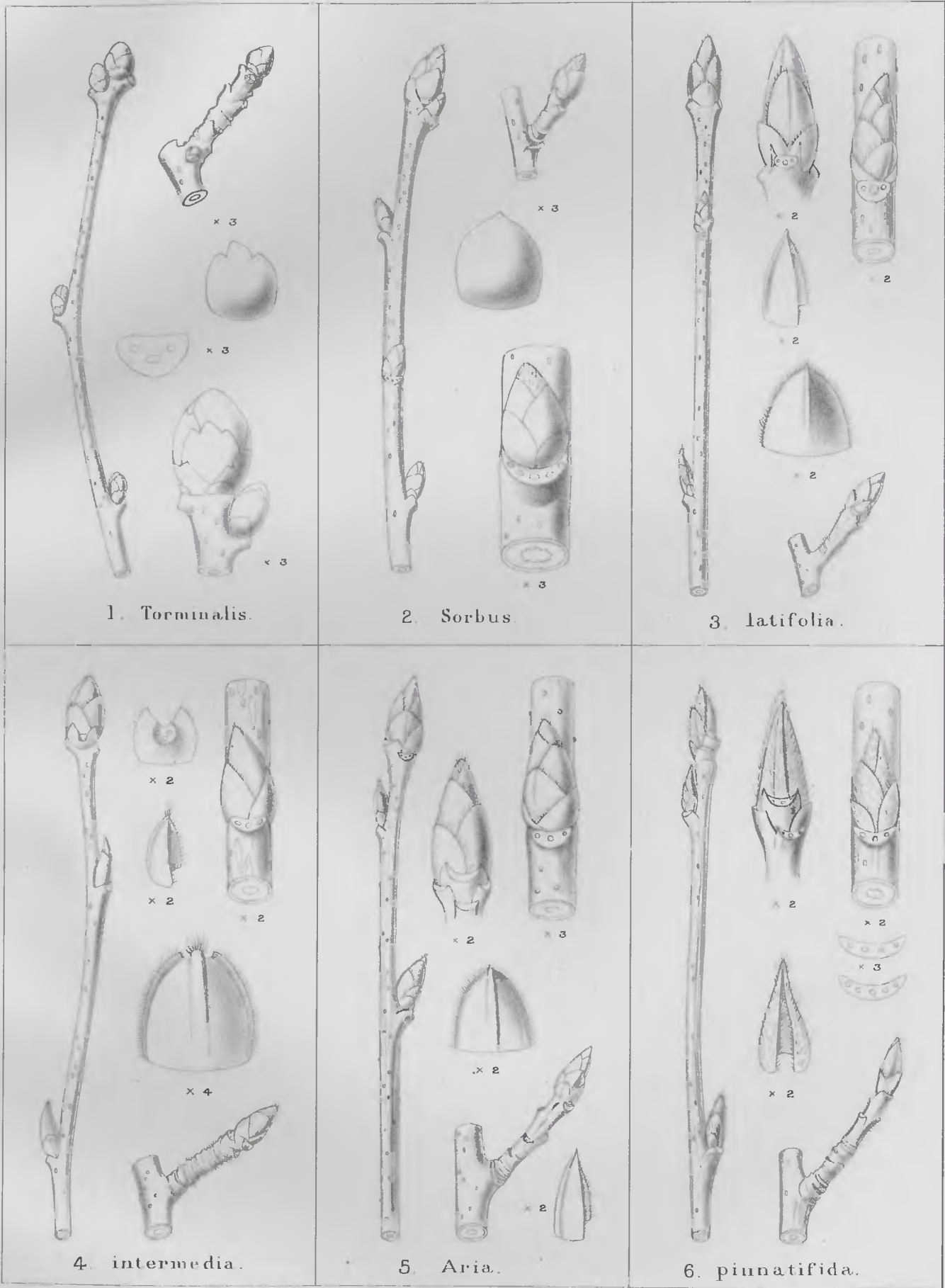
8.

Decaisnea

PYRUS



PYRUS.



fruct. del. Hook. & G.

PYRUS



SORB TREE AT ARLEY

PLATE 46.



PLATE 47.

SERVICE TREE AT TORTWORTHII



SERVICE TREE AT RICKMANSWORTH



SERVICE TREE AT OAKLEY PARK

PLATE 49.



SERVICE TREE AT SYON

PLATE 50.



WHITEBEAM AT CAMP WOOD

PLATE 51.



DECIDUOUS CYPRESS IN VIRGINIA



CYPRESS SWAMP IN NORTH CAROLINA



DECIDUOUS CYPRESS AT SYON

PLATE 54.



PLATE 55.

DECIDUOUS CYPRESS AT WHITTON



GIANT THUYA IN VANCOUVER'S ISLAND



PLATE 57.

GIANT THUVA AT FONTHILL

Plate 58 represents the trunk of what I believe to be the finest beech in Gloucestershire, which is known as "The Gladstone Beech," having been specially admired by the late Mr. Gladstone when staying at Cirencester House. It grows near Pinbury Park, formerly the seat of Sir Robert Atkyns, author of *The History of Gloucestershire*, and now the summer residence of Earl Bathurst. It measures about 110 feet high by 19 feet 9 inches in girth at the smallest part of the trunk, and though a very old tree, past its prime, is still a magnificent object. I am indebted for the negative to Mr. T. A. Gerald Strickland.

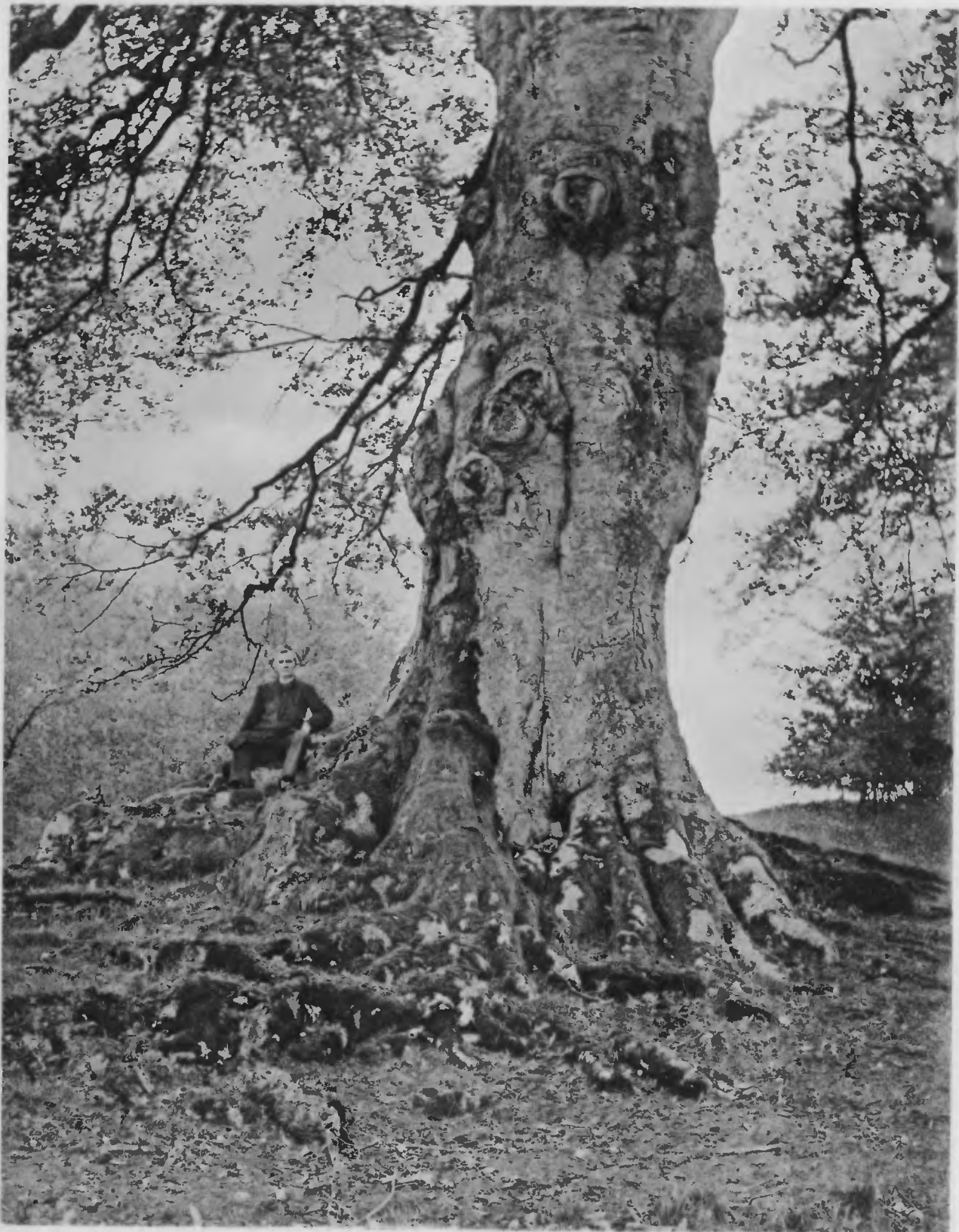


PLATE 58.

THE GLADSTONE BEECH AT PINBURY PARK



PLATE 59.

WESTERN HEMLOCK GROWING ON FALLEN LOG OF GIANT THUYA IN AMERICA



THUJOPSIS DOLOBRATA IN JAPAN

QK488
E4
v. 2
pt. 1

VOLUME II



The Trees
of
Great Britain
& Ireland

BY
Henry John Elwes, F.R.S.
AND
Augustine Henry, M.A.

Edinburgh: Privately Printed

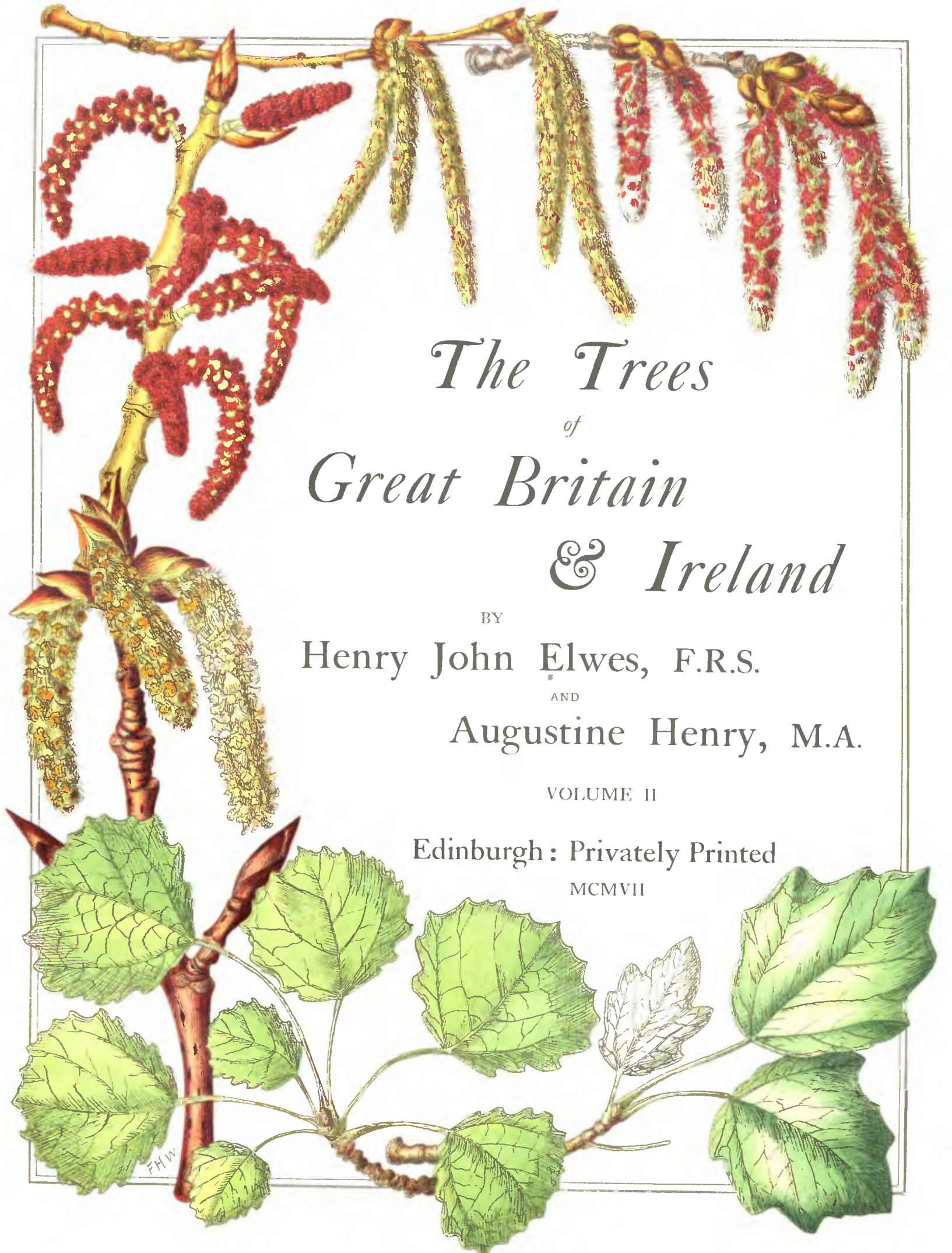
THE TREES OF GREAT BRITAIN AND IRELAND





PINUS LARICIO, FOREST OF BAVELLA, CORSICA

From an Original Sketch by the late Robert Fines.



The Trees
of
Great Britain
& Ireland

BY
Henry John Elwes, F.R.S.
AND
Augustine Henry, M.A.

VOLUME II

Edinburgh: Privately Printed

MCMVII

F.H.W.

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Liriodendron, Cedrela, Ailanthus Cladrastis, and Corylus; twigs and buds	126

THUJOPSIS

Thujaopsis, Siebold et Zuccarini, *Fl. Jap.* ii. 32 (1842).

Thuja, Bentham et Hooker, *Gen. Pl.* iii. 427 (1880).

Cupressus, Masters, *Journ. Linn. Soc. (Bot.)*, xxx. 19 (1893) and xxxi. 363 (1896).

THIS genus is considered by many authorities to be merely a section of *Cupressus* or of *Thuja*. The foliage and cones, however, are remarkably distinct, and justify its retention as a separate genus.

Evergreen trees, belonging to the tribe Cupressineæ of the order Coniferae, with reddish bark scaling off in longitudinal shreds. Branches in false whorls or scattered, giving off secondary branches, which terminate in very flattened branch-systems, disposed in horizontal planes. These resemble in their general arrangement those of *Thuja* and *Chamæcyparis*, and are mostly tripinnate, all the axes being covered with small coriaceous leaves, adnate in part of their length, and arranged in four ranks in decussate pairs. The leaves on the main and ultimate axes differ only in size.

The ventral and dorsal leaves are flattened and ovate or spatulate, with rounded apices; the lateral leaves are carinate, more or less spreading, with a slightly acute apex, which is bent inwards. The dorsal flat leaves are shining green, and marked with a central ridge, which is often hollowed in the middle line. The ventral flat leaves have a central green ridge, with a concavity white with stomata on each side. The lateral leaves, green on the dorsal side, exhibit a single stomatic concavity on their ventral side.

Flowers monœcious, solitary, and terminal, the male and female flowers borne on separate lateral branchlets as in *Thuja*. Male flowers cylindric, $\frac{1}{4}$ inch long, with six decussate pairs of stamens. Female flowers with five ovules on each scale. Cones globular, almost erect, with eight clavate, woody scales, in decussate pairs from a central axis, the upper pair abortive. Seeds three to five on a scale, laterally winged, the wing not notched at the summit.

The seedling¹ resembles that of *Thuja plicata*, but has broader and very blunt cotyledons, with shorter and broader primary leaves.

¹ See Tubeuf, *Samen, Früchte, u. Keimlinge*, 103, fig. 143 (1891).

THUJOPSIS DOLABRATA

Thujopsis dolabrata, Siebold et Zuccarini, *Fl. Jap.* ii. 34, tt. 119, 120 (1842); Franchet et Savatier, *Enum. Pl. Jap.* i. 469 (1875); Shirasawa, *Icon. Essences Forest. Jap.*, text 27, t. xi. 18-34 (1900).

Thuya dolabrata, Linnæus, *Suppl. Pl. System*, 420 (1781); Masters, *Jour. Linn. Soc. (Bot.)*, xviii. 486 (1881), and *Gard. Chron.* xviii. 556, fig. 95 (1882); Kent, in Veitch's *Man. Conif.* 236 (1900).

The species has been described in detail above.

Two well-marked geographical forms occur, both confined to the main island of Japan:—

1. Var. *australis* (var. *nova*). A small tree 40 to 50 feet in height, or a shrub growing as underwood in the dense shade of forests. As a tree it has a slender trunk, with drooping branches and a narrow pyramidal top. Branchlets very flat and only slightly overlapping, the lateral leaves ending in acute points bent inwards. Cones broadly ovoid, with scales thickened at the apex, which is prolonged externally into a blunt triangular process. This is the form which is known in cultivation in Europe, and described and figured in the works cited above.

2. Var. *Hondai*, Makino.¹ A larger tree, attaining 100 feet in height, with a stem of over 3 feet in diameter. The branch-systems are more densely ramified, the branchlets being placed close together and overlapping one another by their edges more than is the case in the preceding variety. The leaves also are smaller, whiter underneath, and crowded more closely on the shoots; those of the lateral ranks being usually blunt and not curved inwards at the apex. The cones are globular, with scales not thickened at the apex, which is devoid of the process so conspicuous in the other form, or merely shows it as an obsolete transverse minute mucro. The seeds appear to be more broadly winged, the wings being more scarious in texture.

This form has not yet been introduced. Elwes has brought home excellent specimens of it in fruit from the Uchimappe Forest, near Aomori, in the extreme north of Hondo. These differ in the characters given above from specimens of the ordinary form obtained by him in the forest of Atera, Kisogawa, and Yumoto (4000 to 5000 feet altitude) in Central Hondo. The smaller leaves, set more closely on densely ramified branchlets in this variety, may be due to the influence of dense shade. The difference in the cone is paralleled by what occurs in the fruit of the different geographical forms of *Cryptomeria japonica*. I am inclined to think that var. *Hondai* is not a distinct species; but as it is very different, from the point of view of cultivators, it may conveniently bear the name *Thujopsis Hondai*.

¹ *Tokyo Botanical Magazine*, 1901, xv. 104.

Several horticultural varieties have been introduced, viz. :—

3. Var. *latevirens*, Masters, *Jour. Linn. Soc. (Bot.)*, xviii. 486.

Thujopsis latevirens, Lindley, *Gard. Chron.* 1862, p. 428.

Thujopsis dolabrata nana, Gordon, *Pinetum*, ed. 2, p. 399.

A dwarf shrub having no definite leader, with slender and much-ramified branchlets, and very small and bright green leaves. This variety often shows acicular leaves, spreading all round the shoot, and is apparently a fixed seedling form. It was introduced in 1861 from Japan by J. Gould Veitch.

4. Var. *variegata*. This only differs from the ordinary cultivated form in having the tips of many of the branchlets pale yellow or cream colour. It was introduced by Fortune in 1861.

DISTRIBUTION

Thujopsis dolabrata was discovered by Kaempfer,¹ who mentions it in his *Amœnitates Exoticæ*, p. 884, as "a kind of Finoki." His specimen is still preserved in the Natural History Museum at South Kensington, and was figured by Lambert² in his account of the species. Thunberg long afterwards (about 1776) sent specimens to Linnæus, who first gave a scientific description of the tree. Thunberg³ cites the locality as follows:—"Crescit in regionibus Oygarwæ et Fakonicæ, inter Miaco et Iedo."
(A. H.)

Thujopsis dolabrata in Japan is known under the name of *Hiba*, and is found in a wild state north of about lat. 35°, and in the southern part of this area is a mountain tree only, occurring in the forest of the Kisogawa district from about 3000 to 5000 feet. In the vicinity of Nikko it is common between about 4000 and 6000 feet according to Sargent, but I only saw it here near Lake Yumoto where it did not appear to attain such large dimensions as farther north. The variety found in the forests of Atera is distinct in its fruit from the northern form. The excellent figure on Plate xi. in Shirasawa's *Essences Forestières* appears to be taken from the southern variety.

The northern form has been described by Makino as var. *Hondai*, but the latter is not mentioned either by Goto or Shirasawa, nor is it recognised as specifically distinct in any of the Japanese collections which I saw. Though the tree usually occurs in mixture with *Tsuga* at Nikko, and with *Sciadopitys* at Atera, yet in the extreme north of Japan, on the hills north of Aomori, it is found in pure forest on hills of volcanic formation from near sea-level up to about 3000 feet. An excellent account of the forest of Uchimappe is given in *Forestry and Forest-Products of Japan*, where it is stated that the mountains are of Tertiary formation, and the under-lying rock composed of tufa, sandstone, and slate. Pieces of this rock which I brought home have been examined by Mr. Prior of the British Museum of Natural History, who considers that in all probability they represent a rather basic andesite or basalt, but owing to the weathered and decomposed state of the specimens, satisfactory sections could not be made. I visited this forest in the

¹ See Salisbury, *Jour. Science and Arts*, 1817, ii. 313.

² *Genus Pinus*, ed. 2, ii. tab. 68 (1842).

³ *Flora Japonica*, 266 (1784), sub *Thuya dolabrata*, Linn.

company of Mr. Shirasawa in June, and after passing through the flat rice-fields which extend from the sea to the foot of the hills, entered the forest, which consists mainly of *Thujopsis* naturally reproduced, though here and there, trees of *Quercus glandulifera*, *Magnolia hypoleuca*, and other species occur, whilst *Cryptomeria* and *Cupressus obtusa* are planted in the valleys, and *Larix leptolepis* on those parts of the hills where the natural forest has been destroyed by fire. From observations taken at the meteorological observatory of Aomori, it appears that the climate of this part of Japan is cold in winter and the snowfall heavy, the thermometer falling in February to -15° Centigrade, and rising in September to 32.5° Centigrade; the average temperature for the whole year being 9° , and the average moisture 78 per cent. The average height of the trees here is about 70 to 80 feet, attaining in deep shady valleys 100 feet or perhaps more, and about 2 feet in diameter when closely grown, at the age of 150 to 180 years when it is considered ripe for felling.

The stems are often much curved at the butt from the pressure of the snow on the young seedlings, which require eight to ten years to get above its surface in winter, and these butts are usually cut separately and used for special purposes. The tree does not seem to have the power of reproducing itself from the stool, but produces abundant seed, which in dense shade germinates freely, though the growth of the seedlings is very slow at first.

The undergrowth of the forest is very different from what I saw in other parts of Japan, bamboo-grass (*Arundinaria Veitchii*) being much less prevalent, but in the damp places tall herbaceous plants were numerous, with *Aucuba*, *Skimmia*, and *Ilex*, and other evergreen shrubs on the drier ground, and many pretty liliaceous plants and orchids in places.

Goto says of this tree,¹ that it formed under the old regime, together with *Cupressus pisifera*, *C. obtusa*, *Thuja japonica*, and *Sciadopitys*, the so-called "Goboku" or Five Trees, which enjoyed careful protection at the hands of the feudal authorities; he also says that it is rarely planted, being regenerated naturally by seed, and that it forms extensive forests in a mixture with other conifers such as *Thuja japonica* and *Pinus parviflora*, in the mountains on the northern frontier of the province of Rikuchu, in Goyosan, and in the mountains of the Tone districts, Kozuké. It has lately come to be in great demand for railway sleepers.

Plate 60 (in Vol. I.) represents a dense growth of trees of this species in the forest of Uchimappe very similar to what I saw in the Kisogawa district at about 3000 feet. I am indebted to the Japanese Forest Department for the negative from which it was made.

The wood of *Thujopsis* is highly valued in those parts of Japan where it grows, on account of its great durability. This is proved by specimens shown at the St. Louis Exhibition, one of which had been used as a gate-post for eighty-three years, another as a plank in a fishing-boat for eighty-four years, others as railway sleepers in use for fourteen years. The wood has an aromatic smell, takes a fine lustrous polish when planed, and is yellowish white in colour, showing a fine grain, which makes selected planks from the butt length very ornamental. Exceptional

¹ *Forestry of Japan*, 18 (1900).

cases occur in which the wood is curiously mottled and freckled. A ceiling and a screen made of such wood, which I saw in the Forestry Bureau at Aomori, were very beautiful.

The wood weighs about 30 lbs. per cubic foot, and is worth at Aomori from 40 to 50 yen per 100 cubic feet, or about 1s. per cubic foot. It is much valued not only for joinery and building purposes, but for foundations, ship and boat building, as it is stronger and more resinous than other woods of the same character.

The bark also, which is thin, tough, and durable, is much used for roofing and for partitions and walls of out-houses, fences, etc.

CULTIVATION

T. Lobb sent a plant from the Botanical Garden at Buitenzorg in Java, to Exeter in 1853, which died; and soon after, Capt. Fortescue, a cousin of Earl Fortescue, brought a plant from Japan which was planted at Castlehill in 1859. But this tree, as I learn from Mr. Pearson, the head gardener, has been dead for some time, though plants raised from its cuttings are still growing at Castlehill and elsewhere.

In 1861 Mr. J. G. Veitch and R. Fortune sent seeds from Japan to the Chelsea and Ascot Nurseries, from which plants were raised and generally distributed, so that the tree is now common in England.

From what I have said of its habitat in Japan it is clear that though this tree is hardy as regards frost in winter, it requires conditions which are rarely found in England to bring it to any size, and, as a matter of fact, it has not yet become a tree anywhere except in Devonshire and Cornwall, though perhaps if seeds from North Japan are obtained the results might be better.

Though no doubt it has ripened seeds elsewhere, I have never obtained any which germinated, except from a tree planted about 1881 by Queen Alexandra in the Earl of Northbrook's grounds at Stratton Park, Hants, which I gathered in October 1900. One of these grew, and is now a healthy plant about 9 inches high. It seems to suffer less from spring frost than many Japanese and Himalayan conifers.

The finest tree that I have seen in England is at Killerton, which in 1902 measured 35 feet 6 inches in height and 2 feet 4 inches in girth. It is growing on a slope facing south-west in a peculiar soil, which Sir C. T. D. Acland describes as "Trap, soft below the surface, but hard after exposure. This trap overlies red sandstone, but is rather darker and more porous." This soil evidently suits most conifers admirably, as I have seen no other collection which contains so many fine specimens as this.

At Boconnoc, at Carclew, and at other places in Cornwall there are trees approaching this in height, but we have not seen any specimen above 15 to 20 feet in other parts of England, though as a bushy shrub 12 feet high it exists in most modern gardens. In Scotland it seems hardy in the west and in Perthshire, whilst at Castlewella in Ireland it has attained 30 feet in height. At Powerscourt and Kilmacurragh, Wicklow, there are trees with the lower branches layering and forming numerous independent stems.

(H. J. E.)

ÆSCULUS

Æsculus, Linnæus, *Gen. Pl.* 109 (1737); Bentham et Hooker, *Gen. Pl.* i. 398 (1862).
Pavia, Boerhave, ex Miller, *Gard. Dict.* ed. 6 (1752).

DECIDUOUS trees and shrubs, belonging to the natural order Sapindaceæ, some authorities, however, making the genus the type of a distinct order Hippocastaneæ. Leaves in opposite decussate pairs, without stipules, stalked, digitately compound; leaflets five to nine, serrate in margin, pinnately veined. Branchlets stout, terete, with large triangular leaf-scars. Buds large, of numerous decussately opposite scales which are homologous with leaf-bases, the outer deciduous, dry or resinous, the inner accrescent and often brightly coloured.

Flowers in large terminal racemes or panicles, appearing later than the leaves, of two kinds, hermaphrodite and staminate, on the same plant; placed in the axils of minute caducous bracts on stout jointed pedicels. Calyx imbricate in bud, five- or two-lobed, the lobes unequal, united with an hypogynous annular disc in the hermaphrodite flowers. Petals four to five, imbricate in bud, alternate with the calyx lobes and inserted on the disc. Stamens five to eight, usually seven, inserted on the inner margin of the disc, unequal in length; filaments filiform; anthers two-celled, sometimes glandular at the apex. Ovary three-celled, rudimentary in the staminate flowers, each cell containing two ovules. Style slender, elongated, generally curved. Fruit a capsule; prickly, roughened, or smooth; coriaceous; three-celled, three-seeded, and three-valved, or by abortion one- to two-celled and one- to two-seeded, the remains of the abortive cells and seeds usually remaining visible. Seeds without albumen, rounded or flattened by mutual pressure; seed-coat brown and coriaceous, marked by a large whitish hilum. Cotyledons thick and fleshy, unequal, cohering together by their contiguous faces, remaining in the seed-coat during germination.

About twelve species of *Æsculus*¹ are known to occur in the wild state. They are natives of North America, Europe, and Asia. The genus was formerly divided into two sections, *Pavia*, with smooth fruit, and *Hippocastanum*, with spiny fruit; but this division is not a natural one. The following synopsis groups the species under sections, which are more natural, being dependent on the characters of the flowers and buds:—

I. HIPPOCASTANUM. Buds viscid. Calyx irregularly campanulate, four- to five-

¹ The two Mexican species, which have tri-foliolate leaves, are now separated as a distinct genus, *Billia*.

lobed. Petals four or five, claws not longer than the calyx; stamens exerted. This section includes all the old-world species.

1. *Æsculus Hippocastanum*, Linnæus. Greece.
2. *Æsculus indica*, Colebrooke. Afghanistan, north-western Himalaya.
3. *Æsculus punduana*, Wallich, *List* 1189 (1828). Sikkim, western Duars, Khasia Hills, Upper Burma, Tenasserim, Siam, Tonking. Large tree. Leaflets six to seven, very large, thinly coriaceous, stalked, acuminate, serrate. Panicles 12 to 15 inches or more, flowers white or yellow. Fruit brown, smooth.

Not introduced and not likely to be hardy.

4. *Æsculus chinensis*, Bunge, *Enum. Pl. Chin. Bor.* 10 (1835). Northern and Central China. A tree, 40 to 50 feet high. Leaflets five to seven, large, stalked, obovate-oblong, rounded at the base, abruptly acuminate at the apex, finely serrate, shining above, glabrescent below except for pubescence along the nerves, petioles pubescent. Panicles, 8 inches long, pubescent. Flowers small, white; sepals shortly and unequally five-lobed, pubescent. Petals four, minute. Filaments glabrous. Fruit¹ pear-shaped or globular, small ($\frac{3}{4}$ inch diameter), one-celled, three-valved, brown, covered with warts, not spiny.

This species has been much confused with the next, from which it differs in every way. The flowers, though small, are numerous in the large panicle, and the foliage is very handsome. It is common enough in the mountains of central China, in Shansi, and in the hills to the west of Peking; and when introduced is likely to prove hardy in England.

5. *Æsculus turbinata*, Blume. Japan.

II. PAVIA. Buds not resinous. Calyx tubular, five-toothed. Petals four, yellow or scarlet.

6. *Æsculus glabra*, Willdenow. North America.
7. *Æsculus octandra*, Marshall. North America.
8. *Æsculus Pavia*, Linnæus, *Sp. Pl.* 344 (1753); *Bot. Reg.* t. 993 (1826). Middle United States. A shrub. Leaves with slender grooved petioles, the edges of the grooves jagged. Leaflets five, obovate, acute at the base, acuminate at the apex, finely serrate without cilia, slightly pubescent beneath. Flowers in loose panicles, 4 to 7 inches long. Petals red, meeting at the tips; upper pair longer, with claws about three times as long as the small spatulate limb; lateral pair shorter, with claws as long as the calyx, and rounded limb equalling the claw in length; margin of petals beset with minute dark glands. Stamens as long as the upper pair of petals. Fruit brown, without spines.

This species, though only a shrub, is mentioned here at some length, as it closely resembles *Æsculus octandra*, and moreover enters into such important hybrids as *Æsculus carnea*, *versicolor*, etc. All its hybrids may be recognised by the red colour of the flowers and the glandular margin of the petals. It is readily distinguished from *Æsculus octandra* by its smaller leaves and peculiar petioles. In winter it shows the following characters:—Twigs slender, glabrous, shining, with numerous lenticels.

¹ Cf. Hance in *Journ. Bot.* viii. 312 (1870).

Leaf-scars obovate or crescentic on slightly prominent cushions, with three groups of bundle-dots; opposite scars joined by a linear ridge. Terminal buds long oval or fusiform, pointed; scales numerous, the upper rounded, the lower pointed at the apex and keeled on the back, minutely ciliate in margin. Pith wide, circular, green.

9. *Æsculus austrina*, Small, *Bull. Torrey Bot. Club*, 1901, xxviii. 359; Sargent, *Man. Trees N. America*, 647 (1905); *Æsculus Pavia*, β *discolor*, Torrey and Gray, *Fl. N. Amer.* i. 252 (1838), in part. A small tree, attaining 30 feet in height, occurring in Tennessee, S. Missouri, E. Texas, and north-western Alabama. This resembles the last species. The leaflets, however, are usually more irregularly but finely serrate, and pale tomentose beneath. Panicles pubescent, 6 to 8 inches long. Petals bright red, meeting at the tips, unequal, oblong-obovate, rounded at the apex, glandular, those of the upper pair about half as wide as those of the lateral pair, with claws much longer than the calyx. Stamens longer than the petals. Fruit brown, slightly pitted. Not introduced.

III. MACROTHYRSUS. Buds not viscid. Calyx five-toothed. Petals four to five, white, claws longer than the calyx. Stamens exerted, very long.

10. *Æsculus parviflora*, Walter, *Flora Caroliniana*, 128 (1788). South-eastern North America. A shrub. Leaflets five to seven, elliptical or oblong-ovate, densely grey-tomentose beneath, finely serrate. Panicles erect, 8 to 10 inches long, slender, narrow. Flowers white, faintly tinged with pink. The long and thread-like stamens are pinkish white and very conspicuous.

This is a valuable shrub, as it flowers late, in July or August, some five or six weeks later than any of the other species except *californica*. Occasionally it forms a short single trunk, but generally it sends up a crowd of stems from the ground. It is figured in *Gard. Chron.* 1877, viii. fig. 129; and is often known in gardens as *Pavia macrostachya*, Loiseleur, or *Æsculus macrostachya*, Michaux. See *Bot. Mag.* t. 2118 (1820), where it is stated that the species was introduced by Mr. John Fraser in 1785. Canon Ellacombe reported in 1877¹ that he had at Bitton a specimen, which was at least forty years old, but that it remained a bush, not exceeding 8 or 10 feet in height.

IV. CALOTHYRSUS. Buds viscid. Calyx two-lipped or five-lobed. Petals four, pink or white, claws not longer than the calyx. Stamens exerted.

11. *Æsculus californica*, Nuttall. California.

12. *Æsculus Parryi*, A. Gray, *Proc. Amer. Acad.* xvii. 200 (1881); Sargent, *Garden and Forest*, 1890, p. 356, fig. 47. Lower California. A small shrub, resembling the preceding species; but differing in the five-lobed calyx, and in the leaflets, which are small, obovate and hoary pubescent beneath. It has not been introduced.

V. HYBRIDS. The most important is *Æsculus carnea*, Hayne, which is a cross between the common horse-chestnut and *A. Pavia*. This is described fully below.

¹ *Gard. Chron.* 1877, viii. 691.

Æsculus plantierensis, André, a supposed hybrid between *Æsculus carnea* and *Æsculus Hippocastanum*, will be mentioned under the former species. *Æsculus versicolor*, Dippel, a hybrid between *Æsculus Pavia* and *Æsculus octandra*, will be treated under the latter species.

The following key to the species in cultivation is based on the characters of the leaves and buds. In Plate 61 the leaves of all these species are shown; and in Plate 62 are represented the twigs and buds of six species, viz., *Hippocastanum*, *carnea*, *indica*, *glabra*, *octandra*, and *californica*:—

A. Leaflets sessile or nearly so; buds very viscid.

1. *Æsculus Hippocastanum*.

Petioles glabrescent. Leaflets obtusely and irregularly serrate.

2. *Æsculus turbinata*.

Petioles pubescent, especially towards their tips. Leaflets regularly and crenately serrate.

B. Leaflets stalked.

*Buds viscid.

3. *Æsculus indica*.

Leaflets finely and sharply serrate, pale beneath. Buds very viscid.

4. *Æsculus carnea*.

Leaflets obtusely and irregularly serrate. Buds only slightly viscid, the brown scales having a dark-coloured margin.

5. *Æsculus californica*.

Leaflets shallowly and crenately serrate, pale beneath. Buds viscid, glistening with white resin.

**Buds not viscid.

6. *Æsculus parviflora*.

Leaflets densely grey-tomentose beneath, finely serrate in margin. Buds minutely pubescent.

7. *Æsculus octandra*.

Leaflets pubescent beneath, broadly lanceolate, shortly acuminate, with twenty or more pairs of nerves in the terminal leaflet; margin finely serrate but not usually ciliate. Petioles without jagged marginal ridges.

8. *Æsculus glabra*.

Leaflets glabrous beneath, except for a slight pubescence along the midrib and tufts in the axils, long-acuminate, with about fifteen pairs of nerves in the terminal leaflet, finely serrate with ciliate tufts in the bases of the serrations. Petioles with smooth marginal ridges.

9. *Æsculus Pavia*.

Leaflets slightly pubescent beneath, narrowly lanceolate, finely serrate but not ciliate in margin. Petioles flattened on the upper side, with marginal sharp ridges, usually jagged.

ÆSCULUS HIPPOCASTANUM, COMMON HORSE-CHESTNUT

Æsculus Hippocastanum, Linnæus, *Sp. Pl.* 344 (1753); Loudon, *Arb. et Frut. Brit.* i. 462, iv. 2543 (1838); *Gard. Chron.* 1881, xvi. 556, figs. 103, 104.

A large tree, attaining in England a height of over 100 feet and a girth of 15 or even 20 feet. Bark smooth and dark brown in young trees, becoming greyish and fissured longitudinally in old trees, at the same time scaling off in thin plates. Leaves palmately compound, digitate, on a long stalk widened at its insertion. Leaflets five to seven, sessile, obovate, cuneate at the base, abruptly acuminate at the apex, unequally and coarsely serrate; green above; beneath pale, tomentose at first, but ultimately glabrous, except for small tufts of hairs in the axils of the veins and a few scattered hairs over the surface; middle leaflet the largest, with twenty-four or more pairs of nerves, lower pair smallest; venation pinnate; petiole glabrous. The leaflets as they emerge from the bud are at first erect, but soon bend downwards on their stalks. When nearly full grown they rise up and become horizontal. In autumn they turn yellow or brownish and fall early, each leaflet disarticulating separately from the petiole.

Flowers in large upright pyramidal panicles, the primary branches of which are racemose, the lateral branches cymose. Upper flowers staminate and opening first; lower flowers hermaphrodite. Calyx greenish, five-toothed. Petals four to five, crumpled at the edge, white, with yellow spots at the base, which ultimately become pink. Stamens seven, longer than the petals, the filaments bent down when the flower opens and the stigma protrudes, later moving up on a level with the style. Fruits few on each panicle, large, globular, green, with stout, thick conical spines, three-valved, usually one-seeded, occasionally two- to three-seeded. Seed large, shining-brown, with a broad whitish hilum. Cotyledons two, large, fleshy, distinct below, blended into one mass above.

SEEDLING¹

The cotyledons are large and fleshy and remain in the seed, which frequently germinates on the surface of the soil or only slightly buried beneath it. The cotyledons have long petioles ($\frac{3}{4}$ -1 inch), which are broad and flattened, with a concavity on their inner surface. The caulicle, very variable in length (1 to 4 inches), is stout, brownish, pubescent, and ends in a stout tap-root, which gives off numerous branching fibres. The young stem is stout, terete, brownish, striated and marked with numerous lenticels, puberulent or glabrous; it has no scale-leaves, differing in this respect from the young stem of the oak. In other respects the germination of the oak and of the horse-chestnut are almost identical. At a varying height

¹ Cf. Lubbock, *Seedlings*, i. 356 (1892), where it is stated that the seed is carried a considerable height above ground during germination owing to the great length of the caulicle. So far as I have observed, the seed does not change its position during germination.

above the cotyledons the first pair of true leaves are produced, which are opposite, compound, digitately five-foliolate, and closely resemble the adult foliage except that they are smaller in size. Successive pairs of similar leaves follow on the stem, each pair being placed decussately with reference to the pair immediately below it.

ABNORMAL FLOWERING

The horse-chestnut sometimes produces a second crop of flowers in autumn, which appear in much smaller panicles than those of spring. This is due to the premature fall of the leaves in July or August, usually following an excessively dry season. The buds are stimulated to premature energy and put forth young leaf-shoots, which are terminated by flowers. This phenomenon, which is equivalent to an anticipation of the opening of the buds by several months, as they would normally open in the following spring, is frequently observed in the trees planted in the boulevards of Paris.¹ In the dry season of 1884, a single tree at Kew produced small panicles of flowers in September, after previously shedding nearly all its leaves. In the following year it produced a few panicles of the ordinary size. At Hythe,² near Southampton, a horse-chestnut is reported to have bloomed and fruited three times in 1868, once in spring, again after the rain which succeeded the long drought, and a third time in September.

IDENTIFICATION

In summer the common horse-chestnut is unmistakable. The only other species with large sessile leaflets, *Æsculus turbinata*, is easily distinguished by their regular crenate serration. In winter the twigs and buds show the following characters:—Twigs stout, brown, glabrous or minutely pubescent towards the tip; lenticels numerous. The large opposite leaf scars, flat on the twigs with no prominent cushion, are joined by a linear ridge, and vary in shape, the larger being obovate with seven bundle-dots, the smaller semicircular or crescentic with usually only five dots. Buds very viscid, larger than in the other cultivated species; the terminal much exceeding the lateral buds in size, occasionally absent, and replaced by the saddle-shaped scar of the previous year's inflorescence; scales imbricate, the external ones in four vertical ranks, rounded at the apex, glabrous, not ciliate, dark red-brown. The buds contain the next year's shoot in an advanced state of development, flowers being visible in them in October. The scales are morphologically equivalent to leaf-bases. In the interior of the bud, scales are observable with traces of leaf-blades, which gradually pass into the true leaves, visible in the upper part of the bud.

VARIETIES

1. Var. *flore pleno*, Lemaire, *Illust. Horticole*, 1855, ii. t. 50. A variety with double flowers, the pistil even in some cases becoming petaloid. Mr. A. M.

¹ See article by Roze, translated in *Gard. Chron.* 1898, xxiii. 228.

² *Gard. Chron.* 1868, p. 1116.

Baumann discovered in 1822, near Geneva, a horse-chestnut tree, of which a single branch bore double flowers; and from this branch the variety was propagated at the Bollweiler nursery in Alsace.¹ The flowers last longer than those of the single kind,² and no fruits are formed, which renders it useful as a tree in streets, where the fall of fruits is an inconvenience. This variety is very hardy, and resisted well the severe winter of 1879-80 in France.³

2. Var. *laciniata* (var. *asplenifolia*, var. *incisa*). Leaflets cut up into narrow lobes. According to Beissner⁴ this variety has been in cultivation for over forty years; and a form of it was found by Herr Henkel of Darmstadt, which keeps its foliage much longer than the typical form; but this is not the case in some localities.

3. Var. *crispa*. Leaves short-stalked, with broad leaflets. Tree compact in habit.

4. Var. *pyramidalis*. Upright in habit.

5. Var. *umbraculifera*. Crown densely branched, and globular in outline.

6. Var. *tortuosa*. Branches bent and twisted.

7. Var. *Memmingeri*. Leaves yellowish in colour, looking as if powdered with sulphur.

8. Var. *aureo-variegata*. Leaves variegated with yellow.

Several other varieties of slight interest, which do not seem to be in cultivation in this country, are mentioned by Schelle.⁵

DISTRIBUTION AND HISTORY

The horse-chestnut occurs wild in the mountains of northern Greece. Halácsy,⁶ the latest authority, gives many localities in Phthiotis, Eurytania, Thessaly, and Epirus; but states that it is not found wild on Mount Pelion or in Crete. Baldacci,⁷ in 1897, found the tree growing wild on almost inaccessible precipices below the lower limit of the coniferous belt near Syrakou in the district of Janina in Albania.

The native country of the tree was long a matter of doubt; but the whole question was satisfactorily elucidated by Heldreich⁸ in a paper, from which we extract most of the following account. Linnæus considered the habitat of the tree to be northern Asia, and De Candolle thought that it came from northern India. The tree is, however, not known wild in India, where it is replaced by *Æsculus indica*. Boissier⁹ states that it is recorded from Greece by Sibthorp, from Imeritia (Caucasus), by Eichwald, and from Persia by various authors. It is, however, unknown in the wild state in Persia; and Radde¹⁰ mentions it only as a planted tree

¹ *Rev. Belgique Horticole*, 1854, iv. 216.

² See *Garden*, 1890, xxxviii. 601, where some observations are recorded on the periods of flowering of the single and double horse-chestnuts, and of *Æsculus carnea*.

³ *Rev. Horticole*, 1884, p. 98.

⁴ *Handbuch Laubholz-Benennung*, 321 (1903).

⁵ *Rivista Collez. Botan. in Albania*, 23 (Florence, 1897).

⁶ *Verhand. Bot. Vereins Prov. Brandenburg*, 1879, p. 139. The British Minister at Athens, Sir F. E. H. Elliot, K.C.M.G., who kindly made inquiries, has sent us a letter from Professor Miliarakis of the University of Athens, dated April 2, 1904, which confirms Heldreich's statements.

⁷ *Flora Orientalis*, i. 947 (1867).

⁸ *Pflanzenverbreitung in Kaukasusländern*, 433, 434 (1899).

⁹ *Mitt. Deut. Dendrol. Gesell.* 1905, pp. 13, 14, and 1906, p. 10.

¹⁰ *Consp. Fl. Græca*, i. 291 (1900).

in the Caucasus. All the evidence goes to show that it is confined to northern Greece and Albania.

Heldreich states that the horse-chestnut was first found wild in Greece by Dr. Hawkins.¹ In his own travels in Greece in 1897 he observed it in many stations, all lying in the lower fir region, between 3000 and 4000 feet altitude, where it grows in shaded moist gulleys, in company with alder, walnut, plane, ash, several oaks, *Ostrya carpinifolia* and *Abies Apollinis*. These stations, situated in remote uninhabited spots, establish the fact that the tree is really wild. Plants introduced into Greece by the Turks are always found in the neighbourhood of towns. Whether the tree was known to the ancient Greeks is doubtful.

The horse-chestnut was first mentioned² by the Flemish doctor Quakleben, who was attached to the embassy of Archduke Ferdinand I. at Constantinople,—in a letter to Matthiolus in 1557. The latter received a fruit-bearing branch, and published the first description³ of the tree as *Castanea equina*, because the fruits were known to the Turks as *At-Kastane* (horse-chestnut), being useful as a drug for horses suffering from broken wind or a cough.

The tree was introduced into western Europe from Constantinople, the first tree being raised by Clusius at Vienna from seeds sent by the Imperial Ambassador, D. Von Ungnad, in 1576. This tree quickly grew, and was mentioned by Clusius⁴ in 1601.

The horse-chestnut was introduced into France⁵ in 1615 by Bachelier, who brought the seeds from Constantinople. Gerard mentions it in his *Herbal* of 1579, p. 1254, as a tree growing "in Italy and sundry places of the eastern countries"; and in Johnson's edition of this work, published in 1633, the tree was stated to be growing in Tradescant's garden at South Lambeth. It was probably introduced into England about the same time as into France. (A. H.)

CULTIVATION

No tree is easier to raise from seed than the horse-chestnut. Its large fleshy fruit are so little hurt by frost and damp that they germinate freely where they fall, and do not seem to be eaten by mice like acorns and beech-mast.

Seeds which have been exposed all winter germinate more readily in spring than those which have been kept dry, and should be sown early and covered with about two inches of soil.

Though it is advised by French writers that the extremity of the radicle should be pinched off before sowing in order to prevent a strong tap-root from forming, as is done in the case of walnuts and chestnuts, I have not observed that they suffer from removal if this is not done; and if transplanted at one or at latest two years after sowing there are abundance of fibrous roots which make the tree an easy one

¹ Sibthorp et Smith, *Fl. Græca Prodrömus*, i. 252 (1806). Hawkins' observation has been disputed, as he records it from Pelion, where the tree does not, so far as we know now, occur wild. Orphanides was the first to establish beyond doubt that the tree is indigenous to the mountains of northern Greece. Cf. Grisebach, *Vegetation der Erde*, French ed. i. 521.

² Matthiolus, *Epistol. Medicin. Libri Quinque* (Prague, 1561).

³ Matthiolus, *Comment. in Dioscorid. Mat. Med.* 211 (Venice, 1565).

⁴ Clusius, *Rar. Plant. Hist.* 7 (1601).

⁵ Toumefort, *Relation d'un Voyage au Levant*, i. 530 (1717).

to move, even when five or six feet high. As the tree is liable to form large side branches, the buds should be rubbed off the stem early in order to form a clean trunk, though it bears pruning well as a young tree.

Though somewhat liable to suffer from cold winds and spring frost, which injure the foliage and flowers, the tree is hardier in this respect than many of our native trees, though coming from a warm southern country.

As regards the chemical nature of the soil it is quite indifferent, for though it grows faster on a good loam and does not come to perfection on sandy soil, it attains a large size on dry, rocky, calcareous soils, and even at an elevation of 800 feet and upwards resists wind better than many trees. I have seldom seen horse-chestnuts blown down, though large heavy branches are often torn off by violent winds.

As an ornamental flowering tree for parks, lawns, and avenues it has no superior, though on account of its branching habit it requires considerable attention in order to form tall shapely trees. Its principal defect is the tendency of the leaves to become brown and ragged early in the autumn, but they fall quickly, and being easily removed make less litter than the leaves of the beech, oak, or sycamore.

The large branches when allowed to rest on the ground in damp situations frequently take root and become naturally layered, the best instance of this that I have seen being at Mottisfont Abbey, Hants.

For town planting, on account of its beautiful flowers and dense shade during the hottest months, the horse-chestnut is perhaps, next to the plane, one of the best trees we have, and does not seem to suffer much from smoke. In parks it is valuable for its fruit, which are so much liked by deer that they are eaten as fast as they fall, and would perhaps be worth collecting for winter food.

The extraordinary hardiness of this southern tree is proved by the fact that it will grow to a large size as far north as Trondhjem in Norway, lat. $63^{\circ} 26'$, a tree figured by Schubeler near this place being 37 feet by 8 feet 9 inches. Another in the Botanic Garden at Christiania, which is considered the largest in Norway, measured in 1861, 16.62 metres by 2.45 metres, and when I saw it in 1903 had increased to no less than 28 metres high by 3 in girth, though it has been exposed to as low a temperature as -18° to -20° Réaumur.

As regards the age which the horse-chestnut attains we have few exact records, but it does not seem a very long-lived tree. J. Smith states¹ that an avenue running south-east from the front of Broadlands House, near Romsey, Hants, was planted in 1735; but in 1887 only two trees remained, which were 11 feet and 12 feet 4 inches in girth.

REMARKABLE TREES

There are so many fine trees in almost every part of Great Britain that I need not go into great detail as to their dimensions, but though it is possible that in Bushy Park, or other places near London, taller trees exist, I have only at

¹ *Trans. Scot. Arb. Soc.* xi. 540 (1887).

Petworth measured one which exceeds in height the group of three which grow near my own house at Colesborne, of which I give an illustration (Plate 63). The height of these as measured in 1902 by Sir Hugh Beevor and myself was 105 feet, and the girth of the largest 11 feet. They grow in a sheltered situation, on damp, cold soil. One of these trees being inclined to split at the base, owing to the great weight and length of one of its principal limbs, was chained up many years ago, and though the iron band which was put round it has become buried in the wood the limb has not broken off.

At Dynevor Castle, Carmarthenshire, the seat of Lord Dynevor, where the park contains a greater number of fine trees than any I have seen in South Wales, there is a very large tree which the Hon. W. Rice measured in 1906 and found to be 109 feet by 17 feet 9 inches. For height and girth combined this seems to be the largest tree in Great Britain.

The tallest tree I have seen is in a grove of beech, chestnut, oak, and silver fir, which grows near the house at Petworth Park, the seat of Lord Leconfield in Sussex, on a deep greensand formation. This tree, though forked at six feet from the ground, has been drawn up to a great height by the trees surrounding it, and though difficult to measure exactly, probably exceeds 115, and may be 120 feet. The two stems are 9 feet 8 inches and 8 feet respectively in girth.

In Bushy Park most of the horse-chestnuts are past their prime; many of the old trees are dead and have been replaced by young ones. The largest, seen in 1906, was growing near the gate; it had a bole of 20 feet giving off four great stems, and measured 100 feet high by 16 feet 5 inches in girth. Another near the pond was 101 feet by 16 feet 1 inch.

At Birchanger Place, near Bishop Stortford, the seat of T. Harrison, Esq., there is one of the largest and finest trees in England, which measures about 80 feet by 20 feet, with a bole about 15 feet high and a spread of 32 yards; a beautiful photograph was taken in 1864 when the tree was in flower, but it is now partially decayed on the north side, and has lost some large branches.

At West Dean Park, Sussex, the seat of W. D. James, Esq., there is a large tree about 70 feet by 16 feet, with branches spreading over an area no less than 36 yards in diameter.

At Hampton Court, Herefordshire, the seat of John Arkwright, Esq., there is a very fine tree growing on deep alluvial soil in the big meadow south of the house. Measured by T. Hogg in 1881¹ it was 93 feet by 16 feet 6 inches. When I saw it in 1905 it had increased about three feet in height and was 18 feet 7 inches in girth, and still handsome and vigorous.

The largest trees I have seen as regards girth and spread of branches are in Ashridge Park, on a bank near the lodge on the Berkhamstead road. The largest of these is about 80 feet high and 20 feet in girth, with extremely wide-spreading branches, and there are several others of 16 to 17 feet girth in the row. These trees are growing on a dry, flinty, calcareous loam.

¹ *Trans. Scot. Arb. Soc.* ix. p. 151 (1886).

There is a fine tree at Syon, which in 1905 was 93 feet high by 15 feet 4 inches in girth; and at Broom House, Fulham, there is a tree 95 feet high.

In the courtyard at Burleigh, near Stamford, the seat of the Marquess of Exeter, there is a large and very beautiful tree, figured by Strutt, plate 37, which was in 1822 60 feet high by 10 feet in girth, with a spread of 61 feet diameter. When I saw it in 1903 it was still in perfect health, and was about 80 feet by 12 feet 6 inches. It had remarkably spiny fruit, and its trunk was covered with small twigs.

At Trebartha Hall, near Launceston in Cornwall, Mr. Enys reports in 1904 a tree 15 feet 6 inches in girth, with an estimated height of 70 feet.

In Scotland the horse-chestnut seems as much at home as in England, and thrives in most places as far north as Gordon Castle, where there is a tree, measured in 1881 by Mr. Webster, 65 feet high by 13 feet 4 inches in girth, and 274 feet in circumference of its branches.

At Newton Don, Kelso, the seat of Mr. C. B. Balfour, there is a tree which was in 1906, 13½ feet in girth with a spread of branches of 165 feet in circumference.

In Perthshire there is a very beautiful tree, remarkable for its weeping habit, in the park at Dunkeld, which measures 80 feet in height by 17 feet 6 inches in girth (Plate 64). At Kilkerran, Ayrshire, Mr. J. Renwick has measured a fine tree 84 feet high by 14 feet in girth, with a bole 22 feet high. At Pollok, near Glasgow, a tree measured, in 1904, 63 feet high by 13 feet 6 inches girth at 2½ feet from the ground, with a bole of 5 feet, giving off four great stems.

None of these are equal to a tree in a group of seven standing at the west end of Moncreiffe House in Perthshire, which Hunter¹ describes as the largest in Scotland, and which then measured 19 feet in girth at five feet from the ground. At ten feet it divides into three great limbs, one of which has become firmly rooted in the ground, and extends so far from the trunk that the total spread of the tree is 90 feet in diameter.

The remarkable hardness of this tree is shown by the existence of one, reported by Mr. Farquharson of Invercauld, as growing at an elevation of 1110 feet, which was supposed to be 177 years old in 1864, when it was 8 feet 7 inches in girth.²

In Ireland the horse-chestnut attains a great size, the largest we know of occurring at Woodstock in Co. Kilkenny, on an island in the River Nore. One tree measured in 1904, 93 feet in height by 18 feet 1 inch in girth, and according to the careful records which have been kept of the growth of the many fine trees on this property, measured in 1825, 10 feet 2 inches in girth; in 1846, 13 feet 2 inches; in 1901, 17 feet 9 inches. Another about the same height, in a meadow near the river, measured in 1825, 11 feet in girth; in 1834, 12 feet; in 1846, 12 feet 11 inches; in 1901, 14 feet 4 inches.

¹ *Woods and Forests of Perthshire*, 1883.

² *Old and Remarkable Trees of Scotland*, p. 115.

TIMBER

The wood of the horse-chestnut is one of the poorest and least valuable we have, on account of its softness and want of strength and durability. Though it has a fine close and even grain, white or yellowish-white colour, and is not liable to twist or warp so much as most woods, it does not cut cleanly, decays rapidly, and is only used as a rule for such purposes as cheap packing-cases and linings.

It burns so badly that it is of little use as firewood, and though occasionally cut into veneers or used as a cheap substitute for sycamore, poplar, and lime, in making dairy utensils, platters, and brush backs, it cannot be said to have a regular market. From 4d. to 8d. a foot is about the usual value in most parts of England, though Webster says that it was worth a shilling in Banffshire some years ago.

Holtzapffel says that it is one of the white woods of the Tunbridge turner, a useful wood for brush backs and turnery, preferable to holly for large varnished and painted works on account of its great size.

I am not aware whether it has been tried for pulp-making, but it would seem to be a suitable wood for that purpose on account of its softness, and could, if required, be produced in quantity at a low price. (H. J. E.)

ÆSCULUS CARNEA, RED HORSE-CHESTNUT

Æsculus carnea, Hayne, *Dendrol. Flora*, 43 (1822).

Æsculus rubicunda, Loiseleur, *Herb. Amat.* vi. t. 357 (1822); Loudon, *Arb. et Frut. Brit.* i. 467 (1838); Carrière, *Rev. Horticole*, 1878, p. 370, coloured figure of var. *Briotii*.

Æsculus Hippocastanum, L. × *Æsculus Pavia*, L., Koch, *Dendrologie*, i. 507 (1869).

A small tree, occasionally 50 feet, but rarely exceeding 30 feet in height. Leaves resembling those of the common horse-chestnut, but darker green with an uneven surface, the leaflets being shortly stalked and more or less curved and twisted. Flowers red, showing as they open an orange-coloured blotch at the base of the petals, which afterwards becomes deep red. Petals five, standing nearly erect, their limbs not spreading horizontally at right angles to the claws, as occurs in the common horse-chestnut; edges of the petals furnished with minute glands, like those present in *Æsculus Pavia*. Fruits with slender prickles.

IDENTIFICATION

In winter, the species is distinguished as follows:—Twigs rather stout, grey, shortly pubescent; leaf-scars as in *Æsculus Hippocastanum*. Buds slightly viscid and smaller than in that species; scales brown, edged with a dry membranous dark-coloured rim. Lateral buds small, oval, pointed, arising from the twig at an acute angle.

VARIETIES

1. Var. *Briotii*. Flowers in larger panicles and more brilliantly coloured, the filaments, calyx, and style being red. Fruits never developing fully, falling soon after the flowers. This variety¹ was obtained in 1858, by M. Briot at the State Nurseries of the Trianon, Versailles, as a seedling of *Æsculus carnea*.

2. Several variegated forms are known, as var. *aureo-maculata* and *aureo-marginata*. Var. *alba* is a form with white flowers. Var. *pendula* is pendulous in habit.

3. *Æsculus plantierensis*, André, *Rev. Horticole*, 1894, p. 246, is supposed to be a cross between *A. carnea* and the common horse-chestnut, as it is intermediate in character. This variety arose in the nursery of Messrs. Simon-Louis Frères at Plantières-lès-Metz, from a seed of *Æsculus Hippocastanum*. Other intermediate forms, named by André *Æsculus intermedia* and *Æsculus balgiana*, were derived from seeds of *Æsculus carnea*.

HISTORY

Nothing is known for certain concerning the origin of *Æsculus carnea*. Loiseleur received the plant from Germany in 1818, and there are no earlier accounts of it. Its parentage, however, is undoubted: it possesses characters of both the supposed parents. The leaves and slightly spiny fruit are derived from the common horse-chestnut. The colour of the petals and the glands on their margins come from *Æsculus Pavia*. According to André² the seeds when sown usually produce plants which bear whitish flowers and are of no horticultural value. The species is accordingly always propagated by grafting. Koch,³ however, reports that while some seedlings are like those of the common horse-chestnut, others produce smooth fruits. At Kew, according to Mr. Bean, it has come true from seed.

The largest specimen of this tree that we have seen occurs at Barton in Suffolk. It was 50 feet high in 1904, with a bole, however, of only 2 feet, girthing 7 feet 9 inches at a foot above the ground, and dividing into three stems.

It does not seem to live long or to attain any great size in England, and is often supposed to be a red-flowered form of the common horse-chestnut. (A. H.)

¹ *Rev. Hort.* loc. cit.

² André, *Rev. Hort.* loc. cit.

³ *Verhand. Ver. Beförd. Gart. König. Preuss. Staat*, 1855.

ÆSCULUS INDICA, INDIAN HORSE-CHESTNUT

Æsculus indica, Colebrooke, Wallich, *List* 1188 (1828); *Bot. Mag.* t. 5117 (1859); Hiern, in *Flora British India*, i. 675 (1875); Bean, in *Gard. Chron.* 1897, xxii. 155 and 1903, xxxiii. 139, *Suppl. Illust.*; Collett, *Flora Simla*, 97 (1902); Gamble, *Man. Indian Timbers*, 193 (1902); Brandis, *Indian Trees*, 185, 705 (1906).

Pavia indica, Wallich, ex Jacquemont, *Voyage dans l'Inde*, iv. 31, t. 35 (1844).

A large tree, attaining in India 150 feet in height and 40 feet in girth of stem. Bark in old trees peeling off in long strips. Leaves large, glabrous, dark green above, pale, almost glaucous beneath; leaflets five to nine, stalked, obovate-lanceolate, acuminate, finely and sharply serrate, with about twenty pairs of nerves in the terminal leaflet. Panicles 12 to 15 inches long, loose, narrow, erect. Flowers large, about 1 inch long; calyx $\frac{1}{3}$ inch long, irregularly lobed, often splitting so as to appear two-lipped. Petals four, white, of two unequal pairs; the upper pair narrow and long with a red and yellow blotch at the base, the lower pair flushed with pink. Stamens seven or eight, scarcely longer than the petals, spreading. Fruit brown, rough, without spines, irregularly ovoid, one to two inches long, containing one to three dark brown shining seeds.

IDENTIFICATION

In summer the viscid buds and the large stalked leaflets with finely serrate margins distinguish it from the other species in cultivation. In winter the twigs show the following characters:—Branchlets coarse, shortly pubescent; lenticels like brown raised warts, numerous; pith circular, white; leaf-scars on slightly prominent cushions, each pair wide apart and joined by a raised linear ridge, obovate or semicircular with a raised rim and three groups of bundle-dots. Buds viscid, greenish, the lower scales only being brown; terminal buds ovoid, pointed, the two lowest scales having projecting beaks; scales not ciliate, the outermost four pubescent; lateral buds small, arising at an acute angle.

DISTRIBUTION

It is a common tree in the north-west Himalayas from the Indus to Nepal, occurring at elevations of from 4000 to 10,000 feet, and also occurs in Afghanistan. Sir George Watt informs me that he has measured many trees 150 feet in height with trunks of enormous size, a girth of 40 feet not being uncommon. The wood is used in building and for making water-troughs, platters, vases, cups, packing-cases, and tea-boxes. The twigs and leaves are lopped for use as fodder. The fruit is given as food to cattle and goats; ground and mixed with ordinary flour, it is part of the dietary of the hill tribes. The bark of old trees is very remarkable in appearance, exfoliating in long flakes, which remain attached at their upper ends and hang downwards and outwards. (A. H.)

CULTIVATION

Colonel Henry Bunbury brought seeds from India in 1851, from which plants were raised by Sir Charles J. F. Bunbury¹ at Barton in Suffolk. The large tree² now flourishing on the lawn at Barton (Plate 65) is one of the original seedlings, and measured, in 1904, 66 feet high by 7 feet 9 inches in girth. Another tree in the arboretum at Barton measured 65 feet high by 7 feet 2 inches in girth; and divides into two main stems at 7 feet above the ground. This tree flowered for the first time in 1858, producing twelve panicles, being then only seven years old from seed, and 16 feet in height. It did not suffer in the least from the terrible winter of 1860, and flowered as usual in the summer following. In 1868 it ripened fruit, and four thriving plants were raised from its seed. There are no records of the tree on the lawn, which is now the finer of the two. Other trees were planted apparently at Mildenhall,³ which is about fifteen miles distant from Barton; but these never thrived, and none remain. The soil at Mildenhall is a light loam on chalk, and probably did not suit the tree.

I saw the beautiful tree at Barton in full flower on June 24, 1905, when it did not seem to have received the least injury from the severe frosts and cold north-east winds which had occurred a month previously, and which ruined the flowers and destroyed the fruit of the common horse-chestnut in many places.

It seems incredible that this species should be so rare and have remained so little known in England, where it ought to be planted generally in the south and west. Mr. Bean says that the seeds soon lose their vitality if kept dry, and that of some scores received in ordinary paper packets from India in recent years, not one has germinated at Kew. He recommends that the seeds should be gathered as soon as ripe, and be sent packed in fairly moist soil. Mr. Walker, the gardener at Barton, informed me that it ripens seed in good years, and showed me several seedlings raised from them which appeared to grow as well as the common horse-chestnut.

The only other place except Kew, however, where we have seen it, is at Tortworth, where the Earl of Ducie planted in 1890 a few seeds which were sent to him by the late Duke of Bedford. The seedlings were planted at first in sunny places in the open, but did not thrive until moved to a sheltered dell in 1900, where they are now growing well, the best being about 12 feet high.

At Kew there are two or three small trees which have flowered a few times. It seems, therefore, that it only requires a good deep soil and a sheltered situation to succeed as well as it has done at Barton. The late Lord Morley informed me that there was a tree recently planted, but growing very well at Saltram, his place in Devonshire.

According to Jouin,⁴ this tree is quite hardy at Metz. (H. J. E.)

¹ *Arboretum Notes*, 73 (1889).

² Figured in *Gard. Chron.* 1904, xxxvi. 206, *Suppl. Illust.*

³ *Gard. Chron.* 1903, xxxiii. 188.

⁴ *Mitt. Deut. Dendrol. Gesell.* 1905, p. 12.

ÆSCULUS TURBINATA, JAPANESE HORSE-CHESTNUT

Æsculus turbinata, Blume, *Rumphia*, iii. 195 (1847); André, *Revue Horticole*, 1888, p. 496, figs. 120-124; Bean, *Gard. Chron.* 1897, xxii. 156, and 1902, xxxi. 187, fig. 58; Shirasawa, *Icon. Essences Forestières du Japon*, text 113, t. 71, ff. 16-28.
Æsculus chinensis, Masters (*non* Bunge), *Gard. Chron.* 1889, v. 716, fig. 116.

A tree attaining in Japan, according to Shirasawa, 100 feet in height and 20 feet in girth of stem. Bark thick and scaly. Leaves resembling those of the common horse-chestnut, but much larger, mainly differing in the serration, which is finely crenate. Leaflets five to seven, sessile, obovate-cuneate, occasionally as much as 15 inches long, abruptly acuminate, pubescent beneath. The terminal leaflet has fifteen to twenty-two pairs of nerves. Petiole remaining pubescent towards the tip. Panicles 6 to 10 inches long, dense, somewhat narrow. Flowers yellowish-white, smaller than those of *Æsculus Hippocastanum*. Fruit slightly pear-shaped, 1½ to 2 inches in diameter, four to five on a verrucose rhachis, brown, warty, without spines; valves three, thick; seeds usually two.

IDENTIFICATION

In summer only liable to be confused with the European species, from which it is distinguished by the character of the serration of the leaflets. In winter the twigs closely resemble those of that species, but are not so stout; they are similarly pubescent towards the tip, and are marked with smaller but similar five to seven dotted leaf-scars. Buds smaller, equally viscid, the scales, however, not being uniform in colour, but partly light chestnut brown and partly dark brown. Pith large, irregularly circular in cross-section, and yellowish in tint.

DISTRIBUTION

The tree is known in Japan as *Tochinoki*, and is common in the forests at 1500 to 5500 feet elevation in the mountains of the main island, descending to lower levels in Yezo. It is recorded by Debeaux, *Fl. Shanghai*, 22, from the provinces of Kiangsu and Chekiang; but no one else has seen the tree in China, and Debeaux's identification is probably incorrect.

The exact date of the introduction of the tree into Europe is uncertain, but it is supposed to be about thirty years ago. It has often passed under the name of *Æsculus chinensis*, an entirely different species. It first produced fruit in 1888 in the arboretum at Segrez in France. It flowered in 1901 at Coombe Wood. As only small trees are known to exist in England, the hardiness of the tree and its suitability for garden decoration are as yet unproved; but at Tortworth it is growing vigorously, and has ripened its buds well whilst still quite small;

and the great size of the leaves on the young trees give it a striking and distinctive appearance. (A. H.)

In Japan I saw this tree planted in gardens and parks near Tokyo, where it does not seem to grow so large as in its native forests and in higher, colder situations. Sargent says¹ that in the forests of the interior of Hondo, at 2000 to 3000 feet, it attains 80 to 100 feet high, with trunks 3 to 4 feet in diameter, and that these were perhaps the largest deciduous trees that he saw growing wild in the forest. It reaches its most northern point of distribution near Mororan in Hokkaido at sea-level, and I did not see it near Sapporo, in the Aomori district, or near Nikko. At a tea-house called Hideshira, near the village of Sooga on the Nakasendo road, Central Japan, I saw the largest trees of this species growing in a dense grove with *Zelkova acuminata*. They attained over 80 feet high, with clean trunks 40 to 50 feet long, and a girth of 14 feet.

On the Torii-toge Pass, between Wada and Yabuhara, at about 3300 feet, there were many fine trees growing by the side of the road, of one of which I give an illustration from a photograph taken for me by Masuhara of Tokyo in November (Plate 66).

TIMBER

The timber of this tree, though not highly valued in Japan on account of its softness and want of strength, is used for boat and bridge building; furniture making, house-fittings, and for the groundwork of lacquer. It often shows a wavy figure, and when old assumes a pale reddish-brown colour, which makes it very ornamental. Such wood, which I procured at Aomori, has been used with good effect in my Japanese wardrobe, and takes a good polish. It is also much used for trays, and from the large burrs and swellings near the root very handsome trays, as much as 18 or 20 inches square, are carved by the Japanese and sold in the villages at a low price. Its value in Tokyo is given at 60 to 100 yen per 100 cubic feet. I saw a plank of this wood in a timber merchant's shop in Osaka measuring 15 feet long and 58 inches wide, showing wavy figure all through. For this plank 90 yen, equal to about £9, was asked, these immense planks being much valued by Japanese connoisseurs for house decoration. (H. J. E.)

¹ *Forest Flora of Japan*, 28.

ÆSCULUS GLABRA, OHIO BUCKEYE

Æsculus glabra, Willdenow, *Enum. Pl. Hort. Berol.* 405 (1809); Loudon, *Arb. et Frut. Brit.* i. 467 (1838), Sargent, *Silva N. America*, ii. 55, tt. 67, 68 (1892), *Man. Trees N. America*, 644 (1905).

Æsculus pallida, Willdenow, *loc. cit.* 406 (1809).

A tree attaining 70 feet in height and 6 feet in girth in America. Bark dark brown and scaly, becoming in old trees $\frac{3}{4}$ inch thick, ashy-grey, densely furrowed and broken into thick plates roughened on the surface by numerous small scales. Leaves with long slender stalks; leaflets five, oval or obovate-cuneate, long-acuminate, finely serrate in margin, with tufts of hairs in the bases of the serrations, glabrous underneath except for a few hairs along the midrib and tufts in the axils; petiolules short. Terminal leaflet with about fifteen pairs of nerves. Flowers in pubescent panicles, 5 to 6 inches long; calyx campanulate; petals four, pale yellow; claws shorter than the calyx; limbs twice as long as the claws, broadly ovate or oblong in the lateral pair, oblong-spathulate, much narrower and sometimes red-striped in the upper pair. Stamens usually seven, long, exerted, pubescent. Ovary pubescent. Fruit ovate or obovate, brown, 1 to 2 inches long, roughened by prickles.

The species is distinguished in summer by the glabrous leaves, which always show some cilia in the bases of the serrations. In winter the following characters of the twigs and buds may be recognised:—Twigs glabrous, shining, with orange-coloured lenticels. Leaf-scars slightly oblique on obscure leaf-cushions, crescentic or semicircular, with three groups of bundle-dots, the opposite scars wide apart and often not joined by any linear ridge. Pith large, circular, greenish. Buds not viscid; terminal much larger than the lateral, the latter arising from the twig at an angle of 45°; ovoid, acuminate; scales keeled on the back, ciliate in margin, acuminate, the pointed tips being raised outwardly, dark brown.

Var. *Buckleyi*, Sargent (*Æsculus arguta*, Buckley, *Proc. Acad. Phil.* 1860, p. 448), is a geographical form, occurring in Iowa, Missouri, Kansas, and Texas, and characterised by six to seven leaflets, which are sharply and unequally serrate.

No well-marked horticultural varieties are known.

The type occurs in alluvial soil in Atlantic North America, from Pennsylvania to N. Alabama, and westward to S. Iowa, Central Kansas, Indian Territory, and S. Nebraska. Sargent says that it is nowhere very common and from an ornamental point of view very inferior to *Æsculus octandra*.

This species was introduced, according to Loudon, in 1812, but appears to be very rare in this country. At Devonshurst, Chiswick, a tree cut down in 1905 was 60 feet in height by 6 feet in girth, but though the tree probably exists in some nurseries and old gardens, where it is mistaken for *Æsculus octandra*, more commonly than is supposed, we cannot mention any which are remarkable.

(A. H.)

ÆSCULUS OCTANDRA, SWEET BUCKEY

Æsculus octandra, Marshall, *Arbust. Am.* 4 (1785); Sargent, *Silva N. America*, ii. 59, tt. 69, 70 (1892), and *Man. Trees N. America*, 646 (1905).

Æsculus lutea, Wangenheim, *Schrift. Gesell. Nat. Fr. Berlin*, viii. 133, t. 6 (1788).

Æsculus flava, Aiton, *Hort. Kew*, i. 403 (1789).

Æsculus neglecta, Lindley, *Bot. Reg.* xii. t. 1009 (1826).

Pavia flava, Moench, *Method.* 66 (1794); Loudon, *Arb. et Frut. Brit.* i. 471 (1838).

A tree attaining in America 90 feet in height and 9 feet in girth of stem. Bark of trunk $\frac{3}{4}$ inch thick, dark brown, slightly fissured, separating on the surface into thin small scales. Leaves with long slender petioles. Leaflets five, occasionally seven, elliptical or obovate-oblong, cuneate at the base, acuminate, finely serrate, pubescent beneath; petiolules short. Terminal leaflet with twenty or more pairs of nerves. Flowers in pubescent panicles, 4 to 6 inches long; calyx campanulate; petals four, yellow, coming into contact at the tips, very unequal, the upper pair much longer than the lateral pair, claws villose within and much exceeding the calyx, limb of lateral pair obovate or round with a subcordate base, limb of upper pair spatulate, minute. Stamens usually seven, shorter than the petals, villose. Ovary pubescent. Fruit 2 to 3 inches long, brown, smooth or slightly pitted.

IDENTIFICATION

In summer distinguished from *Æsculus glabra* by the leaflets being pubescent beneath and devoid of cilia in the serrations; from *Æsculus Pavia*, by the larger leaves, which have petioles with smooth ridges on their upper surface. In winter the twigs show the following characters:—Branchlets glabrous, shining, with a few scattered lenticels. Leaf-scars flat on the twigs (there being no cushion), obovate, with usually three groups of bundle-dots; opposite scars joined by a linear ridge. Pith large, circular, green or white. Buds not viscid, terminal much larger than the lateral, the latter arising at an angle of 45° , long-oval, pointed at the apex; scales brown, the cilia on the exposed margins minute or absent, upper scales rounded at the apex and on the back, lower pair pointed at the apex and keeled on the back.

VARIETIES

1. Var. *hybrida*, Sargent (Var. *purpurascens*, A. Gray; *Æsculus discolor*,¹ Pursh). This is a form occurring wild in the Alleghany mountains. The flowers are purple or red in colour, and the under surfaces of the leaves, as well as the petioles and panicles, are clothed with a dense pale pubescence.

2. *Æsculus versicolor*, Dippel. This is a hybrid between *Æsculus octandra* and *Æsculus Pavia*, and is intermediate in character, the flowers varying in

¹ Figured in *Bot. Reg.* iv. 310 (1818).

colour from yellowish to pink. The edges of the petals show a few glands and are tufted ciliate.

A considerable number of forms of this variety are known in cultivation in which slight differences occur in the length and shape of the petals. *Æsculus Lyoni* and *Æsculus Whitleyi* are apparently sub-varieties of this hybrid. The forms with red flowers are often known in gardens as *Pavia rubra*, a name which belongs properly to *Æsculus Pavia*.

DISTRIBUTION

This tree occurs in alluvial soil of river valleys and on moist mountain slopes, from Pennsylvania southward to Georgia and N. Alabama; and westward to S. Iowa, Indian Territory, and W. Texas. Sargent says that when at its best on the slopes of the Tennessee and Carolina mountains, it sends up a straight shaft sometimes free of branches for 60 to 70 feet, and reaches a total height of 90 feet.

(A. H.)

CULTIVATION

According to Loudon this species was introduced into England in 1764, but though more common in cultivation than any *Æsculus* except *A. Hippocastanum*, and apparently not particular about soil, it does not attain any great size. It is perfectly hardy at Colesborne, and ripens fruit in most years, from which I have raised seedlings, which, however, do not grow so fast or well as those of the common horse-chestnut. A seedling raised from a tree at Tortworth in 1905 was 6 inches high in the first year, and some raised from seed which I gathered in the Arnold arboretum, which germinated earlier, were much injured by the frost of May 21-22.

At Syon there are two trees, probably of a great age, both grafted on the common horse-chestnut. One is 65 feet high by 4 feet 4 inches in girth; the other is 56 feet high by 6 feet 4 inches in girth, with a bole of 7 feet, dividing into three stems, which form a wide-spreading crown. A tree at Belton Park, Lincolnshire, was, in 1904, 50 feet high by 3 feet 4 inches in girth, with a fine straight stem, drawn up in a wood. Another, crowded by other trees near the Broad Water at Fairford Park, Gloucestershire, measures about 60 feet by 4 feet 5 inches. A self-sown seedling was growing near it in 1903. There is also a tree, measuring about 50 feet by 5 feet 6 inches, at Charlton Kings, near Cheltenham.

(H. J. E.)

ÆSCULUS CALIFORNICA, CALIFORNIAN BUCKEYE

Æsculus californica, Nuttall, in Torrey and Gray, *Fl. N. America*, i. 251 (1839); *Bot. Mag.* t. 5077 (1858); Sargent, *Silva N. America*, ii. 61, tt. 71, 72, and *Man. Trees. N. America*, 648 (1905); Bean, in *Gard. Chron.* 1902, xxxi. 187, fig. 57.

A tree, attaining in America 40 feet in height, with a short trunk occasionally 9 feet in girth. Bark smooth, grey or white. Leaves with slender grooved petioles. Leaflets five to seven, stalked, oblong lanceolate, acuminate at the apex, cuneate or obtuse at the base, shallowly and crenately serrate, pale glabrescent beneath. Terminal leaflet, with ten to twelve pairs of nerves. Flowers in dense pubescent panicles, 3 to 8 inches long. Calyx two-lipped, upper lip with three teeth, lower lip with two teeth much shorter than the four narrow oblong petals, which are white or pale rose in colour. Stamens five to seven, long, erect, exserted. Ovary pubescent. Fruit pear-shaped, two to three inches long, smooth, pale brown.

In summer it is readily distinguished from the other species with viscid buds by the small leaves, pale beneath. In winter the twigs are slender, grey, glabrous, with numerous lenticels. Leaf-scars wide apart, joined by a linear ridge, flat on the twig, without a leaf-cushion, crescentic or semicircular, with a row of five to seven bundle-dots. Pith large, circular, white. Terminal buds, larger than the lateral buds, which arise at an acute angle, oval, pointed, glistening with white resin; scales gaping at the apex of the bud, broadly ridged on the back, ciliate in margin, with a tuft of hairs at the apex.

The species is a native of California, where it grows on the banks of streams. A very striking picture of a tree, at San Mateo, California, is given in *Garden and Forest*, iv. 523. It shows a very short forked bole, nearly 20 feet in girth at 2 feet from the ground, and an immense umbrella-shaped head only 32 feet high and 60 feet in diameter, densely covered all over with flowers.

It was introduced in 1855 by Messrs. Veitch, and flowered in their nursery at Exeter in 1858. It fruited¹ at the Bath Botanic Gardens in 1901, and again in 1905, though it remains a shrub. It is perfectly hardy in the south of England, and is remarkable for the beauty of its flowers, which appear in June and July. The best specimen we know of in the country is one which Elwes found growing in a shrubbery at Hutley Towers near Ryde, Isle of Wight. It is about 30 feet high, and was in flower on June 22, 1906.

(A. H.)

¹ *Gard. Chron.* 1902, xxxi. 187.

TSUGA

Tsuga, Carrière, *Traité Conif.* 185 (1855); Bentham et Hooker, *Gen. Pl.* iii. 440 (1880); Masters, *Journ. Linn. Soc. (Bot.)* xxx. 28 (1893).
Hesperopeuce, Lemmon, *Rep. Calif. State Board Forestry*, iii. 111 (1890).

EVERGREEN trees belonging to the natural order Coniferæ. Branches horizontal or pendulous, pinnately and irregularly ramified. Buds, one terminal and a few lateral, arising irregularly in the axils of some of the leaves of the current year's shoot, most of the leaves being without buds in their axils. Leaves linear, arising from the branchlets in spiral order, and usually thrown by a twisting of their petioles into a pectinate arrangement, or in one species spreading radially. Petioles short, arising from prominent leaf-bases on the branchlets, appressed against the twigs, a sharp angle being formed by the leaf with the stalk at the point of junction. The leaf has one resin-canal, lying in the middle line between the vascular bundle and the epidermis of the lower surface. The leaves persist for several years; and all the species have in consequence of this and their numerous and fine branchlets very dense foliage.

Flowers monœcious. Male flowers in the axils of the leaves of the previous year's shoot near its apex, composed of numerous spirally arranged, short-stalked, two-celled anthers, with glandular-tipped connectives. Female flowers terminal on lateral shoots of the previous year, short-stalked or sub-sessile, erect, composed of spirally arranged, nearly circular scales, and membranous, usually shorter bracts. Ovules, two on each scale. Cones solitary, small, composed of concave woody imbricated scales, which persist on the axis of the cone after the escape of the seeds, and of inconspicuous bracts, which, except in one species, are concealed between the scales. The cones, ripening in one season, allow the seeds to fall out in the first autumn or winter, but remain on the tree until the summer or autumn of the second year. The seeds, two on each scale, are minute, furnished with resin vesicles and winged. The seedling has three to six cotyledons, which bear stomata on their upper surface.

Tsuga is confined to temperate North America, Japan, China, and the Himalayas. The genus consists of nine species, and is divided into two sections:—

I. *Hesperopeuce*, Engelmann, in Brewer and Watson, *Bot. California*, ii. 121 (1880).

Leaves rounded or keeled above, bearing stomata on both surfaces, and radially arranged; the shorter and lateral branchlets standing in a plane at right angles

to the longer and terminal ones. Cones oblong-cylindrical, large, composed of numerous (about seventy) scales.

This section includes one species:—

1. *Tsuga Pattoniana*, Sénéclauze. Western North America.

II. *Micropeuce*, Spach, *Hist. Vég.* xi. 424 (1842), identical with *Eutsuga*, Engelmann, *loc. cit.* 120 (1880).

Leaves flat, grooved above, bearing stomata on the lower surface only, pectinately arranged on the branchlets, which are all in one plane. Cones ovoid, small, composed of few scales, rarely more than twenty-five.

This section comprises the remaining species, of which six are in cultivation in this country. These may be conveniently arranged as follows:—

A. *Leaves serrulate in margin. Shoots pubescent.*

2. *Tsuga Canadensis*, Carrière. Eastern North America.

Leaves, $\frac{1}{3}$ to $\frac{2}{3}$ inch long, usually tapering from the base to the acute or rounded apex; lower surface marked with two narrow well-defined white stomatic bands, the part of the leaf external to them being pure green in colour. Buds brown, ovoid, pointed, composed of pubescent, keeled acute scales.

3. *Tsuga Albertiana*, Sénéclauze. Western North America.

Leaves, $\frac{1}{4}$ to $\frac{3}{4}$ inch long, usually rounded at the apex and uniform in breadth; lower surface with two ill-defined broad white stomatic bands, which are indistinctly continued to the margins, there being no distinct bands of pure green. Buds greyish, ovoid, apex obtuse and flattened; scales keeled, pubescent.

4. *Tsuga Brunoniana*, Carrière. Himalayas.

Leaves, 1 to $1\frac{1}{4}$ inch long, gradually tapering from the base to the acute apex; lower surface silvery white, stomatic bands well-defined and extending almost to the margins. Buds globose, flattened on the top, surrounded at the base by a ring of modified leafy scales, the other scales ovate, acute, pubescent.

B. *Leaves entire in margin. Shoots glabrous.*

5. *Tsuga Sieboldii*, Carrière. Japan.

Leaves, $\frac{1}{4}$ to 1 inch long, oblong, rounded and notched at the apex, shining above; lower surface with two narrow well-defined white stomatic bands. Buds red, ovoid, slightly acute at the apex; scales glabrous and ciliate.

C. *Leaves entire in margin. Shoots pubescent.*

6. *Tsuga diversifolia*, Maximowicz. Japan.

Shoots pubescent, both on the leaf-bases and in the furrows between them. Leaves, $\frac{1}{4}$ to $\frac{1}{2}$ inch long, oblong, rounded and notched at the apex; lower surface with two narrow well-defined white stomatic bands. Buds red, pyriform, flattened above; scales obtuse, minutely pubescent.

7. *Tsuga Caroliniana*, Engelmann. Southern Alleghany Mountains.

Shoots pubescent in the furrows between the leaf-bases, which are glabrous.

Leaves, $\frac{1}{4}$ to $\frac{3}{4}$ inch long, oblong, rounded at the apex, which is entire, minutely notched or mucronate; lower surface with two narrow well-defined white stomatic bands. Buds reddish, ovoid, sharp-pointed; scales indistinctly keeled.

In addition to the preceding, two species of *Tsuga*, belonging to this section, occur in China. They are as yet imperfectly known. *Tsuga chinensis*, Masters,¹ a native of the high mountains of Szechuan, is closely allied to *Tsuga diversifolia*, and, like it, has pubescent young shoots. It differs in the cones, which are quite sessile, and have very lustrous scales. The leaves are described as being green beneath; but this is probably an inconstant character.

Tsuga yunnanensis, Masters,² which was discovered by Père Delavay in the mountains near Likiang in Yunnan, is unknown to me. Franchet considers it to be closely allied to *T. Sieboldii*.

TSUGA PATTONIANA, HOOKER'S HEMLOCK

Tsuga Pattoniana, Sénéclauze, *Conif.* 21 (1867); Engelmann, in Brewer and Watson, *Bot. California*, ii. 121 (1880); Masters, *Gard. Chron.* xii. 10, fig. 1 (1892).

Tsuga Hookeriana, Carrière, *Traité Conif.* 252 (1867); and Lemmon, *Erythea*, vi. 78 (1898).

Tsuga Mertensiana, Sargent, *Silva N. Amer.* xii. 77, t. 606 (1898), and *Trees N. Amer.* 51 (1905); Kent, *Veitch's Man. Conifera*, 468 (1900).

Pinus Mertensiana, Bongard, *Végét. de Sitcha*, 54 (1832).

Pinus Pattoniana, Parlatores, *D. C. Prod.* xvi. 2, p. 429 (1864).

Abies Pattoniana, Balfour, *Rep. Oregon Assoc.* 1 (1853); Murray in Lawson, *Pin. Brit.* ii. 157 (1884).

Abies Hookeriana, Murray, *Edin. New Phil. Journ.* 289 (1855); and in Lawson, *loc. cit.* 153.

Abies Williamsonii, Newberry, *Pacific R. R. Report*, vi. pt. iii. 53, t. 7, fig. 19 (1857).

Hesperopeuce Pattoniana, Lemmon, *Rep. Calif. State Board Forestry*, iii. 128 (1890).

A tree, occasionally attaining in America 150 feet in height, with a girth of 15 feet. Bark dark cinnamon in colour, deeply divided into rounded connected scaly ridges. Shoots brownish-grey, and densely pubescent. Branchlets in different planes, the shorter and lateral ones usually arising on the upper side of the longer and terminal ones, and disposed at right angles to them, giving a tufted appearance to the branch. Leaves radially arranged on the branchlets, not markedly different in size, $\frac{3}{4}$ to 1 inch long, curved, linear; apex usually rounded and obtuse, rarely acute; upper surface convex and keeled towards the apex; lower surface rounded with a median groove; both surfaces with about eight lines of stomata, which are sparse and do not form conspicuous white bands; margin entire. Buds brownish, ovoid, acute at the apex, composed of a few closely imbricated, strongly keeled scales.

Cones sessile, about two inches long, oblong cylindrical, tapering at the apex and slightly narrowed at the base, composed of five series of scales, each series with

¹ *Journ. Linn. Soc. (Bot.)* xxvi. 556 (1902); *Abies chinensis*, Franchet, *Journ. de Bot.* 1899, p. 259.

² *Journ. Linn. Soc. (Bot.)* loc. cit.; *Abies yunnanensis*, Franchet, *loc. cit.* p. 258; and cf. also Masters, *Journ. Linn. Soc. (Bot.)* xxxvii. 421 (1906), who identifies the specimens from Szechuan with this species; but judging from Franchet's description, they are the other species.

fourteen to fifteen scales. Scales thin, broader than long, semicircular with a wedge-shaped base, convex, margin irregularly denticulate, pubescent on both surfaces. Bract oblong, abruptly tapering at the apex, which is visible between the scales. Seed with terminal asymmetrical wing, and two resin-vesicles on the side next the scale.

The name *Pattoniana* is adopted as being the first published under the correct genus *Tsuga*. The tree is known to American botanists as *Tsuga Mertensiana*, which is unfortunate, as this name was for many years in use for the western hemlock. There is no confusion possible if *Pattoniana* be selected, as no other hemlock has been known at any time by this name.

VARIETIES

The preceding description is drawn up from living specimens of the form with bluish entire leaves, cultivated in this country, and applies, in all essential characters, to dried specimens from trees growing wild in America. I have examined the material in the Kew herbarium and also specimens collected by Elwes on Mount Shasta at 7500 feet elevation; and there do not appear to be two distinct varieties of the tree in the wild state, as the presumed alpine form is only a stunted shrub which agrees in botanical characters with the trees from lower levels.

In England, however, there is a form in cultivation, distinguished by its green serrulate leaves, which differs in many respects from the other form. Concerning its origin, we only know, on the authority of Murray,¹ that it was raised at Edinburgh from seeds collected by Jeffrey in 1851 on the Mount Baker range in British Columbia. Jeffrey found trees growing there from 5000 feet elevation to the snow line, varying in size from 150 feet in height and 13½ feet in girth at lower levels to a stunted shrub not more than 4 feet high close to the timber line. Specimens at Kew from Mount Baker gathered by Jeffrey all have entire leaves and belong to the ordinary wild form.

Engelmann,² who visited the Mount Baker range, states that the trees growing there are the ordinary forms of *Tsuga Pattoniana* and *Tsuga Albertiana*. He suggests that the plants raised from Jeffrey's seed may be a mountain form of the latter species; but this cannot be admitted, as they do not resemble that species in botanical characters (buds, leaves, etc.). It is possible that these plants are only a seedling variation of *Tsuga Pattoniana*, and do not correspond with any distinct species or geographical form in the wild state.

Murray,³ believing that he had two species to deal with, named the bluish form *Abies Hookeriana*, and assigned the name *Abies Pattoniana*, Balfour, to the other form. The original figure of Balfour's species represents, however, the same plant as *Abies Hookeriana* of Murray; and much confusion has resulted in consequence in the use of the two names *Hookeriana* and *Pattoniana*. It is most convenient to

¹ *Edin. New. Phil. Jour.* 289 (1855) and *Proc. Hort. Soc.* ii. 202 (1863).

² *Gard. Chron.* xvii. 145 (1882).

³ The distinctions relied on by Murray in the cones are trifling; and in the Kew Herbarium there are wild specimens showing these differences, but all belonging to the form with blue entire leaves. I have not seen cones belonging to the other form.

apply the name *Pattoniana* to the bluish form, as it is the earliest name of the wild plant, and to consider the green-foliaged plant to be a variety of it, which may be called var. *Jeffreyi*.

The two forms are distinguished as follows:—

1. Var. *typica*. The form distinguished in cultivation by its bluish foliage. Introduced in 1854 by William Murray, who found the tree on Scots Mountain, in California.

Leaves, though radially arranged, tending on the lower side of the shoot to be in the plane of the branch and not spreading; those on the upper side of the shoot curved and directed outwards and forwards. They are long and narrow, ½ to ⅞ inch long, and ⅓ inch wide, entire in margin, convex on both surfaces, the groove in the median line above being very short or absent and never continued to the apex of the leaf, which is rounded or acute; both surfaces marked with conspicuous lines of stomata extending from the base to the apex of the leaf.

2. Var. *Jeffreyi*. Only known in cultivation, distinguished by its greenish foliage.

Leaves spreading radially and directed outwards (never forwards) on all sides of the shoot; straight, short, and broad, less than ½ inch long and about ⅓ inch in width, serrulate in margin; upper surface flattened and distinctly grooved, the groove continued to the rounded apex; lower surface convex, with lines of stomata the whole length of the leaf. On the upper surface the stomata only occur in four to six broken lines towards the apex.

This form agrees with the typical form in the character of the buds and pubescence of the branchlets; the shoots, however, are not so slender.

(A. H.)

Mr. Gorman gives the following account¹ of the supposed Alpine form, alluded to above:—"Among the hardy alpine trees Hooker's hemlock stands pre-eminent, having a northern range far beyond that of even the white-barked pine. It is a small, dwarfed and stunted tree compared with the type, and seldom exceeds 12 inches diameter or 30 feet in height. It usually ranges in altitude from 5500 to 6400 feet, but is occasionally found up to and beyond 7000 feet where it can find sufficient moisture. Though generally favouring the heads of moist valleys it is sometimes to be found on the leeward side of peaks and slopes, where snowbanks of sufficient size have formed in winter to maintain an adequate supply of moisture during the rest of the year. It is in the latter situations where the tree reaches its highest altitude. In addition to its smaller size and more alpine habit it further differs from its nearest congener in having thinner bark and *small erect* cones, all the other hemlocks having pendent cones. The tree is too small and inaccessible to have any economic value."

This seems to be distinguished principally by its erect cones. Sargent,² who alludes to Gorman's account, does not consider this variation to be worthy of distinc-

¹ *Survey E. Part Washington Forest Reserve*, p. 336 (19th Ann. Report of the Survey, Part v. 1899).

² *Silva N. Amer.* xii. 78, note 1.

tion, and explains it by saying that the position of the cones "is evidently due to the thickness of the short lateral branchlets, on which they are terminal and which are sometimes so rigid that the weight of the cones does not make them pendent."

DISTRIBUTION

This tree is only found at high elevations, where it has much the same geographical range as the western hemlock, but it extends farther south in California and reaches its southern limit at 9000 to 10,000 feet on the south fork of King River in the Sierra Nevada.

In the north it descends to sea level on Baranoff Island, and on the shores of Yes Bay in Alaska, lat. 55° 54' N., where Mr. Martin Gorman collected it. As a rule it is a tree of high altitudes, growing on exposed ridges and slopes near the upper limit of the forest, in company with *Abies lasiocarpa*, *Picea Engelmanni*, and *Pinus albicaulis*. In the Rocky Mountains of British Columbia Mrs. Nicholl found it as a good-sized tree near Glacier up to 7000 feet, though Wilcox,¹ in his excellent account of the trees of that region, pp. 61-65, does not mention it.

Though usually a more or less stunted and ragged tree, it attains a large size on the Cascade Mountains, where I saw it in perfection on the road from Longmire Springs to Paradise Valley, on the south side of Mount Tacoma,² in August 1904, first at about 4000 feet, where it was only a scattered tree, and higher up it mixed with the western hemlock in a splendid forest. I was not able to distinguish the two species by their bark, though when not crowded, the habit of Hooker's hemlock is very distinct; but they could be identified by the fallen cones under the trees. The largest that I measured here was about 150 feet by 13 feet 8 inches. Higher up, where the forest³ opened out into glades at the bottom of the Paradise Valley, which is, in Professor Sargent's opinion, one of the most interesting in America for its alpine flora, it assumed a different and more flat-topped habit; the largest here that I measured was 108 feet by 13 feet 3 inches. It grew in company with *Abies lasiocarpa*, and seedlings of both were numerous on rotten logs on the shady sides of the clumps in which they always grew.

The tree in a very stunted state reaches the timber line—about 7500 feet—in company with *Abies lasiocarpa* and *Cupressus nootkatensis*; but in California, J. Muir⁴ measured a specimen at 9500 feet, near the margin of Lake Hollow, which was 19 feet 7 inches in girth at 4 feet from the ground.

Mr. Gorman gives an excellent account of the tree in his *Survey of the Eastern Part of the Washington Forest Reserve*, pp. 335-336, from which I quote as follows:—

"This hemlock is confined to the moist valleys and vicinity of the passes. It is the prevailing tree in Cascade Pass, 5421 feet, and is quite common about the

¹ *The Rockies of Canada*, 61-65 (1900).

² The local name is Mount Tacoma, but in maps and writings it is usually called Mount Rainier.

³ An account of this forest, with two beautiful illustrations of "Patton's spruce," is given in *Garden and Forest*, x. 1, figs. 1, 2 (1897).

⁴ *Mountains of California*, p. 20.

sources of the Stehekin, where it attains a very fair size for this region, ranging from 50 to 90 feet in height and from 12 to 27 inches in diameter. The altitudinal range is greater than was expected, from 3100 feet to 5800 feet, and a tree supposed to be of this species was found as low as 2100 feet in the Stehekin Valley.

"The tree is sometimes taken for the western hemlock, but may be distinguished by the erect top of the sapling, the cones long, purple, and more or less massed about the top of the tree; and the mature tree has an unusually thick, roughly corrugated bark: while in the western hemlock the top is generally drooping, the cones small, oval, and brown, and well distributed over the branches, and the mature tree has a comparatively thin bark. The wood is close grained and of fine texture, and is quite suitable for lumber or fuel, but is not much used on account of its growing usually in inaccessible situations."

Near Crater Lake in Southern Oregon, Mr. Leiberg (*Cascade Forest Reserve Report*, pp. 245, 259), says:—"A few scattered groves of Patton hemlock occur in the southern tracts, some of which are of large size, occasional individuals reaching six to seven feet in diameter. Occasional stands of Patton hemlock 200 to 300 years old exhibit fine proportions at this elevation, 6000 feet; the species usually grows in close groups, composed of ten or twenty individuals, collected together on what appears to be a common root; such close growth develops clear trunks, though not commonly of large diameter. Stands of this character sometimes run as high as 25,000 feet per acre."

REMARKABLE TREES

Though now introduced for about fifty-five years this tree has made but little show in our gardens, as the climate of most parts of England is probably too warm for it. I have seen flourishing specimens of no great size in several places, the best, perhaps, being one at Tyberton Court, Herefordshire, the seat of Chandos Lee Warner, Esq., where there is a tree of the typical form 43 feet high by about 3½ feet in girth, said to be fifty years old, and perhaps one of those introduced by William Murray, and sent out by Lawson.

In Scotland it seems to thrive even better, especially at Murthly Castle, where there is a fine group of trees on a lawn (Plate 67). When measured for the Conifer Conference in 1892 the best of these was 35 feet by 3 feet 10 inches, another 30 feet by 4 feet. When I last saw them in September 1906 the tallest tree on the left of the row was 47 feet by 3 feet 8 inches, the tree in the middle with weeping branches 43 feet by 4 feet 2 inches, and the thickest between these two was 6 feet 7 inches in girth. The difference in the habit of these three is well shown in the plate. They produced seed in 1887, from which a number were raised and planted at Murthly. These have grown slowly, and the tallest in 1906 were six or seven feet high, though quite healthy; and the growth of seedlings which I raised from seed gathered on Mount Rainier is extremely slow.

At Keillour, Henry measured, in 1904, a specimen which was 40 feet by 3 feet 9 inches; and at the Cairnies, near Perth, the seat of Major R. M. Patton, there were in 1892 two specimens little inferior to those at Murthly. (H. J. E.)

TSUGA ALBERTIANA, WESTERN HEMLOCK

Tsuga Albertiana, Sénéclauze, *Conif.* 18 (1867); Kent, Veitch's *Man. Coniferae*, 459 (1900).

Tsuga Mertensiana, Carrière, *Traité Conif.* 250 (1867); Masters, *Gard. Chron.* xxiii. 179, fig. 35 (1885).

Tsuga heterophylla, Sargent, *Silva N. Amer.* xii. 73, t. 605 (1898), and *Trees N. Amer.* 50 (1905).

Abies heterophylla, Rafinesque, *Atlant. Jour.* i. 119 (1832).

Abies Mertensiana, Gordon, *Pinetum*, 18 (1858).

Abies Albertiana, A. Murray, *Proc. Roy. Hort. Soc.* iii. 149 (1863).

A large tree, attaining in America 200 to 250 feet in height and 20 feet or more in girth, narrowly pyramidal in habit. Bark of old trees reddish brown, and deeply divided into broad, flat, connected scaly ridges. Young shoots whitish grey, and covered with short pubescence, intermixed with scattered long straggling hairs. Leaves pectinately arranged, the shorter leaves on the upper side of the branchlets, those in the median line above often parallel to the twig and directed forwards, exposing their stomatic surfaces. The leaves are $\frac{1}{4}$ to $\frac{3}{4}$ inch long, linear-oblong, uniform in width, serrulate in margin, dark green above, with a median groove continued up to the rounded apex; under surface with inconspicuous midrib and two broad white stomatic bands, which are ill defined on the outer side, there being no distinct marginal green bands. Buds greyish brown, ovoid, with an obtuse and flattened apex; scales keeled and pubescent.

Cones sessile, about one inch long, ovoid, composed of five series of scales, each series with six to seven scales. Scales spatulate, nearly twice as long as broad, wider in the upper half, abruptly narrowed below, rounded with a slightly acute apex, entire and slightly bevelled in margin, striate and slightly pubescent on the outer surface. Bract small, concealed, lozenge-shaped, pubescent and keeled. Seed with a very long wing, decurrent on the outer side of the seed to the base; seed with wing about three-fourths the length of the scale.

The young seedling has three to four cotyledons, which are a little more than $\frac{1}{4}$ inch in length, gradually tapering to an acute apex, sessile, flattened beneath, the upper surface two-sided and bearing stomata, margin entire. The young stem is pubescent and bears first two to three whorls of true leaves (three in each whorl), which are serrulate, shortly stalked, and bearing stomata on their upper surface. These are succeeded by leaves borne spirally. The cotyledons are supported by a caulicle, reddish and glabrous, about an inch in length, which terminates in a very slender flexuose tap-root.

The name *Albertiana* has been chosen, as it appears to have been published as early as that of *Mertensiana* under the correct genus *Tsuga*. *Tsuga Mertensiana* is now the name given by American botanists to *Tsuga Pattoniana*, and its adoption would cause considerable confusion. *Albertiana*, never having been applied to any other species, is correct on the grounds of common sense as well as of priority.

(A. H.)

DISTRIBUTION

On the west coast of North America it extends southwards from south-eastern Alaska, where it forms the greater part of the great coast forest, which reaches from sea-level up to about 2000 feet, and is associated with Menzies's spruce.

In British Columbia it is very abundant on the coast, and extends as far inland as the heavy rainfall reaches up the valley of the Frazer, on the Gold and Selkirk ranges, and east of the Columbia valley nearly up to the continental divide.¹ In Vancouver's Island it forms with the Douglas fir and red cedar a large though not economically important part of the forest. In Washington and Oregon it is also one of the principal elements of the forest, of which, in the Cascade Forest Reserve, it forms about nine per cent of the timber,² and extends up to 5000 feet, crossing the watershed of the coast range in lat. 45°.

In the drier parts of southern Oregon it becomes rare, and though it occurs in the redwood forests of northern California as far south as Cape Mendocino, I did not see it on the Siskyou mountains or on Mount Shasta. In the interior it is found in the wetter parts of northern Montana, Idaho, and in southern British Columbia, where, in company with Douglas spruce, *Picea Engelmanni*, *Abies grandis*, and *Larix occidentalis*, it sometimes forms a considerable part of the forest, and reaches up to 6000 feet in the Cœur d'Alène mountains, though I did not see it in the valley of the Blackfoot river, near Missoula, where the climate is drier.

It attains its finest development on the coasts of Washington and Oregon, where Sargent says that it attains 200 feet in height, with a stem 20 to 30 feet in girth. Plummer, in his Report on the Mount Rainier Forest Reserve,³ says (p. 101) that it attains an extreme diameter of 6 feet, with a height of 250 feet, of which half to two-thirds is crown. The largest that I actually measured, however, on my visit to Mount Rainier in August 1904, were under 200 feet, with a girth of 12 to 14 feet, and these were growing mixed with *Tsuga Pattoniana* at an elevation of 4000 to 5000 feet.

In the Cascade Reserve Forest of northern Oregon, near Bridal Veil, at about 3500 feet elevation, I measured and Mr. Kiser photographed a tree 175 feet high and 16 feet 6 inches in girth, with a clean bole of about 60 feet, but I am unable to reproduce this, as the negative has not arrived.

The growth of seedlings in all the forests that I saw was exceptionally good. Mr. H. D. Langille says,⁴ p. 36:—

“Certain cone-bearers are better adapted for restocking than others, though the reasons are not apparent. For example, young lovely firs (*A. amabilis*) are abundant everywhere within the zone of that species, whilst noble fir (*A. nobilis*), having a cone and seed of very similar size and nature, seldom germinates, and a seedling of that species is rarely seen.

¹ Mrs. Nicholl, who explored the Rocky Mountains in 1904 and 1905, tells me that it is a large tree at Glacier, on the Canadian Pacific Railway, and grows up to about 5000 feet.

² *Forest Conditions of Cascade Reserve*, p. 25, Washington, 1903.

³ *Twenty-first Annual Report of the U.S. Geological Survey*, part v. Washington, 1900.

⁴ *Forest Conditions in Cascade Reserve*, U.S. Geological Survey, Washington, 1903.

"From many observations made in the zone of the hemlock and lovely fir, it is apparent that these trees, from their ability to thrive under the most adverse conditions, are rapidly superseding the others, and will, under natural conditions, be the sole components of the alpine forests. It is a striking fact that, upon many areas where from 50 to 100 per cent of the present forest is red fir (Douglas), the reproduction is entirely hemlock and lovely fir. Should these forests be destroyed by fire it is probable that red fir would rival these species in restocking the burn; but under natural conditions it is evident that the red fir will be displaced, and the limits of the alpine trees become much lower than at present.

"The yellow pine (*P. ponderosa*), in some instances, does good work in stocking open spots in the timber, but seldom extends far beyond the parent tree. In the yellow pine forests most of the young growth is red or white fir (*A. grandis*), which, taking advantage of the shade and moisture afforded by the yellow pine cover, is growing rapidly, and will in time form a larger percentage of the forest than it has in the past."

I can confirm this from my own observation both in the Cascade Forest and in Vancouver's Island. The seedlings germinate most freely when they fall on the moss-covered rotting trunk of a fallen tree, along which a complete row of young trees often grows; and Plate 59, vol. i. shows a tree of this species, probably 150 years old, whose roots had completely enclosed the still sound trunk of a red cedar (*Thuja plicata*). A valuable paper¹ by Mr. E. T. Allen, dealing with the western hemlock from a forestry point of view, has been published by the U.S. Bureau of Forestry.

CULTIVATION

It was introduced in 1851 by Jeffrey, and named in 1863 by Murray, at the request of Queen Victoria, in memory of the late Prince Consort, who was a patron of the Oregon Association, and President of the Royal Horticultural Society.²

In grace, freedom of growth, and adaptability to varied conditions of culture, in England this, as an ornamental tree, is second to none, and much superior to any other hemlock. Though it has been in cultivation little over fifty years it has already attained a height of about 90 feet in such widely distant counties as Kent, Devonshire, and Perthshire.

The only soils on which it will not thrive are chalk, limestone, and heavy clay, and though it enjoys all the moisture that the wettest parts of England afford, it wants, like all its congeners, a well-drained soil and a sheltered situation.

It ripens seed abundantly in England, and has sown itself in several localities, especially at Blackmoor, the seat of the Earl of Selborne, where there are several self-sown trees, of which the best, growing on the lower greensand formation, is, at about fifteen years old, 10 to 12 feet high, though the parent trees do not exceed about 65 feet.

In Fulmodestone Wood, on Lord Leicester's estate in Norfolk, I have also seen self-sown seedlings; and though they are very slow in growth for the first four or five

¹ "The Western Hemlock," U.S. Dept. Agric. Forestry Bulletin, No. 33 (1902).

² Hunter, *Woods of Perthshire*, p. 359.

years, yet if kept moist and shaded in a mixture of sand and leaf-mould they may be planted out at five to six years old, with every hope of success.

So far as my experience goes, trees grown from cuttings are not so satisfactory, and there is no excuse for this practice except the saving of trouble, as seedlings are raised in quantity at a very low cost from home-grown seed in Scotland, as I have seen in the nursery at Murthly Castle.

REMARKABLE TREES

Among so many fine trees of this species, all of about the same age, it is hard to choose, but perhaps the largest¹ which we have measured is at Hafodunos, in Denbighshire, which in 1904 was found by Henry to be 94 feet 6 inches by 8 feet 5 inches, and this tree has also produced self-sown seedlings.

At Dropmore there is a very beautiful tree of the spreading type (Plate 68), about 70 feet by 6 feet. At Hemsted, in Kent, I was shown by Lord Cranbrook, in 1905, a tree which is perhaps as tall as any in England, but which, growing in a hole and surrounded by other trees, it was not possible to measure accurately. It is, however, about 90 feet by 4 feet 11 inches, well shaped and growing fast.

At Penllergare, near Swansea, the seat of Sir J. T. D. Llewellyn, Bt., are several fine trees growing in a sheltered valley, which were planted about fifty years ago in company with *Tsuga canadensis*. They are now from 70 to 80 feet high, whilst the best of the eastern hemlock is only 50 feet, and the difference in habit of the two trees is very well shown.

A very large tree, reported² to be 110 feet high, is growing at Singleton Abbey, near Swansea, the residence of Lord Swansea, but I have been unable as yet to get confirmation of the height stated. At Castlehill, N. Devon, are several fine trees, the best of which, on a steep bank above a waterfall, where it is somewhat drawn up by beeches, is 90 feet by 6 feet 7 inches. At Cardlew, Cornwall, is a fine tree, which in 1902 was 80 feet by 6 feet 3 inches, and in 1905, 82 feet by 6 feet 6 inches, both measurements taken by myself.

At Barton, Suffolk, a young and very thriving tree, shut in by tall beeches and conifers, in 1905 was 80 feet by 4 feet 3 inches, a remarkable instance of height as compared with girth.

In Scotland the tree flourishes exceedingly, and has been planted in many places. Perhaps the tallest is one at Castle Menzies, which in 1904 I made about 90 feet by 7 feet 8 inches, though the gardener thinks it is taller; but one of the most beautiful for its shape, graceful habit, and situation, grows by a deep shady burn on the road from Dunkeld to Murthly Castle, and is about 70 feet by 5 feet (Plate 69), and there are many other fine trees in the grounds there. A tree at Riccarton, near Edinburgh, planted in 1855, measured in 1905, 73 feet by 7 feet 1 inch. A very large tree, measuring in 1907, 10 feet in girth, is reported by Major P. J. Waldron, to be growing at Hallyburton, Coupar-Angus, the seat of Mr. W. Graham Menzies.

¹ This tree was in 1868, 28½ feet high by 2 feet 3 inches in girth at the base. In 1883 it measured 65 feet by 4 feet 11 inches at 3 feet from the ground (*Gard. Chron.* 1868, p. 657, and 1885, xxiii. 179). According to the owner, Colonel Sandbach, it was planted probably in 1856.

² *Gard. Chron.* xxxvii. 136 (1905).

The only place where the tree is reported to have been killed by frost is in the plantations at the Cairnies, Perthshire, where Hunter says (p. 364) that in the severe winter of 1880-81 many were injured and some killed. Two of the finest specimens in Scotland are, however, growing in the grounds at this place.¹

In Ireland the best specimen we know of is one at Glenstal, Co. Limerick, which measured in 1903, 78 feet high by 7½ feet in girth. One of exactly the same height by 6 feet in girth is growing at Kilmacurragh, Co. Wicklow; and around it are several self-sown seedlings. At Mount Usher, in the same county, there is a fine specimen, 28 years old, from seed, which was 57 feet high by 4 feet 5 inches in 1903.

TIMBER

The timber of the western hemlock has not until recently been much valued, or cut for lumber, on account of its supposed inferiority to that of the Douglas spruce, and is often left standing by loggers, but the increasing scarcity of lumber in some districts has led to its being converted into boards, and it is now largely used for the construction of buildings. Sargent says that it is light, hard, and tough, stronger, more durable, and more easily worked than the other American hemlocks. Allen² says that in strength it cannot be classed with oak, red fir, or longleaf pine, nor is it suitable for heavy construction, especially where exposed to the weather; but it possesses all the strength requisite for ordinary building material. It is largely used in Washington for mill frames.

At Mr. Bradley's sawmill at Bridal Veil, Oregon, I saw it being manufactured, and brought away a sample which quite bears out Sargent's high opinion of it. If such timber existed in Japan or in Europe, I am sure it would be highly valued for joinery, but so far as I can learn none has yet been shipped to Europe. Hemlock timber³ has been exported to Manila, and is likely to prove of considerable value in the tropics for housebuilding and indoor finish, as it appears to be free from the attacks of white ants. The wood is distasteful to rodents, and is used on that account by farmers for the construction of oat-bins.

The bark, according to Sargent, forms the most valuable tanning material produced on the west coast of North America, and the inner bark is eaten by the Indians of Alaska.

James M. Macoun³ says of it—"The abundance of other wood of better quality has prevented the hemlock from coming into general use, and the same prejudice exists in British Columbia against the western tree that prevailed until very recently against hemlock in eastern Canada. Though its grain is coarse, western hemlock is for many purposes just as serviceable as other woods which cost more. The bark is rich in tannin, but is too thin to be extensively used while there is such an abundance of Douglas fir in the same region." (H. J. E.)

¹ These are trees growing in peat soil at 635 feet altitude. The seeds were sown in 1853, and in 1868 one tree was 29 feet by 1 ft. 11 in., and the other 26 feet by 2 feet at three feet from the ground (*Gard. Chron.* 1868, p. 518).

² Allen, "Western Hemlock," 20, 21 (*U.S. Forestry Bulletin*, No. 33, 1902).

³ *Forest Wealth of Canada*, 82 (1904).

TSUGA CANADENSIS, HEMLOCK OR HEMLOCK SPRUCE

Tsuga canadensis, Carrière, *Traité Conif.* 189 (1855); Sargent, *Silva N. Amer.* xii. 63, t. 603 (1898), and *Trees N. Amer.* 48 (1905); Kent, *Veitch's Man. Conifera*, 463 (1900).
Pinus canadensis, Linnæus, *Sp. Pl.* 1421 (1763); Lambert, *Genus Pinus*, i. t. 32 (1803).
Abies canadensis, Michaux, *Fl. Bor. Am.* ii. 206 (1803), and *Hist. Arb. Amer.* i. 137, t. 13 (1810); Loudon, *Arb. et Frut. Brit.* iv. 2322 (1838).
Picea canadensis, Link, *Linnaea*, xv. 523 (1841).

A tree attaining in America over 100 feet in height, but usually only 60 to 70 feet, with a girth of 12 feet as a maximum. Bark of old trees brownish and deeply divided into narrow rounded ridges, covered with appressed scales.

Young shoots greyish in colour and covered with short stiff pubescence. Leaves pectinately arranged, the shorter ones on the upper side of the shoot; those on the median line above pointing forwards, appressed to the twig, and displaying their white under surfaces. They are ½ to ⅔ inch long, linear, usually broadest towards the base and tapering to the apex, which is rounded or acute; distinctly and sharply serrulate in margin; dark green above with a median groove often not continued to the apex; lower surface with distinct midrib and two narrow well-defined white stomatic bands, the edges being pure green in colour. Buds brown, ovoid, pointed; scales ciliate, pubescent, keeled, acute.

Cones, ½ to ¾ inch long, ovoid, on slender puberulous stalks nearly ¼ inch long, composed of five series of scales, with about five scales in each series. Scales orbicular oblong, nearly as broad as long, entire and slightly bevelled in margin, striate, glabrescent in the exposed part. Bract small, concealed, lozenge-shaped. Seed with an oblong wing, decurrent half-way on its outer side. The seed with wing about two-thirds the length of the scale.

VARIETIES

A considerable number of horticultural varieties are known, no less than fourteen being described by Beissner. Some of these are variegated forms, as var. *argentea* or *albo-spica*, in which the tips of the young shoots are whitish. Others differ in habit and stature, as var. *pendula*, with pendulous branches, and var. *Sargentii*,¹ a flat-topped bushy form of compact habit with short pendulous branches. The latter was found about forty years ago on the Fishkill Mountains in New York, and was first cultivated and made known by Mr. H. W. Sargent. One of the original plants, growing on the Howland estate, in Matteawan, New York, is now about 25 feet across. Grafted plants of this variety form in a few years an erect stem, and lose the dense low habit which is the charm of the original seedlings.¹

Var. *parvifolia*, as cultivated at Kew, is a shrub, with stout branchlets, and very short leaves, about ¼ inch long, which spread radially outwards from the shoot.

(A. H.)

¹ Sargent, *Garden and Forest*, x. 490 (1897).

DISTRIBUTION

In the colder parts of New England and Canada the hemlock is one of the most characteristic trees of the virgin forest, and extends, according to Sargent, from Nova Scotia and New Brunswick westward through Ontario to eastern Minnesota, southwards through Delaware, southern Michigan, and central Wisconsin, and along the Appalachian Mountains to north-western Alabama. He says that it attains its largest size in the south, in the mountain valleys of North Carolina and Tennessee, and gives its size as usually 60 or 70 and occasionally 100 feet in height, with a trunk 2 to 4 feet in diameter; but Pinchot and Ashe (*loc. cit.* p. 134) give 110 feet with a diameter of 6 feet as its extreme size, with a beautiful picture of it (pl. xix.). When, however, I was at Ottawa in September 1904 I visited, in company with Mr. James M. Macoun of the Geological Survey, a forest near Chelsea, in the Gatineau valley, where several hemlocks of nearly 100 feet were standing, mixed with birches, maples, and other hardwoods, and found a fallen tree which must have been at least 125 feet, and perhaps 135 feet long, though the top was too rotten to follow it out to the end. Mr. Macoun, however, said he had never seen one so large before.

It often grows on rocky ridges, where it forms dense groves on the north side, and loves the steep banks of river gorges. Henry visited in 1906 Pisgah Mountain, near Hinsdale, in New Hampshire, where there remain on the estate of Mr. Ansell Dickinson about 700 acres of virgin forest. This mainly consists of a mixture of hemlock and hardwoods, with white pine occurring here and there singly and in small groups; though on one or two areas of a few acres the white pine and hemlock form a pure coniferous stand. The largest hemlock seen measured 113 feet by 7 feet 10 inches, with a clean stem of only 30 feet, being much branched though densely crowded by other trees. A great many small hemlocks throughout the forest formed an undergrowth, and had been suppressed in growth, one which was $\frac{3}{4}$ inch in diameter and 10 feet high showing 65 annual rings.

In the Arnold Arboretum, near Boston, is a fine natural grove of this tree, called Hemlock Hill, which gives a very good idea of its normal growth in New England. The average height here is 60 to 70 feet by 3 to 4 feet, and the best that I measured at the bottom of the hill was 80 feet by 4 feet 6 inches. These trees were rather crowded, and had clean boles for 15 to 30 feet up.

The growth of the tree is very slow, and Sargent says that the specimen of its timber in the Jessup Collection in the American Museum of Natural History at New York (which is the most complete that has ever been formed of the woods of any country) is only $13\frac{1}{2}$ inches in diameter inside the bark, though it shows 164 annual rings, of which the sapwood, 2 inches thick, has twenty-nine.

It seeds freely, but the seedlings do not germinate well in the open or on land which has been recently burned over, and seem to succeed best on a mossy stump or fallen log, where they must often remain eight to ten years before their roots reach the earth. According to Sargent they are only three or four inches high at four years old, under favourable conditions, and are easily destroyed.

CULTIVATION

Though introduced by Peter Collinson about 1736,¹ and at one time planted in almost every garden as an ornamental tree, the hemlock is rarely seen in Europe in a condition to remind the American of it as he knows it at home. Of late years it has been superseded by more modern and faster growing introductions.

I cannot exactly say what are the conditions which suit it best in this country, because I have not seen it planted in the shady, damp, and rocky gorges which it likes at home; but a deep light soil, free from lime and well drained, and a northern aspect, seem to suit it best in gardens. Its graceful habit and perfect hardiness should recommend it to all lovers of trees. It has a general tendency to fork near the ground, and this can only be checked by crowding it when young, or perhaps to some extent by careful pruning, as Loudon says that it bears the knife well, and is used for hedges in American nurseries; though I should consider either common spruce or arbor vitæ much better suited for the purpose here.

It ripens seed freely, but the plants I have raised were so small that frost and March winds destroyed them before I learned the necessity of protecting them; and in future I would imitate nature, and sow them on a mossy piece of half-rotten wood, or in a mixture of sand and leaf mould in a shaded frame.

REMARKABLE TREES

By far the most remarkable specimens of this tree which exist in England, or, as I believe, in Europe, are at Foxley, Herefordshire, the seat of the Rev. G. H. Davenport, which are believed to have been planted by Sir Uvedale Price, who was once the owner of this place. He was born in 1747, and died in 1828. In Nash wood, about half a mile from the house, on a rich soil of old red sandstone formation, in a dell facing south-west, a number of these trees are growing, which, though not quite so large as the tree at Studley, average about 55 feet high by 8 to 10 in girth, and although their trunks are not so straight and clean as in an American forest, are nearly all sound and healthy. I measured twenty of these trees in July 1906 and found the largest, the only one which was forked near the ground, to be 10 feet in girth. Another was 9 ft. 10 in., and had a trunk which would contain from 120 to 130 cubic feet. The others ranged from 7 to $9\frac{1}{2}$ feet at 5 feet from the ground, averaging over 8 feet, and were mostly clear of branches, or nearly so, for 15 to 30 feet from the ground. The dense shade of these trees keeps the soil quite free from vegetation below them, but I saw no seedlings in the grove. Though Mr. Davenport was good enough to have a considerable clearing made in order to get a better view of the trees, and Mr. Foster went to Foxley on purpose to photograph them, the difficulty of the subject was so great that the prints taken (Plate 70) do not show them as well as I could wish.

The largest tree which I have seen in England is at Studley Royal, not far below

¹ A tree said to be the original one planted by him at Mill Hill still survives, but was, when I saw it in 1906, in poor condition, the soil being too dry for it.

Fountains Abbey, and close to two very tall spruce. This, though hard to measure correctly owing to its crowded position, which makes a satisfactory illustration impossible, is over 80 feet high and 11 feet in girth, but is forked at about 7 feet from the ground.

The next best is at Strathfieldsaye, a very spreading tree in damp soil, also forking near the ground. The two stems measure 9 feet 6 inches and 8 feet 3 inches, and the height in 1903 was about 75 feet, the branches weeping to the ground on all sides (Plate 71). At Althorp there is a fine old specimen on the lawn, of a more upright type, which in 1903 was 63 feet by 8 feet 10 inches. At Walcot, in Shropshire, the seat of the Earl of Powis, is one of the best grown trees I have seen, with a bole about 25 feet high, and measuring 60 feet by 8 feet 8 inches. At Mr. Heelas' residence, near Reading, part of the old White Knights estate, is a tree, probably planted 150 years ago, which Henry in 1904 found to be 67 feet by 8 feet. At Arley Castle there is a fine tree dividing into three stems, of which the largest is 6 feet 7 inches in girth and nearly 70 feet high.

At Hardwick, Bury St. Edmunds, there is a tree, forked at 30 feet up, 60 feet by 5 feet 10 inches. At Beauport, Sussex, a tree measured in 1904, 65 feet by 7 feet. At Osberton, Notts, the seat of Mr. F. Savile Foljambe, there is a remarkably spreading old tree about 42 feet high, and dividing near the ground into three stems, each about 6 feet in girth. It has some layered branches which are over 20 feet high, and the total circumference is no less than 80 paces. Bunbury, *Arboretum Notes*, p. 140, mentions as the largest hemlock in the country one growing at Bowood, Wiltshire, the seat of the Marquess of Lansdowne, which, however, cannot now be found.

In Scotland, where the tree should succeed well, I have seen none of great size, except the tree at Dunkeld, which is growing in a thick wood of conifers mixed with beech on rocky ground, close to the Hermitage bridge. This is mentioned by Hunter as being 80 feet high by 10 feet in girth. Mr. D. Keir twenty years later made it 85 feet by 11 feet, and when he showed it to me in 1906 I found that, though the top is not easy to see, it is probably as much as 90 feet, and looks as if it would grow taller. It divides at about 12 feet into several stems, and is believed to be 140 to 150 years old.

At Dalkeith there was in 1891 a tree 42 feet high by 10 feet 6 inches in girth; and at Buchanan Castle, Stirlingshire, the seat of the Duke of Montrose, one measuring 45 feet by 6 feet 10 inches.¹

In Ireland the largest known to us is one at Carton, the seat of the Duke of Leinster, which in 1903 was 45 feet by 6½ feet.

TIMBER

Opinions as to the value of this wood differ a good deal, and I have no personal experience in the matter. Sargent says that it is light, soft, not strong, brittle, coarse, crooked-grained, difficult to work, liable to wind-shake and splinter, and not

¹ *Journ. R. Hort. Soc.* xiv. 520, 544 (1892).

durable when exposed to the air; but that it is now largely manufactured into coarse lumber for the outside finish of buildings, and is also used for railway ties and water-pipes. James M. Macoun, in *The Forest Wealth of Canada*, p. 82, says: "Though little inferior to white pine as rough lumber, a prejudice has for a long time existed against this wood, which is only now dying out. As a coarse lumber it to-day commands almost as high a price as pine. It is one of our best woods for wharves and docks, and great quantities are used annually for piles." It is not, so far as I can learn, imported into Europe. The value of its bark, however, for tanning heavy leather has long been known, and it is used more largely than any other in Canada and the Eastern States of America, often mixed with oak bark in order to modify the red colour of the leather tanned with it alone.¹

Canada pitch, made from the resin of this tree, and oil of hemlock, distilled from its twigs, were formerly used to some extent in medicine, but are not now of any commercial importance. (H. J. E.)

TSUGA CAROLINIANA, CAROLINA HEMLOCK

Tsuga Caroliniana, Engelmann, Coulter's *Bot. Gazette*, vi. 223 (1881); Sargent, *Gard. Chron.* xxvi. 780, fig. 153 (1886), *Silva N. Amer.* xii. 69, t. 604 (1898), and *Trees N. Amer.* 49 (1905); Kent, Veitch's *Man. Coniferae*, 466 (1900).

A tree attaining in America 70 feet in height with a girth of 6 feet. Bark reddish brown, and deeply divided into broad, flat, connected scaly ridges. Young shoots shining grey, with scattered short pubescence in the furrows between the glabrous leaf-bases. Leaves pectinately arranged, those on the upper side of the branchlet shorter than the others, ¼ to ¾ inch long, linear-oblong, uniform in breadth or slightly narrowed towards the rounded apex, which is occasionally minutely emarginate; dark green and shining above, with a median groove either continued up to the apex or falling short of it; lower surface with distinct midrib and two narrow, well-defined white stomatic bands, the edges being green; margin entire. Buds reddish brown, ovoid, sharp-pointed; scales indistinctly keeled and pubescent.

Cones on short stout stalks, pendulous or deflected, cylindrical-oblong, 1 to 1½ inch long, consisting of five series of scales, five scales in each series. Scales oblong-orbicular, rounded and slightly narrowed at the apex, pubescent externally, edge thin and bevelled. Bract concealed, wedge-shaped at the base, rounded at the apex. Seed with a long wing, which is decurrent half-way down its outer side.

Tsuga Caroliniana appears to be the American representative of *Tsuga*

¹ Prof. H. R. Procter of the Leather Industries Department of Leeds University, tells me that though the bark is still the principal tanning material of North America, it has been cut so recklessly that in many districts the supply is now insufficient, and is supplemented by extracts of other materials, especially that of Quebracho wood (*Loxopterygium*). In England its use was at one time considerable, but it is no longer a specially cheap material, and its colour has now to a large extent prevented its employment. The bark appears to contain from 8 to 12 per cent of a catechol tannin, yielding large quantities of insoluble "reds," and in this respect it is very inferior to the bark of the common spruce fir, which is largely employed in Austria, though it does not seem to be used in England.

diversifolia, and is remarkable for its limited distribution. It occurs at elevations of 2500 to 3000 feet, usually on dry rocky banks of mountain streams along the Blue Ridge, extending from south-western Virginia through South Carolina to northern Georgia. Sargent states that it occurs either in small groves or mingled with other species, and describes it as a beautiful tree of compact pyramidal habit, with dense dark-green lustrous foliage. Elwes saw it on the Blue Ridge in 1893, and brought home young plants, which, however, died in a year or two.

This tree was discovered in 1850 by Professor L. R. Gibbes. It was first raised in the Arnold Arboretum in 1881, and has proved there quite hardy. It was introduced from thence to England in 1886. There are two or three small specimens in the collection at Kew which are three or four feet in height and have a bushy, spreading habit. This species, judging from the slow rate of growth at Kew, is not likely to attain to timber size in England, and we know of no trees of any size living in this country. (A. H.)

TSUGA BRUNONIANA, HIMALAYAN HEMLOCK

Tsuga Brunoniana, Carrière, *Traité Conif.* 188 (1855); Hook. f., *Gard. Chron.* xxvi. 72, fig. 14 (1886), and *Flora Brit. India*, v. 654 (1888); Masters, *Gard. Chron.* xxvi. 500, fig. 101 (1886); Kent, Veitch's *Man. Coniferae*, 462 (1900); Gamble, *Man. Indian Timbers*, 718 (1902); Brandis, *Indian Trees*, 693 (1906).

Tsuga dumosa, Sargent, *Silva N. Amer.* xii. 60 (1898).

Pinus dumosa, D. Don, *Prod. Fl. Nepal.* 55 (1825).

Pinus Brunoniana, Wallich, *Pl. Asiat. Rar.* iii. 24, t. 247 (1832).

Abies Brunoniana, Lindley, *Penny Cyclop.* i. 31 (1833).

Abies dumosa, Loudon, *Arb. et Frut. Brit.* iv. 2325 (1838), and Brandis, *Forest Flor. N.W. India*, 527 (1874).

A tree forming in the Himalayas, according to Hooker, a stately blunt pyramid, with branches spreading like the cedar, but not so stiff, and drooping gracefully on all sides, attaining 120 feet in height and 28 feet in girth. In cultivation in England it assumes a bushy habit, and never makes a clean stem, the trunk being concealed by the dense pendulous branches.

Bark thick and rough. Branchlets light brown in colour with a short and not very dense pubescence. Leaves long, 1 to 1½ inch, narrow linear, gradually tapering towards the acute and recurved apex, serrulate in margin; upper surface dark green and deeply grooved; lower surface silvery white, the bands of stomata extending almost to the margins. Buds globose, flattened on the top; scales ovate, acute, pubescent.

Cones sessile, ovoid, an inch long, composed of about twenty-five woody scales, which are nearly orbicular, vertically striate, shining, showing externally a thickened ridge a little distance from and parallel to the thin entire margin; bract concealed. Seed two-thirds the length of the scale, with an oblong-ovate wing, which is decurrent on the outer side of the seed to its base.

Tsuga Brunoniana occurs in the Himalayas, from Kumaon to Bhotan, at altitudes varying from 8000 to 10,500 feet. Franchet considers that certain Chinese specimens constitute a distinct variety of the species, which he has named var. *chinensis*.¹ These were collected in N.E. Szechuan by Père Farges, and in the mountains of western Yunnan at 9000 feet altitude by Père Delavay. Diels² also identifies with this variety specimens collected by Von Rosthorn in Szechuan. I have seen no Chinese examples, and Mr. E. H. Wilson considers that there is only one species of *Tsuga* in the mountains of Szechuan, which is *Tsuga chinensis*, Masters. Small plants of the Chinese *Tsuga* are now in cultivation at Coombe Wood; and are as yet too young to entitle us to speak definitely concerning its affinities. (A. H.)

In the interior of Sikkim I saw this beautiful tree in great perfection in the same forests where Sir Joseph Hooker so well describes it,³ during my journey with the late W. E. Blanford to the Tibetan frontier in 1870. It occurs first in the Lachen valley at about 8000 feet in an extremely moist summer climate, where snow lies for two or three months in winter, growing in company with *Picea Morindoides*, *Abies Webbiana*, and, higher up, with *Larix Griffithii*, in a forest unrivalled in the temperate region for its botanical and zoological wealth; where it commonly attains a height of 100 to 120 feet. Afterwards, on the path from Lachoong to the Tunkralah, I saw even grander specimens, one of which, as measured by Sir J. Hooker, was over 120 feet high by 28 feet in girth. In these almost pathless forests it is covered with ferns and lichens and forms a graceful pyramidal tree with very drooping branches, and reaches an elevation of about 10,000 feet. On the outer ranges it is not so large, but extends into Bhotan, where Griffith found it from 6500 to 9500 feet. It probably occurs throughout Nepal and in the N.W. Himalaya, as far west as Kumaon, where it is a smaller tree and of little economic value, though in Sikkim the bark is used for roofing huts.

The Himalayan hemlock was introduced into England in 1838, according to Loudon,⁴ but is rarely seen, except in a stunted state, with several branching stems, and suffering from the absence of sufficient moisture. Like most of the Himalayan conifers, it grows too early and is injured by spring frosts; but in a few favoured districts of Cornwall and Ireland it seems more at home and has attained considerable size and beauty.

The best specimen that I have seen is at Boconnoc in Cornwall, the seat of J. B. Fortescue, Esq. (Plate 72). This tree measures about 53 feet high by 12 feet in girth near the ground, where it branches into several stems, which spread to about 70 feet in diameter. When I saw it in April 1905 it was covered with cones, from which I have raised many young plants.

There is a rather fine tree at Dropmore, planted in 1847, but not so large or healthy as the one described above; and at Beauport, near Battle, Sussex, there is also a fair specimen.

¹ *Jour. de Bot.* 1899, p. 258.

³ *Himalayan Journals*, i. 209, ii. 108, etc.

² *Flora von Central China*, 217 (1901).

⁴ *Encycl. Trees and Shrubs*, 1036 (1842).

At Southampton,¹ in the Red Lodge nursery belonging to Mr. W. H. Rogers, there was a tree twenty-five years old in 1884, about 20 feet high, which bore cones in profusion. At Kew a specimen planted in a sheltered position lived for many years, but ultimately succumbed. Sir Joseph Hooker² knew of no good specimen nearer London than one on a south slope near Leith Hill in a very sheltered and well-watered valley.

At Fota, in the S.W. of Ireland, the seat of Lord Barrymore, Henry measured a tree about 40 feet by 4 feet 10 inches in 1904; and there are trees at Kilmacurragh and Powerscourt, in Co. Wicklow, which are about 30 feet high, all of very branching bushy habit, and with several main stems.

Sargent³ has never seen a specimen in the United States. (H. J. E.)

TSUGA SIEBOLDII, SIEBOLD'S HEMLOCK

Tsuga Sieboldii, Carrière, *Traité Conif.* 186 (1855); Masters, *Jour. Linn. Soc. (Bot.)*, xviii. 512 (1881); Mayr, *Abiet. des Jap. Reiches*, 59, t. iv. fig. 12 (1890); Kent, *Veitch's Man. Coniferae*, 472 (1900).

Tsuga Tsuja, A. Murray, *Proc. R. Hort. Soc.* ii. 508, ff. 141-153 (1862).

Tsuga Araragi, Koehne, *Deutsche Dendrologie*, 10 (1893), and Sargent, *Garden and Forest*, x. 491, fig. 62 (1897).

Pinus Araragi, Siebold, *Verhandl. Batav. Genoot. Konst. Wet.* xii. 12 (1830).

Abies Tsuga, Siebold et Zuccarini, *Fl. Jap.* ii. 14, t. 106 (1842).

Abies Araragi, Loudon, *Trees and Shrubs*, 1036 (1842).

A tree attaining in Japan about 100 feet in height and 12 feet in girth, forming in England a small tree with a short bole and a dense crown of foliage, with numerous branches and pendulous branchlets.

Young shoots greyish in colour and quite glabrous. Leaves pectinately arranged, variable in size, the smaller on the upper side of the shoot, some of these being directed outwards at right angles to the general plane of the foliage. They are oblong, uniform in width, $\frac{1}{4}$ to 1 inch long, shining and dark green above with a median furrow continued to the rounded and emarginate apex; lower surface with green midrib and two narrow well-defined white bands of stomata; margin quite entire. Buds reddish, ovoid, slightly acute at the apex: scales glabrous on the surface, ciliate in margin.

Cones elongated ovoid, on a stalk about $\frac{1}{4}$ inch long, pendulous or deflected, composed of five series of orbicular scales, which are rounded at the apex and at the base and have a slightly bevelled margin. Bract included, very short and bifid. Seed with a long wing decurrent half-way along its outer side.

This tree has been much confused with the other Japanese species, from which it is very distinct in botanical characters. Koehne's proposed name, *Tsuga Araragi*, is not adopted by us, the name *Sieboldii* being the first one under the correct genus *Tsuga*. (A. H.)

¹ Note in Kew herbarium, and Nicholson in *Woods and Forests*, 1884, p. 243.

² *Gard. Chron.* xxvi. 72 (1886).

³ *Garden and Forest*, x. 491 (1897).

TSUGA DIVERSIFOLIA, JAPANESE HEMLOCK

Tsuga diversifolia, Masters, *Jour. Linn. Soc. (Bot.)* xviii. 514 (1881); Mayr, *Abiet. des Jap. Reiches* 61, t. xiv. fig. 13 (1890); Sargent, *Garden and Forest*, vi. 495, fig. 73 (1893), and x. 491, fig. 63 (1897); Kent, *Veitch's Man. Coniferae*, 467 (1900).

Abies diversifolia, Maximowicz, *Mél. Biol.* vi. 373 (1867).

A smaller tree than Siebold's hemlock, which it resembles in habit.

Young shoots pubescent, the pubescence occurring on both the leaf-bases and the intervening furrows. Leaves arranged as in *Tsuga Sieboldii*, but considerably shorter, scarcely exceeding $\frac{1}{2}$ inch in length, oblong, uniform in breadth, shining and dark green above with a median furrow continued to the rounded and emarginate apex; lower surface with green midrib and two narrow well-defined white bands of stomata; margin entire. Buds red, pyriform, flattened above; scales rounded at the apex, minutely pubescent and ciliate.

Cones subsessile, pendent or deflected, ovoid; scales shining, orbicular-oblong, truncate at the base, with edge slightly bevelled and thickened. Bract minute, concealed, rhomboid. Seed with a short terminal wing, which is not decurrent along its side. (A. H.)

DISTRIBUTION OF THE JAPANESE TSUGAS

In Japan I saw both species in their native forests; but so far as I could learn they are not distinguished by the foresters and are both called *Tsuga* (pronounced *tsunga*). By the Japanese botanists *Tsuga Sieboldii* is termed *Tsuga*, the other species being named *Kuro-tsuga* or *Kome-tsuga*. Of the two, the latter apparently has a more northern range than *Tsuga Sieboldii*. I saw it in the forest round Lake Yumoto at 4000 to 5000 feet elevation, where it is a picturesque and graceful tree of no great size. Both species, however, according to Shirasawa, are found in this district. *Tsuga diversifolia* also occurred high up in the Atera valley. Further south in the Kisogawa valley and at Koyasan I saw *Tsuga Sieboldii*, which at 2000 to 3000 feet attains a large size, growing scattered in mixed forests and not gregariously, like the other species at Lake Yumoto. I measured a tree at Koyasan, which had been felled; it was over 100 feet in height, of which half was free from branches, the butt being about 3 feet in diameter. I estimated it as 250 to 300 years old, though the growth had been so slow that I could not count the rings beyond 150. The wood of this tree, as I was told by the chief priest of the Gemyo-in temple, who was my host at Koyasan, is even better than that of Hinoki (*Cupressus obtusa*); and much of the wood used in building the temple had been *Tsuga*. Old trees, however, are now so scarce that the timber cannot be obtained in quantity. I bought some beautiful boards cut from it at Osaka, which have a pale yellow colour and very fine wavy figure. The wood is also made into shingles, which are said to last about forty years, and it has lately been used for paper-making. The bark is used for tanning fishing-nets, and the timber sells in Tokyo at thirty-five to forty yen

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per 100 cubic feet.¹ The growth of the tree from seed is very slow at first as in the allied species.

HISTORY AND CULTIVATION

Tsuga Sieboldii was introduced into Europe by Siebold in 1850. Cones both of this species and of *Tsuga diversifolia* were brought from Japan by John Gould Vetch in 1861, and the latter species was sent out under the name *Abies Tsuga*, var. *nana*. Specimens cultivated at Kew as *Tsuga Sieboldii*, var. *nana*, belong to *Tsuga diversifolia*.

Though both species have been introduced long enough to prove their hardiness in favoured parts of the South of England, we have never seen even a moderately large tree, and doubt much if either species will attain timber size in this country. The Japanese hemlocks seem to prefer a light moist rich soil, free from lime, with shade and shelter from cold winds. They will not grow at all on the limestone soil of Colesborne. The best specimen we know is in the garden of Mr. W. H. Griffiths at Campden, Gloucestershire, and is about 15 feet high. It bore cones in 1905.

Sargent² says that *Tsuga Sieboldii* is one of the most graceful and satisfactory of the exotic conifers cultivated in American gardens, where it promises to grow to a large size; but in the garden of Mr. Hunnewell at Wellesley, Massachusetts, which I visited in May 1904, I noted that it had been almost killed to the snow line by the exceptionally severe winter of 1903-1904, though it had produced cones in the preceding year.³

(H. J. E.)

¹ In *Industries of Japan*, 236 (1889), Rein, who did not distinguish between the two species, probably speaking of *Tsuga Sieboldii*, says that the finest specimens seen by him were in the forests of Kin-shima-yama in Southern Kiu-siu, where it grows with *Picea polita*, and equals it in size, attaining 4 to 5 metres in girth. This goes to show that the tree enjoys a warm moist climate.

² *Silva North America*, xii. 60.

³ Beissner states in *Mitt. D. D. Ges.* 1905, pp. 165, 167, that *T. diversifolia* is hardier than *T. Sieboldii*, but both of them grow well in East Friesland, and Mayr says that *T. diversifolia* is hardy at Munich.

JUGLANS

Juglans, Linnæus, *Gen. Pl.* 291 (1737); Bentham et Hooker, *Gen. Pl.* iii. 398 (1880).

DECIDUOUS trees with furrowed bark. Twigs with chambered pith. Buds scaly, the lateral buds often extra-axillary or accompanied by superposed accessory buds. Leaf-scars large with three groups of bundle-traces. Leaves large, alternate, compound, imparipinnate; leaflets opposite, entire or serrate. Stipules absent.

Flowers monœcious. Male flowers numerous in pendulous catkins, which arise singly or in pairs above the leaf-scars of the preceding year's shoot, appearing in autumn and then visible as short cones covered by imbricated scales. Stamens eight to forty, in several series on the axis of a scale, which is five- to seven-lobed, the lobes representing a bract, two bracteoles and two to four perianth-lobes. Connective of the anthers clavate or dilated. Pistillate flowers few, in an erect spike terminating the current year's shoot; each flower with a three- to five-lobed or toothed involucre, composed of a bract and two bracteoles, adnate to the ovary. Inside the involucre is an epigynous and adherent four-lobed or toothed perianth. Ovary one-celled with one basal straight ovule. Style divided into two linear or lanceolate recurved spreading fimbriated plumose stigmas.

Fruit a large ovoid, globose, or pear-shaped drupe, with a fleshy, irregularly splitting husk, formed by the accrescent involucre and perianth. Nut ovoid or globose, thick-walled, longitudinally and irregularly wrinkled, two- to four-celled at the base, indehiscent or separating at last into two valves. Seed two- to four-lobed at the base, with fleshy cotyledons, which remain within the shell in germination.

About thirteen species of *Juglans* have been described; and there are two or three unnamed and little-known species in tropical South America. Of the described species three¹ confined to Mexico, one² a native of the Antilles, and the Californian walnut³ have not yet been introduced, and will not be dealt with in the following account.⁴

Plate 73 illustrates the leaves, branchlets, and leaf-scars of the species in cultivation.

¹ *Juglans mollis*, Engelmann; *J. pyriformis*, Liebmann; and *J. mexicana*, Watson.

² *Juglans insularis*, Grisebach. Concerning the walnut reputed to occur in Jamaica, *J. jamaicensis*, C. DC., cf. *Kew. Bull.* 1894, p. 371.

³ *Juglans californica*, Watson.

⁴ Since the above was written, Mr. Dode has published a paper containing descriptions of several new species in *Bull. Soc. Dendr. France*, i. 67 (1906); but these seem to us to be founded on variable characters, and to be rather forms due to cultivation.

KEY TO THE SPECIES OF JUGLANS IN CULTIVATION

I. Leaflets not serrate; usually entire or sinuate (Plate 73).

1. *Juglans regia*, Linnæus. Bosnia and Greece, through W. Asia and Himalayas to N. China.

Leaf-scars deeply notched without a pubescent band on their upper edge.
Leaflets 7 to 9, glabrous beneath except for inconspicuous axil tufts.

II. Leaflets serrate. Leaf-scars without a pubescent band on their upper edge.

* Leaflets glabrous beneath, except for the axil tufts.

2. *Juglans regia* × *nigra*. Two forms: *Juglans Vilmoriniana*, Carrière, and *Juglans pyriformis*, Carrière.

Leaflets 11 to 13, with fine shallow serrations.

** Leaflets pubescent beneath.

3. *Juglans rupestris*, Engelmann. Arizona, Texas, New Mexico, Mexico.

Leaflets small, 7 to 15, ovate or lanceolate, never oblong, green beneath.
Young shoots glandular-pubescent.

4. *Juglans nigra*, Linnæus. Canada and United States, east of the Rocky Mountains.

Leaflets large, 15 to 19, ovate-oblong with long-acuminate apex, pale beneath.
Young shoots glandular-pubescent.

5. *Juglans stenocarpa*, Maximowicz. Manchuria.

Leaflets large, 11 to 13; all oblong, except the terminal one which is broadly obovate, pale beneath. Young shoots glabrous.

III. Leaflets serrate. Leaf-scars with a transverse pubescent band on their upper edge.

6. *Juglans cinerea*, Linnæus. Canada and United States, east of the Rocky Mountains.

Leaf-scars semicircular, the upper edge straight and scarcely notched. Leaflets, 11 to 13, oblong; serrations fine and directed outwards.

7. *Juglans Sieboldiana*,¹ Maximowicz. Japan, Saghalien.

Leaf-scars obcordate, 3-lobed, notched above. Leaflets, 13 to 15, oblong; serrations shallow, irregular, directed forwards; base rounded and unequal.

8. *Juglans mandshurica*,¹ Maximowicz. Manchuria, Korea, China.

Leaflets and leaf-scars practically indistinguishable from those of the last species, though the leaflets are usually longer-acuminate. Fruit, however, remarkably distinct. See detailed description.

9. *Juglans cordiformis*,¹ Maximowicz. Japan.

Leaf-scars and leaflets closely resembling those of *J. Sieboldiana*, the leaflets, however, fewer (11 to 13) and with a cordate base.

¹ These three species, though differing remarkably in fruit, are very similar in leaves and shoots.

JUGLANS REGIA, COMMON WALNUT

Juglans regia, Linnæus, *Sp. Pl.* 997 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1421 (1838).

A deciduous tree, attaining 100 feet in height and 15 to 18 feet in girth. Bark smooth and silvery grey in young trees, becoming ultimately more or less deeply fissured.

Leaves large, up to 10 inches long, coriaceous, of five to nine (rarely as many as thirteen) leaflets, sub-opposite or opposite, the terminal leaflet stalked, the others sessile; elliptic, long-ovate or obovate, shortly acuminate at the apex, tapering and unequal at the base, glabrous on both surfaces, except for inconspicuous tufts of pubescence in the axils of the nerves on the lower surface; dark green above, paler beneath, entire or slightly sinuate in margin; exhaling an aromatic odour. Venation pinnate, with ten to fourteen pairs of lateral nerves, which run nearly straight to near the margin, where they curve forwards and join with the next vein. The leaflets diminish in size from the apex to the base of the leaf. Rachis glabrous, terminal leaflet not articulated. Young shoots glabrous, with yellow sessile glands and white inconspicuous lenticels.

Male catkins arising singly or in pairs (one above the other) above the leaf-scars of the previous year's shoots, green, two to five inches long, sessile, pendulous, thickly cylindrical and densely flowered; flowers with stalked bracts, two to five perianth leaves and two bracteoles; stamens ten to twenty; anthers oblong, apiculate. Female flowers, one to four, at the apex of the young shoots, green, with usually purple stigmas; involucre minute, indistinctly four-toothed; perianth green, with four linear-lanceolate divisions.

Fruit globular, about two inches in diameter; pericarp green, smooth, glandular-dotted, coriaceous, and very aromatic, splitting irregularly when mature. Nut very variable in shape, wrinkled and irregularly furrowed, thin- or thick-shelled; divided interiorly by two thin dissepiments into four incomplete cells; one dissepiment separating the two cotyledons, the other dissepiment dividing them into two lobes. The structure of the fruit of the walnut is very complicated, and the reader is referred for further details to Lubbock's paper¹ on the fruit and seed of the Juglandæ.

The common walnut, according to Kerner,² is truly monœcious, the stigmas, however, ripening several days before the pollen is shed from the anthers.³ The unripe male catkins have the flowers crowded together in a short thick spike directed upwards. As soon as the pollen develops the spike elongates to three or four times its former length and becomes loose and pendulous, the flowers

¹ *Jour. Linn. Soc. (Bot.)*, xxviii. 247 (1890). Cf. also Lubbock, *Seedlings*, ii. 506 seq. (1902). Malformed walnuts are occasionally produced, which are very curious. Cf. *Gard. Chron.* 1858, p. 5, and 1890, viii. 758, fig. 154.

² Cf. Kerner, *Nat. Hist. Plants*, Eng. trans. i. 742, fig. 184 (1898).

³ This is not invariable. Delpino observed that while certain trees of the common walnut were protogynous, *i.e.* the stigmas ripening first, other trees were protandrous, the stigmas ripening after the anthers. In such cases the trees behave as if they were dioecious. Cf. Darwin, *Diff. Forms of Flowers*, 10 (1877), and Trelease, *Missouri Bot. Garden Report*, vii. 27 (1896).

separating from one another. The pollen then falls into a depression on the side of the neighbouring flower below, from which it is shaken out by the wind and carried to neighbouring branches of the tree, where it alights on the stigmas of the female flowers.

SEEDLING¹

The cotyledons are large, fleshy, obovate, bi-lobed and crumpled, filling the cavity of the seed, from which they do not emerge on germination, but remain underground. The primary root makes its exit by the apex of the nut, and becomes stout and flexuose, giving off a few lateral fibres. The caulicle is very short, stout, and woody. Young stem, erect, compressed, glabrous, greenish, and covered with lenticels. The first four pairs of leaves are mere scales, opposite or sub-opposite on the stem. The ninth leaf is foliaceous, and consists of three leaflets, the terminal one large, obovate or elliptical, and cuspidate, the lateral ones small, oblong and alternate. The next leaf is five-foliolate; the terminal leaflet, oblong-obovate; the middle pair ovate, acuminate, oblique at the base, unequal, and sub-opposite; the basal pair small, ovate, oblique, and unequal. The last leaf is like it, or bears only four leaflets. All these primary leaflets are serrate in margin, and more acuminate than those of the adult plant, which are entire. In these respects they resemble the adult leaves of *Carya* or other species of *Juglans*.²

IDENTIFICATION

The common walnut is distinguishable in summer from all the other species by its glabrous, entire, few leaflets. In winter the following characters are available:—Twigs stout, glabrous,³ shining, greenish or grey, with scattered longitudinal lenticels. Leaf-scars on prominent pulvini, broadly obcordate, the upper margin deeply notched in the centre and not surmounted by a band of pubescence; bundle-dots in three groups. Pith large, white or buff in colour, with wide chambers. Terminal bud ovoid, obtuse at the apex, with four external grey tomentose scales in two valvate pairs, the scales not lobed at their apex and merely representing leaf-bases. In many cases, as in slow-growing old trees, the true terminal bud is aborted on most of the branchlets, and its scar marks the end of the twigs. Lateral buds small, arising at an angle of 45°, globose, the two outer scales usually concealing the inner ones, pubescent at first, but ultimately becoming glabrous. Superposed lateral buds occur only rarely.

VARIETIES

Two distinct geographical forms are known:—

(a) *typica*, in Europe, Asia Minor, Persia, and the Himalayas. Leaves elliptic; nuts ovoid-globose with thin septa.

(b) *sinensis*, C. DC. in *Ann. Sc. Nat.* 4 Sér. xviii. 33, figs. 38, 39. North

¹ Cf. Lubbock, *Seedlings*, ii. 516, fig. 661 (1902).

² Cf. Fliche, *Bull. Soc. des Sciences*, Nancy (1886).

³ Some varieties of cultivated walnuts have the twigs covered with a minute pubescence.

China and Japan. Leaves oval or ovate. Nut globose, scarcely apiculate at the apex, sparingly wrinkled; septa thick and bony.

A large number of varieties have arisen in cultivation.

1. Var. *pendula*. Tree, pendulous in habit.
2. Var. *præparturiens*. A bushy shrub, producing fruit at an early period, sometimes when only two or three years old. According to Carrière¹ it was obtained from seed by Louis Chatenay, a nurseryman at Doué-la-Fontaine, about the year 1830, the first mention of it being in *Ann. Soc. d'Hort. Paris*, 1840, p. 741. M. Chatenay found in the midst of a number of seedlings of walnuts three years old a single individual which bore fruit. This variety was put into commerce by M. Janin of Paris. According to Carrière, when the seeds of it are sown, different forms are produced, from young plants which bear fruit in their second year up to others which only produce fruit at an advanced age. The plants are also variable in size. The nuts are generally thin-shelled and small, but good in quality.

3. Var. *præcox*. Comes into flower and fruit a fortnight earlier than the common kind.

4. Var. *serotina*, Desfontaines. This variety flowers very late, and is recommended in localities liable to spring frosts. It is said² that of this variety, when sown, only three per cent came true, and flowered late in the season.

5. Var. *monophylla*. Leaves simple or trifoliolate. A small tree of this kind, which bears both simple and trifoliolate leaves, the basal pair of leaflets being very small, is growing at Bayfordbury, the residence of Mr. H. Clinton Baker.

6. Var. *rotundifolia*. Leaflets oval.

7. Var. *serratifolia*.³ Leaves serrate. There is a specimen in the Kew herbarium from a tree in Germany, all the leaves of which were distantly serrate in margin. The leaves of young seedlings are always serrate; and this juvenile character is often retained in some walnut trees up to a considerable age.

8. Var. *laciniata*, Loudon. Leaves very deeply cut. The foliage of this variety is light and feathery, much more so than that of the common walnut, and is retained till late in the autumn. A fine specimen was reported in 1884 to be growing at Bicton.⁴ Elwes has seen only three trees of this form, of which the largest, growing on a lawn at Westonbirt, was 30 to 40 feet high. Another was at Melbury, and a third, of no great size, at Poltalloch in Argyllshire.

9. Var. *heterophylla*. Leaflets variable, some of the ordinary form, others irregularly cut.

10. Var. *variegata*.⁵ Leaflets with white margins.

11. A tree was growing in 1890 at Chawton Park, Alton, Hampshire, of which specimens with extremely narrow leaflets were sent to Kew.

The number of varieties of the walnut in cultivation, as regards the shape,

¹ *Rev. Hort.* 1882, p. 419.

² *Gard. Chron.* 1883, xx. 114. See *Rev. Hort.* 1861, p. 430, fig. 108. Called St. John's Walnut, as it does not put forth leaves till Midsummer or St. John's Day, in Parkinson's *Theatrum Botanicum*, 1414 (1640).

³ The serrate-leaved walnut is mentioned by Parkinson, *loc. cit.* 1413.

⁴ *Woods and Forests*, 1884, pp. 164 and 512. See also concerning this variety *L'Horticulteur Français*, 1862, p. 47.

⁵ *Rev. Hort.* 1861, p. 429, fig. 104.

colour, and other qualities of the fruit, is very great; but a detailed description of these does not come within the scope of our work. The most remarkable is the huskless walnut¹ of North China, which is cultivated in the mountains to the north-west of Peking. In this curious form the husk is almost wanting, being very thin and irregular. In var. *racemosa* the fruits are numerous, fifteen to twenty-four, and are set close together on the peduncle. In var. *maxima*, Loudon (var. *macrocarpa*), the fruits are very large. The nuts are elongated and very narrow in var. *elongata* (var. *Bartheriana*²); very sharp-pointed at both ends in var. *rostrata*; and have very thin shells in var. *tenera*,³ Loudon (var. *fragilis*). The kernel of the nut is bright red in var. *rubra* (var. *rubrocarpa*).⁴

HYBRIDS

I. *Juglans regia* × *nigra*. Two forms of this are well known in cultivation; they differ mainly in the character of the fruit.

1. *Juglans Vilmoriniana*, Carrière, *Rev. Hort.* 1863, p. 30. Young shoots glabrous. Leaf-scars obcordate, three-lobed, deeply notched above. Leaflets eleven to thirteen, ovate-lanceolate, sub-sessile, apex acuminate, base rounded or tapering; serrations fine and shallow, directed forwards; lower surface green and glabrous, except for conspicuous tufts of pubescence in the axils of the main veins. Rachis glabrous in the upper leaves of the shoot, pubescent towards its base in the lower leaves. Fruit with the thick husk of *J. nigra*. Nut smooth, globose, thicker shelled and more deeply furrowed than that of the common walnut.

In *Garden and Forest*, iv. 51 (1891), M. M. de Vilmorin gives particulars of the original tree in his garden at Verrières les Buisson, near Paris, and an excellent illustration of it in winter. He says that it was planted about 86 years previously as a young seedling by his grandfather as a memorial of the birth of his eldest son. Nothing certain is known of its origin, though it was supposed by Dr. Engelmann to be a hybrid, between the European and the black walnut. The characters of the bark, branchlets, and buds are intermediate; the leaves resemble those of *J. regia* more than those of *J. nigra*. The fruit, which is not produced every year, and never in quantity, is figured, and resembles most that of the black walnut. Of the few seedlings which have been raised from it one is growing beautifully in the Arboretum at Segrez, and produces fertile nuts. All the seedlings have grown well when planted in deep sandy soil mixed with clay. The tree at Verrières was seen by Elwes in 1905, and measured 95 feet high by 10 feet in girth, with a bole about 16 feet long. The habit of the tree was considered by him to resemble the black walnut rather than the common species.

There are young trees of *J. Vilmoriniana* growing at Kew, and one has been recently sent to Colesborne by M. de Vilmorin.

2. *Juglans pyriformis*, Carrière, *loc. cit.* 28, figs. 4 to 9. *Garden*, L. 478, fig. (1896).

¹ See Hance, in *Journ. Bot.* 1876, p. 50.

² Figured in *Garden*, L. 478 (1896); and *Rev. Hort.* 1859, p. 147, and 1861, p. 427.

³ The thin-shelled walnut is mentioned in Parkinson, *Theatrum Botanicum*, 1413 (1640).

⁴ See *Gard. Chron.* xxiii. 346 (1898). This variety is figured in *Wien. Illust. Gart. Zeitung*, 1898, p. 165.

Carrière states that this tree arose from a cross between *J. regia* and *J. nigra*. The leaves are identical with those of *J. Vilmoriniana*. The young shoots differ in having a glandular pubescence. The fruits are long-stalked and pear-shaped, but otherwise closely resemble those of *J. nigra*. Young trees of this kind are in cultivation at Kew.

3. Other hybrids between these species have been described. One mentioned by Sargent was an immense tree, found in 1888 by Prof. Rothrock on the Rowe Farm on the north bank of the Lower James River, Virginia. It is described as having the habit, foliage, and general appearance of *J. regia*, but producing a nut not unlike that of the black walnut, though longer and less deeply sculptured. The nut is exactly like that of *Juglans regia gibbosa*, Carrière,¹ which was raised by a nurseryman at Fontenay-aux-Roses in 1848.

De Candolle also described,² as *Juglans regia intermedia*, a tree which was found at the Trianon, and supposed to be a cross between the common and black walnuts. M. C. de Candolle informed Elwes that a similar hybrid exists at Geneva, and that its seedlings have characters intermediate between the two parents.

There are specimens at Kew, which were sent by Mr. E. Lyon in 1901 from Hurley, Marlow, where there is a fine old tree of *Juglans nigra*, from the seed of which plants were raised, which are apparently intermediate between that species and the common walnut.

II. *Juglans regia* × *cinerea*. *Juglans alata*, Carrière,³ *Rev. Hort.* 1865, p. 447. This is described as having young shoots pubescent: leaflets seven to nine, with the end leaflet stalked, the others subsessile; all oval or elliptic-lanceolate, abruptly acuminate, obscurely and remotely serrate, pubescent on both surfaces: rachis shortly pubescent. Three trees, presumably of this hybrid, have been observed near Boston in the United States; and a description and figure of them are given in *Garden and Forest*, 1894, p. 435, fig. 69.

III. *Juglans regia* × *californica*. A remarkable hybrid between the common walnut and the Californian wild species, has been obtained by Luther Burbank, who names it "paradox."⁴

DISTRIBUTION

The common walnut has a very wide distribution, occurring wild in Europe in Greece, Bosnia, Servia, Herzegovina, Albania, and Bulgaria; and extending eastward through Asia Minor, the Caucasus, Persia, and the Himalayas to Burma and North China and Japan. Its occurrence as an indigenous plant in Greece was first demonstrated by Heldreich,⁵ who found it growing wild in Ætolia at Korax, in Phthiotis on the Cæta and Kukkos mountains, and in Eurytania on Veluchi, Chelidoni, etc. It grows wild in Greece in mixture with oaks and chestnuts in great quantity, especially

¹ *Rev. Hort.* 1860, p. 99, figs. 21-23, and 1861, p. 428, figs. 101-103. Rehder considers this hybrid to be the same as *J. Vilmoriniana*.

² *Ann. Sc. Nat. Sér. iv.* xviii. t. 4.

³ This is probably the same as *Juglans intermedia quadrangulata*, Carrière, *Rev. Hort.* 1870, p. 493, figs. 66-68.

⁴ *Garden and Forest*, 1894, p. 436.

⁵ *Verhand. Bot. Vereins Prov. Brandenburg*, 150 (1879).

in the moister valleys and ravines up to the region of the silver fir, at altitudes varying between 2200 and 4300 feet. Small woods of walnut, undoubtedly wild,¹ occur in Bosnia and Servia, especially on the north slopes of mountains rich in springs. It ascends in Herzegovina to 2400 feet, in southern Servia to 1400 feet, and in Albania to 2200 feet. Velenovsky² considers it to be truly wild in the Rhodope mountains. According to Radde³ it occurs in the Caucasus, from the sea-level to 4500 feet altitude; also in Ghilan in North Persia. According to Meakin,⁴ it is met with wild in the mountains not far from Bokhara. There are wild specimens at Kew from Armenia. According to Aitchison it is wild in Afghanistan, at 7000 to 9000 feet, and also in the Kuram valley. It occurs in the temperate Himalayas and Ladak, at altitudes of 3000 to 10,000 feet from Kashmir and Nubra eastward. Kurz met with it in the Shan Hills in Burma. It is cultivated throughout China, and appears to be indigenous in North China and Japan;⁵ but other species of *Juglans* are much commoner in the wild state throughout China and Japan.

We are indebted to Sir W. Thiselton Dyer for the following:—

“The walnut found its western natural limit in Greece, but early made its way into Italy. Its classical name *Juglans* is *Jovis glans*, but in poetry it is always *Nux*. Virgil's *ramos curvabit olentes* hits off the acrid smell of the foliage. The nuts were thrown at weddings, as Virgil tells us, *sparge marite nuces*, because, amongst other reasons, Pliny says, they made the maximum of noise.

“*Relinquere nuces* was to put away childish things: so Catullus, *da nuces pueris iners*. The green rind enclosing the nut contains a dye used to darken the hair, the *viridi tincta cortice nucis* of Tibullus, in modern times more often the skin.”

The walnut is extensively cultivated in France, Germany (except in the north where it ripens fruit rarely), and throughout southern Europe. It is cultivated chiefly in the region of the beech, as in Hungary up to 2160 feet, on the southern slopes of the Alps up to 3800 feet, in the Vosges up to 2200 feet. In Norway it is grown on the west coast as far north as Trondhjem, where it has reached a height of 30 feet, and in very favourable summers ripens fruit. Many other localities are mentioned by Schubeler, vol. ii. pp. 429-431. In Sweden it exists near Stockholm, and in Scania, at Cimbrishamn (55° 30'), Linnæus measured, in 1749, a tree 60 feet high.
(A. H.)

PROPAGATION AND CULTIVATION

If the walnut is wanted as a fruit-bearing tree it is better to procure from a nurseryman grafted or budded trees of some of the large-fruited, thin-shelled sorts, which have been raised in France; and which grow best in the south and east of

¹ Beck von Mannagetta, *Vegetationsverhält. Illyrischen Ländern*, 219 (1901).

² *Flora Bulgarica*, 512 (1891).

³ *Pflanzenverbreitung in Kaukasusländern*, 170, 182.

⁴ *Russian Turkestan*, 23 (1903).

⁵ It is included as a wild plant in Japan by Matsumura in *Shokubutsu Mei-I*, 155 (1895); but Sargent in his *Forest Flora of Japan*, p. 60, says, “It is occasionally cultivated in the neighbourhood of temples and as a fruit tree; but we saw no evidence of its being anywhere indigenous, and it is probable that it was introduced from Northern China, where one form of this tree apparently grows naturally.”

England. The process of budding or grafting them is fully described by Loudon, p. 1431, and need not be repeated here.

If, however, walnuts are to be planted for timber or ornament, it is far better to raise them from nuts, which may be sown as soon as they are ripe, if they can be protected from mice and vermin; or kept in sand until February, when they should be sown two to three inches deep in rich light soil, which will encourage the production of fibrous roots at an early period. As the large strong tap-root makes the tree difficult to transplant, it should be undercut with a spade about six inches below the soil in the first year, or the nut may be allowed to germinate before sowing and the end of the root pinched off. If this is not done they must be carefully transplanted in March, and protected from late spring frost as much as possible until they have made stems four to six feet high. For though the walnut is one of the latest trees to come into leaf, none is more tender as regards spring frost, and as it does not bear pruning well and has a natural tendency to form branches rather than a clean stem, it is important that the trees should be carefully trained when young.

It is now much less planted than formerly, and the wood is not so much valued by country timber merchants as it ought to be, but there is no reason why it should not be treated as a forest tree on suitable soils, and drawn up among other trees with the object of growing clean timber; though I consider it inferior to the black walnut in this respect. It is evidently a lover of a warm soil and climate, and though on good limestone soil or deep loam resting on chalk it grows fast and to a great size, it should not be planted on heavy clay, on poor sand, or in exposed windy situations.

The walnut is very seldom blown down on account of its strong roots, and I have never seen one struck by lightning. It does not reach a very great age; so far as I know, 200 years is about the limit of its life, and many trees become hollow or decayed before attaining as much as this.

The only place where I have seen walnuts self-sown in England is at Holkham, where, in the Triangle plantation, are several trees, one 17 feet high, in a fairly thick plantation of larch and Scots pine on light sandy soil. They are 100 to 150 yards distant from the parent tree, the nuts having probably been carried by squirrels or rooks. On the sandhills at the same place I saw a self-sown tree five to six feet high, and on the roadside near Colesborne a young tree has sprung up from a nut dropped by a passer-by.

Mr. E. Kay Robinson¹ mentions the occurrence of young walnut trees amidst clumps of other large trees, due to the carrying away by rooks of the fruit from an old walnut tree in a garden near by. He has kindly sent us a photograph of a walnut tree growing in a field at Warham, near Wells, Norfolk, which had evidently been deposited by a rook, as the young tree in its growth had thrust up the roots of an old willow tree, amongst which it had grown.

¹ *Garden*, lxxi. 412 (1904).

REMARKABLE TREES

Though there are many very fine walnuts scattered through the southern half of England I cannot say where the largest tree actually is. Nothing that I know of now living equals a tree recorded by Mr. W. Forbes,¹ which grew on the estate of Sir Charles Isham at Lamport Hall, Northamptonshire, and was sold to Messrs. Westley Richards, gunmakers of Birmingham. According to the measurements given, this tree contained 816 cubic feet of sound wood, of which the butt, measuring 12 feet by 18 feet in girth, contained 243 feet and one limb 108 feet.

A magnificent tree, said to have been the largest in England, grew at Cothelstone, near Bishops Lydeard, Somersetshire, which Loudon records as being 64 feet high and 6½ feet in diameter,² but I am informed by Mr. E. V. Treplin, agent to Viscount Portman, that it was blown down some years ago.

No tree mentioned by Loudon equals the one of which I give a figure (Plate 74), which grows in front of the house at Barrington Park, near Burford, Oxfordshire, the property of Mr. E. C. Wingfield, on an oolite formation. This tree measured in 1903, 80 to 85 feet in height by 17 feet in girth, and has a fine bole and a very burry trunk. There are two other splendid walnuts in this park nearly as tall and over 15 feet in girth, and others have been cut down of which the timber, when cut up in London, was considered by Mr. A. Howard equal in colour and figure to Italian walnut. At the Moot, Downton, Wilts, the residence of my old friend Mr. Elias P. Squarey, are four fine walnut trees, one of which was said by Mr. D. Watney to be the largest he had seen during his long experience as a valuer, and estimated to contain over 400 feet. It measures 17 feet 2 inches in girth, with a short butt dividing into four big limbs which run up to about 80 feet in height. Another is the tallest walnut I have ever seen or heard of, and measured in 1903 about 100 (perhaps more) feet high by 13 feet in girth.

In the village street of Bossington, Somersetshire, I was shown by Mr. S. F. Luttrell of Dunster Castle, a very picturesque old gnarled walnut tree which at 5 feet is 17 feet in girth, but the roots are so spreading that the trunk, measured close to the ground and following the sinuosities, is 35 feet round. A walnut of apparently no great age in a field at Cobham village in Kent measured in 1905 about 70 feet by 13 feet, and the branches spread over a circumference of 99 paces.

An avenue of walnuts is seldom planted in England, but at Moor Court, Herefordshire, there is a short one which from an illustration in the *Gardeners' Chronicle* of February 6, 1875, seems very effective. They are 60 to 70 feet high and 10 to 12 in girth.

At Sudeley, Gloucestershire, the seat of Mr. H. Dent Brocklehurst, there are in a line before the Castle four beautiful trees of great age, the largest measuring 90 feet by 14 feet, and in Rendcombe Park near the Temple there is a fine old tree about 80 feet by 15 feet whose branches cover an area 105 paces in circumference.

¹ *Trans. Eng. Arb. Soc.* v. 155.

² In *Trans. Eng. Arb. Soc.* ii. 225, measurements of this tree made in 1888 by Dr. Prior are given as follows:—height, 94 feet 6 inches; girth, 18 feet; spread, 22 yards by 27.

At Laverstoke Park, Whitchurch, Hants, the residence of Mr. W. W. Portal, there is a fine well-shaped walnut, which was measured by Henry in August 1905, as 80 feet high by 13 feet 8 inches in girth, with a bole of 12 feet, dividing into two stems above.

In the eastern counties there must be many fine walnuts, but the only one of which I have any exact record is a tree which was figured by Grigor¹ at Ketteringham Park, Wymondham, Norfolk, the seat of Sir M. Boileau, Bart., and is said to have been planted at the restoration of Charles II. This tree was one of the best shaped as regards its branches that has been figured, and measured in 1841 68 feet high with a girth of 12 feet.

At Rickmansworth, Herts, Sir Hugh Beevor measured in 1901 a tree 98 feet high by 11 feet 9 inches in girth, the first limb coming off at 18 feet up, the second limb at 36 feet from the ground. At Gayhurst, near Newport Pagnell, Mr. W. W. Carlile showed me a tree growing on a clayey limestone, which, though of great age, is absolutely sound and has lost hardly a branch. It measures no less than 80 feet by 17 feet, and is very perfect in shape. At Ware Park, Herts, Mr. Baker tells us of a tree 16 feet 4 inches in girth, and this seems to be a district where the walnut comes to great perfection. He showed me another of the thin-shelled French variety growing close to the bank of the Lea at Roxford, which, though much cut by frost, was 16 feet in girth.

At Castle Howard, Yorkshire, there is a large tree in the park near the stables, growing among beech and oak which have drawn it up to a height of 80 or 90 feet, though it leans very much to one side. It has a clean bole about 20 feet long by 11 feet 8 inches, dividing into two long straight clean stems, a very unusual form in this tree.

In Scotland the walnut is not so much at home as in England, but in the warmer parts of the east and in Perthshire it attains considerable dimensions. The best that I have seen myself is a tree at Gordon Castle (Plate 75) which in 1904 measured 60 feet by 10 feet, and is, considering the exposed position and latitude, a remarkable tree. But there must have been a still finer one here in 1881, when Mr. J. Webster, father of the present gardener, recorded in the *Trans. Scot. Arb. Soc.* ix. 63, a tree of equal height and 13 feet 4 inches in girth at 5 feet. Col. Thynne has given me a photograph of a fine tree at Cawdor Castle, Nairnshire, which measures 65 feet by 15 feet 7 inches.

Hunter records several very fine trees in Perthshire as follows: "At Gask the largest tree in the policies is a walnut, a little west of 'The Auld House.' It measures 17 feet 5 inches at 5 feet and then swells to a girth of 21 feet at 8 feet from the ground, and at Blair Drummond there is a fine tree," which Mr. A. Morton, the gardener, informs me is now about 80 feet by 13.

Though the walnut is not uncommonly planted in Ireland, we have seen none remarkable for size. The largest one is reported to be growing at Kilkea Castle in Kildare.

¹ *Eastern Arboretum*, 279 (1841).

TIMBER

Until mahogany became common in England about the middle of the eighteenth century, walnut was considered the most valuable wood for furniture, carving, and inside work, and on the Continent most of the best old furniture was made from it. Later it became very valuable for gun-stocks, and is still almost the only wood used, for all except cheap guns. Loudon states that during the long wars at the beginning of the last century in France no less than 12,000 trees were cut annually for gun-stocks, which caused it to become very scarce, and in England as much as £600 was paid for the wood of one tree.

Sir W. Thiselton Dyer informs me that when for political reasons the War Office thought it no longer desirable to depend on walnut, which was mostly imported from the Black Sea, he was consulted as to what other wood might be found as a substitute; but though some twenty sorts of colonial woods were sent for trial from the Museum at Kew to the Small Arms Factory at Enfield, none except the black walnut was found to be at all suitable.

The reason for this is that walnut wood does not warp, and can be cut cleanly in any direction to fit the locks and mechanism of the magazine rifle, and is not liable to swell and bind the lock when wet. But it requires a good deal of care in selection and in cutting out the stocks, so that they are not liable to break at the grip; and the best gunmakers in England obtain their stocks ready cut to specified sizes from French merchants who make a *spécialité* of this trade.

Maple wood has been found suitable in Japan, for when I was there during the late war, I saw numbers of roughly shaped gun-stocks of that wood being cut in the forest near Koyasan, and carried out on men's backs to supply the immense demand of the arsenal. But in England it was found to make a rifle stock 4 ounces heavier than walnut, and is also liable to warp.

The late Mr. J. East told me that, in the year 1838, at Missenden in Bucks, four walnut trees were sold in one lot for £200, and about the same time two other trees were sold for £100 each, but the demand is now so much lessened by foreign importations, and by the substitution of other woods, such as mahogany and American walnut, that its average price now is not more than from 1s. 6d. to 3s. per foot.

The wood requires a long time to season thoroughly, and should not be used for good work until three to six years after felling, as it is liable to shrink considerably. It is also liable to be ring shaken, and has another great defect in the fact that the sapwood, which forms a large proportion of most trees, is pale in colour and very liable to be attacked by wood-eating beetles. Almost all the old Italian furniture which I have seen is more or less damaged in this way, and though the sapwood is often stained so as to look like the heartwood, it is better in first-class work only to use the latter.

As a rule English walnut does not show so much of the dark markings as is found in the logs imported from Italy and the Black Sea, and Italian walnut is usually specified by English architects. But I have seen such fine panelling made from English wood alone that I have no hesitation in saying that with careful

selection and seasoning, the best effect can be obtained from old trees grown on dry soil in this country; and in a small work on English timber by "Acorn"¹ it is stated that the home-grown timber is harder and more durable than the foreign.

The finest wood as regards colour and pattern comes from near the root, and from the forks in the tree, which, however, are liable to twist if used in the solid, and in order to obtain as much as possible of these figured pieces the tree, if old, should be grubbed, and great care taken in cutting it up into suitable thicknesses for the purpose for which it is wanted. The forked parts should be cut into thin veneers and matched as well as possible. For panelling, walnut comes only second to oak, and is found in some of the best houses in England. As a fine example of Italian walnut panelling I may mention the billiard room at Edgworth, near Cirencester, which was designed for my friend Mr. Arthur James, by Mr. Ernest George. Of modern English walnut panelling I have seen a good example put up in Mr. Franklin's beautiful old house, Yarnton Manor, near Oxford, which he has recently restored, and in which the panelling both of oak and walnut is admirable. The late Mr. Holford of Westonbirt, Tetbury, had his large music-room entirely fitted with walnut cut on his own estate.

A newer system of using walnut wood in large knife-cut unpolished veneers is now adopted by modern decorators, of which a fine example may be seen in the board room of the Royal Insurance Company at Liverpool.

One of the most valuable woods in the world is produced by the burrs or excrescences which are produced on the walnut tree, rarely in England, but more commonly in its native country, and which are sought for by agents travelling for French firms at Marseilles, who seem to have a monopoly of this wood. Sometimes they are very large, measuring two to three feet in diameter, but more usually smaller, and are sold at very high prices, as much as £50 to £60 per ton, according to Laslett. They are called *loupes* in France, and are cut into very thin sheets to cover the very finest pianoforte cases, and much used for cabinet-making. These burrs are said to grow on trees in mountainous and inaccessible regions in Circassia, Georgia, North Persia, and Afghanistan; and I am told by Mr. C. W. Collard that those now imported are not so fine as they used to be some years ago.

I can find no records or measurements of walnuts abroad which show that it ever exceeds in warmer climates the size it attains here; but the largest foreign log which I have ever seen was shown by Messrs. Riva and Massara of Milan at the Exhibition held there in 1906. This log measured about 28 feet long by 15 feet in girth, and was said to contain about 16 cubic metres of timber, equal to about 560 feet. Its weight was 14,800 kilogrammes, and I was informed by the owners that they paid 5800 francs (about £232) for it in Switzerland. But Correvon² quotes *La Patrie Suisse* to the effect that a walnut was cut at Bois-de-Vaux, near Lausanne, which required twenty-four horses to haul it. The lower part of its trunk measured about 24 feet, the diameter was 6 feet 4 inches, and the total contents about 700 cubic feet. This butt was sold for £150 to make gun-stocks.

(H. J. E.)

¹ Published by W. Rider and Son, London, 1903.

² *Nos Arbres*, 267 (1906).

JUGLANS NIGRA, BLACK WALNUT

Juglans nigra, Linnæus, *Sp. Pl.* 997 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1435 (1838); Sargent, *Silva N. America*, vii. 121, tt. 333, 334 (1895), and *Manual Trees N. America*, 128 (1905).

A tree attaining 150 feet in height, with a girth of about 15 to 20 feet, forming in the forest a narrow round-topped head, but with spreading branches when isolated. Bark of old trees dark brown, deeply furrowed with broad ridges, which are scaly on the surface.

Leaves up to 3 feet in length, of fifteen to twenty-three leaflets, which are ovate or ovate-lanceolate, long-acuminate at the apex, rounded at the base, sub-sessile, with coarse sharp irregular serrations; upper surface with a very minute and very scattered pubescence; lower surface with numerous glandular and simple hairs. Rachis with yellow glands and scattered glandular hairs. Young shoots with sessile yellow glands and numerous glandular hairs; older shoots pubescent. Leaf-scars obcordate, deeply notched at the apex, without any band of pubescence on their upper edge.

Staminate catkins three to five inches long; scales with six orbicular concave pubescent lobes, and a bract $\frac{1}{4}$ inch long, which is triangular and tomentose; stamens twenty to thirty. Pistillate flowers, two to five in a spike; involucre lacinate in margin or reduced to an obscure ring below the apex of the ovary; perianth lobes ovate, acute.

Fruit solitary or in pairs,¹ globose or slightly pear-shaped, pubescent, not viscid, yellowish green, $1\frac{1}{2}$ to 2 inches in diameter; nut oval or oblong, $1\frac{1}{8}$ to $1\frac{1}{2}$ inch, deeply ridged irregularly, four-celled interiorly at the base, and slightly two-celled at the apex.²

IDENTIFICATION

In summer it is readily distinguishable from *J. cinerea* and the Eastern Asiatic species, which have serrate leaflets, by the character of the leaf-scar, which is deeply notched at the apex and without the transverse band above its upper margin, which characterises those species. The long acuminate pubescent leaflets distinguish it from the hybrids *pyriformis* and *Vilmoriniana*. It has much larger leaflets than *J. rupestris*, and cannot be confused with *J. stenocarpa*, which has a broadly obovate terminal leaflet.

In winter the following characters are available:—Twigs stout, reddish brown, glandular-pubescent; lenticels small. Leaf-scars on prominent pulvini, obcordate, deeply notched above, without pubescent band, with three groups of bundle-dots. Pith large, buff-coloured, with wide open chambers. Terminal bud ovoid or conical, grey-

¹ A tree at Albury, Surrey, has, however, borne fruit in clusters of three, four, and six, of which specimens are preserved at Kew.

² For a detailed account of the fruit, seed, and cotyledons of the species, see Lühbock, *Seedlings*, ii. 517 (1902).

tomentose, usually with four external scales visible in two valvate pairs, the scales not lobed at the apex. Lateral buds, arising at an angle of 45°, small, globose, pubescent, with two to three scales visible externally; there are often two buds superposed, the lower one minute and embedded in the notch of the leaf-scar. The reddish-brown pubescent twigs and superposed pubescent lateral buds will distinguish this species from the common walnut.

VARIETIES AND HYBRIDS

No varieties are known. The Black Walnut forms hybrids with the common walnut, which have been dealt with under the latter species. Burbank has raised a hybrid, which he calls "Royal," between *J. nigra* and *J. californica*.¹

Juglans nigra × *cinerea*. A tree supposed to be this hybrid grew in the Botanic Garden at Marburg, and was described by Wender as *Juglans cinerea-nigra* in *Linnaea*, xxix. 728 (1857). (A. H.)

DISTRIBUTION

According to Sargent the black walnut occurs in rich bottom lands and fertile hillsides, from western Massachusetts to southern Ontario, southern Michigan and Minnesota, central and northern Nebraska, eastern Kansas, and southward to western Florida, central Alabama, and Mississippi, and the valley of the San Antonio River, Texas; most abundant in the region west of the Alleghany Mountains, and of its largest size on the western slopes of the mountains of North Carolina and Tennessee, and on the fertile bottom lands of southern Illinois and Indiana, south-western Arkansas, and the Indian Territory.

The black walnut is not only one of the largest deciduous trees throughout a great part of the Middle States, but also one which, until it became too scarce, furnished a great part of the most valuable hardwood. It reached its maximum of size and abundance in the western foothills of the Southern Alleghany Mountains and in the rich, fertile alluvial river bottoms through which the great rivers of Ohio, Indiana, Tennessee, and Kentucky flow, and which were the first homes of the settlers who crossed the mountains towards the end of the eighteenth century, and for a quarter of a century carried on an unceasing warfare with the Indians. These pioneers also waged war against the forest whenever they could spare time, and for many years used the black walnut for fencing and for house-building, because it was an easy wood to split and to work; but they did not foresee that the trees which they destroyed would become one of the most valuable products of their farms, and would in a century be almost extinct as timber trees in many places where they were formerly the commonest.²

When I was travelling in the mountains of North Carolina in 1895, I saw but

¹ *Garden and Forest*, 1894, p. 436.

² An interesting account of the war waged against the black walnut by pioneers in Indiana in 1834 is given in *Woods and Forests*, 1884, p. 633.

few black walnuts of large size, and met with men who were travelling about purposely to find and buy them in all accessible places. In the North Carolina forestry exhibit at the St. Louis Exhibition in 1904, I saw a walnut log from a tree in Jackson County, Kentucky, over 12 feet long and 52 inches in diameter which had evidently been lying long in the forest, and had been repeatedly burnt over, which produced over 800 cubic feet of timber, and was sold, as I was told, for \$800. I heard of another still standing in Kentucky which was valued at \$1000.

These great trees are now hardly to be seen except in remote regions where it is impossible to get them out, and when I visited the Lower Wabash Valley in southern Illinois, where Prof. R. Ridgway¹ found the largest deciduous trees in the United States, I did not see one of great size. Dr. J. Schneck, who was my guide and who knows the flora of this region better than anyone, gives in his *Catalogue of the Flora of the Lower Wabash*, the measurements of a tree taken by himself as follows:—Circumference, at 3 feet above the swell of the root, 22 feet; height of trunk to first branch, 74 feet; total height, 155 feet. Prof. Ridgway measured another 15 feet in girth at 3 feet, and 71 feet to the first branch, where the trunk was 3 feet in diameter. Assuming such trees to have measured 12 feet in girth in the middle they would contain 600 to 700 feet of clean timber in the first length alone, and now be worth as much as many acres of the land they grew on would fetch when cleared for agriculture.

But in regions which have colder summers and poorer soil, the black walnut does not attain anything like these dimensions, and I have seen none in New England which equal the best trees in Britain. Emerson² speaks of one in the Botanic Garden at Cambridge, Mass., as measuring 6 feet 3 inches at 3 feet from the ground, and the tree which he figures growing near Roslyn was a poor specimen of small size.

In Canada it was once abundant in the rich forests of Southern Ontario, but almost all the old trees have been cut down, and plantations are now being made in various parts of Ontario and Western Quebec, and in Alberta and British Columbia, as well as in many parts of the United States from Kansas to California.

Black walnuts of great size are indeed now so rare that I have been unable to procure a really good photograph of the tree in its native forest, and there is none in Pinchot and Ashe's *Timber Trees of N. Carolina*. These authors say that it bears seed abundantly only every three or four years, and that young seedlings are not common except in low fertile, rather open lands, or in meadows which border streams. The growth is very rapid until the tree has reached a large size; only small trees send up shoots from the stump.

The tree, however, has been so largely planted in many parts of the States and in Canada, and succeeds so well, even so far west as British Columbia, that it may again become generally useful as a timber tree.

¹ *Proc. U.S. Nat. Museum*, 1882, p. 49.

² *Trees of Massachusetts*, i. 213.

CULTIVATION

The black walnut was first described by Parkinson,¹ and was introduced into England by the younger Tradescant before 1656, as it is mentioned in the list² of the plants growing in his garden at that time. A tree was growing in Bishop Compton's garden at Fulham in 1688, according to Ray.³

The black walnut is easy to grow from seed, but, except the hickories, none is more difficult to transplant, on account of the long fleshy tap-roots which it forms at an early age, and which, when grown in the good deep soil which it likes, are at a year old often three or four times as long as the seedling itself. For this reason, unless special care is given to its treatment, it is not likely to become so fine a tree as when sown *in situ*, and, though I have successfully transplanted many at one or two years old, I would much prefer the other method.

Though the nuts ripen in England in hot summers, they are not so large, and do not, I think, produce such strong plants as those imported from North America, and, if possible, I should prefer to get them from trees growing in Canada or New England than from farther south.⁴ The nuts are best sown when ripe, as if kept dry for some time, they either lose their germinating power or come up so late that they make weak plants. In any locality which is subject to late frosts it would be better to sow them in boxes at least two feet deep and plant them out when a year old, as like many exotic trees they do not ripen their young wood well, and are liable to be frozen back in winter or spring, which induces a bushy instead of a straight habit of growth.

As this tree requires to be well sheltered and drawn up by surrounding trees in order to form a tall and valuable trunk, it should be sown or planted in small deeply-dug patches in a rich wood, kept free from weeds and protected from mice, rabbits, and boys, until the trees are six to eight feet in height, which they should be under favourable circumstances at four to six years after sowing.

All these difficulties have made the tree unpopular with nurserymen, who rarely care to grow trees for which there is little regular demand. But the great value of the timber, its rapid growth on suitable places, and its perfect hardiness when once established, give it, in my opinion, so much importance, that, however troublesome it may be in its early stages, it should be tried at least on a small scale as a timber tree in the warmest and best soils of the southern, eastern, and west midland counties. For further particulars of the nursery treatment of this tree see Cobbett's *Woodlands*, Art. 553; or *Arboriculture*,⁵ iv. 7, July 1905. Cobbett,

¹ *Theatrum Botanicum*, 1414 (1640).

² *Museum Tradescantianum*, 147 (1656).

³ *Historia Plantarum*, ii. 1798 (1688)—no doubt the tree mentioned by Loudon as existing in 1835 (see p. 268).

⁴ But the question as to whether the seeds of trees grown in a comparatively cold climate produce hardier plants than seed from a warm one, is as yet unsolved; and Prof. H. Mayr of Munich, than whom there is no better authority, is inclined to believe that the differences which are observed in the comparative resistance to frost depend on the variable constitution of the individual plant rather than on inherited power.—Cf. H. Mayr, *Fremdl. Wald. u. Park-bäume* (Berlin, 1906).

⁵ A magazine of the International Society of Arboriculture; J. P. Brown, Connorsville, Ind., U.S.A.

who knew the tree well, considered as I do that it was a hardier and better timber tree than the common walnut.

The black walnut cannot be expected to attain great size except on deep soil in a warm situation. A tree grown from a nut, brought by my father from America over 60 years ago, is now only about 60 feet high and 3 feet in girth, on the dry oolite of the Cotswolds; whilst in Kent, on good loam, it has attained 100 feet by 12 feet in about 100 years, and probably contains as much timber, and that of twice the value, as any oak of its age in Great Britain. It seems indifferent to the chemical nature of the soil, if it is deep, light, and well drained, and should have a southern or western aspect.

It is stated in *Woods and Forests* that the tree is almost if not entirely rabbit-proof, for when nearly everything else is barked it is left untouched, even in a young state.

I have no certain knowledge as to the age which this tree attains, but from the fact that the old ones at Fulham Palace and Syon are dead or dying, I should suppose that, like the common walnut, it is not a very long-lived tree.

CULTIVATION IN GERMANY AND FRANCE

The high value of the timber of the black walnut has led to experiments with the tree in Continental forests. These trials have, however, hitherto been only on a small scale.

In the State forests of Prussia the black walnut has been planted in twenty-two different stations, the whole area under cultivation being thirty-one acres, the separate plots varying in size from seven acres to a rood. Schwappach¹ draws the following conclusions from the results obtained in these experimental plots:— Of all the exotic species which have been tried in Prussia, *Juglans nigra* is the most exacting as regards soil and climate. It only thrives on deep moist rich soils, such as loamy sand rich in humus or pure loam, and never succeeds on shallow soils of any kind, or on wet clay or sand. It requires for its good development a considerable amount of warmth and a long season of vegetation. It has only succeeded on the best oak soils, such as the alluvial lands by the rivers Oder, Mulde, and Elster, and in certain restricted areas of the hilly land of central and western Germany.

Schwappach gives a description of the long tap-root of the seedling, and the consequent difficulty in transplanting; but he lays stress upon the fact that in Germany the seedlings normally make their appearance very late, and believes that this is one of the main causes of failure, as the young plants do not then ripen their wood, and are destroyed by late frosts. He advocates the early germination of the seeds by artificial means, such as by placing them in pits covered with straw, soil, and horse-dung. These speedily germinate, and are then planted in the forest in gaps of about a rood in extent, which are the result of clear felling, or under

¹ *Ergebnisse Anbauversuche Fremländischen Holzarten*, 37 (1901).

the existing canopy of an old wood where the trees will soon be removed. The black walnut requires strong sunlight for its successful growth, yet lateral protection is necessary during the first few years. Heavy shade is hurtful, as it hinders the ripening of the wood of the shoots. The black walnut, after it has successfully passed the dangerous period of youth, becomes perfectly hardy; and older plants resist both spring and winter frosts. Schwappach advocates close planting, with beech or hornbeam as nurses, and recommends thinning at 15 to 20 years old, to remove badly-shaped trees, and to give more light to those which are destined to remain.¹

In France Henry has seen a small plantation of black walnut near Annecy; but the results obtained were unsatisfactory, as the young plants had suffered much from frost. M. Pardé,² however, strongly recommends its cultivation, and points out that, unlike the common walnut, it can be grown as a forest tree; and states that at Les Barres it sows itself regularly and abundantly.

REMARKABLE TREES

The largest tree which we know of in England is growing in the London County Council public park of Marble Hill, Twickenham, in rich alluvial soil close to the Thames. It was measured by Sir Hugh Beevor and Dr. Henry in August 1905, and the height was found to be 98 feet, the stem girthing at 5 feet up 14 feet 3 inches. The bole is about 18 feet long, dividing into two great limbs, with large spreading branches, forming a beautifully symmetrical crown. The diameter of the greatest spread of the branches was 93 feet (Plate 76).

Perhaps the next finest tree now standing in England is the one which I figure (Plate 77), and which grows on a bank at The Mote, near Maidstone, the property of Sir Marcus Samuel, Bart. I have twice measured this tree, first in 1902, when I made it 103 feet by 12 feet in girth, and again in 1905, when I made it 101 feet by 12 feet 6 inches. I am informed by Mr. Bunyard of Maidstone that it was probably planted about 100 years ago by his grandfather. The tree is so healthy, and apparently growing so fast, that it may become very much larger than it now is. At Gatton Park, Surrey, the seat of J. Colman, Esq., there was, in 1904, a tree about 100 feet by 9 feet 6 inches in girth, with a very tall, handsome trunk. Another at the same place, which, when I saw it, was lying on the ground, was about 95 feet by 9 feet, with a bole 10 feet long, and, according to the measurement given me by the late Mr. Cragg, agent for the estate, contained 315 cubic feet of timber.

At Highclere, Berks, there is a fine tree 90 feet by 9 feet 6 inches; and at Bute House, Petersham, Henry measured one 78 feet by 11 feet 10 inches in 1903. At Burwood House, Surrey, Col. Thynne has measured a tree, which I have not seen,

¹ Mr. John Booth of Berlin, who has for many years been one of the best advocates for the planting of exotic trees for timber, tells me that the black walnut has been largely planted near Strassburg under the direction of Forstmeister Rebmann, and the results are extremely successful.

² *Les Principaux Végétaux Ligneux Exotiques*, p. 21.

79 feet by 12 feet. At Syon House there was a fine tree mentioned by Loudon, as then 79 feet high and 2 feet 11 inches in diameter. In 1849, according to the manuscript catalogue of trees at Syon, it was 90 feet by 7 feet 3 inches; when I saw it in 1903 its top was gone, the tree fast decaying, and the girth about 10 feet.

At Youngsbury, near Ware, Herts, there are two fine trees which Mr. H. Clinton Baker measured in March 1906. The larger was 90 feet high by 11 feet 10 inches in girth; the smaller 80 feet by 11 feet 3 inches. At Albury, Surrey, near the gardener's cottage, there is a tree which measured in 1904, 90 feet by 9 feet 2 inches. At Arley Castle a black walnut is bearing mistletoe. At Barton, near Bury St. Edmunds, there is one which is about 75 feet by 7 feet, which cannot be more than about 60 years old.

Sir Hugh Beever reports a fine tree, 80 feet high by 12 feet girth, at Spixworth Hall, Norfolk. In the rooms of the Hall there is some flooring made of locally-grown black walnut. At Wimpole, he measured another tree 78 feet by 12 feet 8 inches.

At Strathfieldsaye there is a plantation of eighteen young black walnuts in a group on the lawn, which, though about eighteen years old when I saw them in 1903, were only 8 to 10 feet high. Three others raised at the same time but planted out younger are twice as high. This seems to me to prove the importance of not keeping this tree long in the nursery. A fine tree on the other side of the house at the same place is about 80 feet by 7 feet, and had a few nuts on it even in the wet season of 1903.

At Fulham Palace there was a tree, which, according to Loudon, was 150 years old in 1835, being then about 70 feet high and 5 feet in diameter. In 1879¹ this tree was 16 feet in girth breast-high, and had passed its prime; and has been quite dead for ten years. This is the largest girth of any black walnut recorded in England.

At Bisham Abbey, near Marlow, the property of Sir H. J. Vansittart Neale, growing in a grove near the garden, where they have been drawn up by other trees, are four fine black walnuts, of the age of which there is no record. The tallest is nearly if not quite 100 feet high, with a clean bole about half as long, and a girth of 8 feet 2 inches; the others have shorter trunks, the biggest being 10 feet 3 inches in girth, and another 8 feet 6 inches, but are nearly as tall.

At Corsham Court, Wilts, the seat of Lord Methuen, is one of the finest specimens in England, with a clean trunk about 35 feet without a branch and 11 feet 5 inches in girth. It is 75 to 80 feet high, and has a very spreading crown of drooping branches, which cover a space 30 yards across. At Lacock Abbey, near Corsham, the seat of Mr. C. H. Talbot, are some good trees planted by the grandfather of the present owner between 1780 and 1800, of which the largest is about 100 feet by 11 feet 5 inches, with a bole of 8 feet, but this has ceased to bear nuts. The others were planted subsequent to 1828, and the best of them is 60 to 70 feet high by 7 feet girth, and bears nuts profusely.

¹ Figured in *Gard. Chron.* 1879, xi. 372, t. 52. Cf. p. 265.

At Walsingham Abbey, Norfolk, the seat of H. Lee Warner, Esq., there was a specimen figured in Grigor's *Eastern Arboretum*, p. 300, as a tree clothed to the ground with foliage, and of which the spreading branches were propped up. In 1840 it was 8 feet in girth, with a spread of branches 165 feet in circumference, but is now much decayed.

At Brightwell Park, Oxon, the property of R. Lowndes Norton, Esq., there are three or four well-grown trees about 50 years old, the largest of which measures 68 feet by 5 feet 10 inches, and bears fruit abundantly. The leaves of these trees were conspicuous by their yellow colour in the first week of October.

At all the four last-named places these trees have been known as hickories, and it is probable that others of the so-called hickories in England are really black walnuts.

Two trees¹ growing close together at The Firs, Manor Lane, London, S.E., both measured, in 1886, 10 feet 9 inches at 4 feet above the ground, and were estimated to be 90 feet high. They were then in excellent health, and bore good crops of nuts, which, however, were rarely perfectly developed.

Many other trees no doubt exist in old places south of the Thames; but we have never seen or heard of any large ones in the midland or western counties. Sir Charles Strickland, however, tells us that the black walnut is quite hardy in Yorkshire; and that he has trees at Hildenley, 15 to 20 feet high and ripening seed, whilst at Housham, another place of his in the same county, they thrive even better in the woods, where they look like becoming fine timber trees.

In Ireland, the largest tree seen by Henry is at Ballykilcavan, Queen's County: it measured in 1907, 68 feet high by 9½ feet in girth. We know of no trees of any size in Scotland.

The largest which we have heard of in Europe is a tree growing at Schloss Dyck, the seat of Fürst Salm-Dyck in Germany, which was planted in 1809, and in 1904 measured 35 metres high by 3.58 metres in girth, with a crown diameter of 35 metres.

TIMBER

It is very strange that though this timber has been imported on a large scale from North America for many years, both to England and the Continent, where it commands a very high price, its value is quite unknown to the English country timber merchant, and none of the writers on wood seem to know much about it. Even Marshall Ward, in his edition of Laslett (1894), says (p. 181) that it will not bear comparison with the quality of either Black Sea or Italian walnut wood. Boulger, in *Wood* (p. 339), says that it is "more uniform in colour, darker, less liable to insect attack, and thus more durable than European walnut." Stone says (p. 211), "This wood is readily confused with *J. regia*."

I can only say that I have seen four different trees felled in England, of which the wood was perfectly distinct by its purplish colour from that of any European walnut; and though I have not been able to get any definite proof of the truth of

¹ *Gard. Chron.* 1886, xxvi. 616, fig. 120.

Boulger's statement as to its freedom from insect attack, yet the furniture which I have had made from three of the trees in question is distinctly superior to that of common walnut, and as good as imported black walnut, in colour; and when properly seasoned, for which three or four years should be allowed, as good cabinet-maker's wood as the best Circassian or Italian walnut: and Unwin,¹ quoting Nordlinger and Mayr, says that the timber of trees grown in Germany has the same specific gravity and the same beautifully coloured heartwood as in America. I am informed by experienced cabinetmakers and timber merchants that the colour and quality of the wood now imported is, either on account of its being younger or grown in different localities, inferior to what it used to be when first introduced to this market, and Mr. A. Howard told me that he could not buy American timber of better quality than that of a tree blown down at Albury which was given me by the Duke of Northumberland. It takes a beautiful polish either with oil or French polish, has not warped in the least degree, and has in many cases a beautifully variegated figure. The sapwood is thick and of a paler colour, and should not be used in first-class work any more than that of the common walnut, which is always attacked sooner or later by the larvæ of a woodboring beetle.

From what I saw of it in America, I believe it to be extremely durable when exposed to the weather, as it lasts long in fences, and large canoes were made from it, whilst it was the favourite wood for furniture until its increasing scarcity and price caused it to be superseded by oak and mahogany.

Old trees often show a beautiful wavy grain, as well as a variety of markings, and from the forks and burrs veneers are cut, which, though of a different colour, are equal in beauty and pattern to mahogany or satinwood.

Cobbett² states, though he does not appear to have seen it himself, that there was at New York part of a black walnut trunk, which measured 36 feet round at the base, and had been scooped out and used as a bar-room, and afterwards as a grocer's shop, and that this tree, if it had been sawed into inch boards, would have yielded 50,000 feet, worth at that time \$1500, but this seems exaggerated; though Loudon states (p. 1438) that a tree, perhaps the same as the one Cobbett speaks of, and grown on the south side of Lake Erie, was exhibited in London in 1827, which was 12 feet in diameter, hollowed out and furnished as a sitting-room.

(H. J. E.)

¹ *Future Forest Trees*, 38 (1905).

² *Woodlands*, Art. 553.

JUGLANS CINEREA, BUTTERNUT

Juglans cinerea, Linnæus, *Sp. Pl.* 1415 (1763); Loudon, *Arb. et Frut. Brit.* iii. 1439 (1838); Bentley and Trimen, *Medicinal Plants*, iv. t. 247 (1880); Sargent, *Silva N. America*, vii. 118, tt. 331, 332 (1895); and *Manual Trees N. America*, 126 (1905).

A tree attaining in America occasionally 100 feet in height, with a girth of 9 feet, but usually smaller in size, dividing at 20 or 30 feet above the ground into many stout horizontal limbs, and forming a broad, low, round-topped head. Bark of young trees smooth and light grey, becoming in older trees deeply fissured, with broad scaly ridges.

Leaves with eleven to seventeen leaflets, which are sub-opposite, sessile, oblong, unequal-sided, rounded, and slightly unequal at the base, acuminate at the apex; margin finely serrate, the tips of the serrations being directed outwards, ciliate; upper surface finely pubescent with stellate and long simple hairs; lower surface pale, with numerous fine stellate hairs, there being some glandular hairs on the midrib towards its base. Rachis with numerous short glandular hairs. Young shoots with white sessile glands and numerous short white glandular hairs; old shoots pubescent. The leaf-scars are semicircular or triangular, with the upper edge a straight line, and furnished with a transverse band of pubescence.

Flowers: staminate catkins 2 to 3 inches long; scales with six puberulous lobes; bract rusty-pubescent with acute apex; stamens eight to twelve. Pistillate flowers in six- to eight-flowered spikes; involucre with viscid glandular hairs, and slightly shorter than the linear-lanceolate perianth lobes.

Fruit: in drooping clusters of three to five, ovate oblong with two or rarely four obscure ridges, coated with rusty clammy hairs, 1½ to 2½ inches in diameter. Nut ovate, abruptly acuminate and contracted at the apex, with eight ribs, internally two-celled at the base and one-celled above the middle with a narrow pointed apical cavity.

VARIETIES AND HYBRIDS

No varieties are known. A hybrid between it and *Juglans nigra* has been observed. See *Juglans nigra*.

IDENTIFICATION

The best mark of distinction of this species at all seasons is the leaf-scar, which has a transverse raised band of pubescence above its upper margin, which is never notched, and is straight or slightly convex. In winter the following characters are observable in the twigs and buds. Twigs stout, reddish brown, covered with dense glandular pubescence. Leaf-scars, as described above, obovate, on prominent pulvini, with three groups of bundle-dots. Terminal buds oblong, greyish, densely pubescent, the two outer scales conspicuously lobed at the apex, the two inner scales scarcely

lobed. Lateral buds, directed outwards at an angle of 45°, small, ovoid, pubescent; frequently two superposed. Pith dark brown, with narrow chambers. (A. H.)

DISTRIBUTION

According to Sargent, it occurs in rich moist soil near the banks of streams and on low rocky hills from southern New Brunswick and the valley of the Saint Lawrence in Ontario to eastern Dakota, south-eastern Nebraska, central Kansas, and northern Arkansas, and on the Appalachian Mountains to northern Georgia and northern Alabama; most abundant and of its largest size northward. The grey walnut or butternut, as it is commonly called, is a common tree over the same region as that which produces the black walnut, but never attains the same size, and, as a rule, unless drawn up in the forest is a much more spreading and less valuable tree. It does not in New England usually exceed 30 to 50 feet in height, with a trunk 1 to 4 feet in diameter, but sometimes in the rich forests of the Wabash valley attains greater dimensions. Ridgway says, *loc. cit.* 76, that two trees felled in the "Timber Settlement," Wabash county, measured 97 feet and 117 feet in length, with clear trunks 50 feet and 32 feet long, and 1 foot 10 inches in diameter. Pinchot and Ashe, *loc. cit.* 82, say that in North Carolina it is nowhere common, but in cool rich mountain valleys it attains 70 feet high with a diameter of 3 feet. In New England Emerson, *loc. cit.* 210, mentions a tree in Richmond, Mass., which was 13 feet 3 inches in girth at the smallest place below the branches. I never saw any such trees as these; and near Ottawa, where the tree is approaching its northern limit of distribution, it was a small branchy tree bearing little fruit.

INTRODUCTION

The butternut was first described by Parkinson,¹ and was apparently introduced into England at the same time as the black walnut, *i.e.* sometime before 1656, as it is probably one of the species mentioned by Tradescant² as growing in his garden. Loudon states that it was introduced into cultivation by the Duchess of Bedford in 1699; but the tree referred to by him was *Carya alba*.³

CULTIVATION

Though it must have been planted in many places in this country the butternut seems to be now a very scarce tree. The only one I have seen of any size grows in the grounds of Mr. C. S. Dickens at Coolhurst, near Horsham, and was in 1902 52 feet high and 4 feet 2 inches in girth. This produced fruit in 1900 from which I raised two seedlings, one of which is now growing at Colesborne. I noticed that the roots of these seedlings instead of being long, fusiform, and free from rootlets, as in *J. regia* and *J. nigra*, formed a thick, fibrous mass, which made the tree

¹ *Theatrum Botanicum*, 1414 (1640).

² *Museum Tradescantianum*, 146, 147 (1656).

³ Aiton, *Hort. Kew*, iii. 360 (1789), *ex Brit. Museum Sloane MSS.* 525 and 3349.

very easy to transplant. I have since then raised numerous seedlings from imported seed, by sowing them both in pots and in the open ground. If allowed to become dry they sometimes lie over a year, and should therefore be sown as soon as ripe. The young trees are distinguishable from those of *J. nigra* by having fewer pairs of leaflets, but they grow quite as fast, and are quite as hardy as the latter. Both *nigra* and *cinerea*, though liable to injury from late spring frosts, are much hardier as regards winter frost when old enough to ripen their wood, but as, like other walnuts, they do not bear pruning well, they require careful attention when young in order to become shapely trees. Sir Charles Strickland has raised from seed plants at Boynton in Yorkshire which grew to five or six feet high, but all ultimately died.

Mr. J. H. Bonny, Ratcliffe Cottage, Forton, Garstang, sent specimens to Kew in 1900 from a tree 60 years old, which fruited for the first time in that year. It had only attained 22 feet high by 2½ feet in girth at 5 feet from the ground. There is a tree at Bayfordbury which produced a few nuts in 1905. It is 35 feet high by 3 feet 2 inches in girth, and is as large as a black walnut planted beside it. At Tredethy in Cornwall, the seat of F. T. Hext, Esq., I am told by Mr. Bartlett, that there was in 1905 a tree 35 feet by 2 feet 2 inches.

At Riccarton near Edinburgh, the seat of Sir James Gibson Craig, Bart., there is a butternut growing in a sheltered spot which Henry measured in 1905, and though its position makes it difficult to measure accurately, he believes it to be about 50 feet by 3 feet 3 inches.

In Ireland Henry measured in 1904 at Kilmacurragh, Co. Wicklow, a tree 32 feet high by 3 feet 4 inches; while at Charleville in the same county, the seat of Lord Monck, a tree, planted probably in 1869, was 25 feet high by 2 feet in girth.

TIMBER

The timber of this tree, though it resembles that of other walnuts in texture and grain, is much inferior in colour to that of the black walnut, but Hough¹ says that though not so high-priced it is nevertheless of great value for interior finish and wainscoting. In Prof. Sargent's house at Brookline, near Boston, I saw a very handsome mantelpiece and some panelling made from it, and it is occasionally used for furniture. It is pale brown in colour, with whitish-grey sapwood, and the burrs are sometimes cut into handsome veneers. Mr. John Booth² states that he cut down some exotic trees planted by his father at the celebrated Flottbeck nurseries near Hamburg when about 50 years old; and from the wood of a butternut wainscoted a room; "the polish was even finer than that of *J. nigra*, with a splendid glossy hue."

Emerson says, *loc. cit.* 209, that from the bark a mild purgative is made, and that the Shakers at Lebanon obtain a rich purple dye from it. The common dye used by the early settlers for their homespun cloth was from the husk of the

¹ *American Woods*, p. 61.

² *Gard. Chron.* xxx. 407 (1901).

butternut, which gives a fawn colour. The young half-grown nuts make excellent pickles if gathered early in June, but the ripe nuts, though eaten by boys and Indians, are oily and soon become acrid.

According to L. B. Case, who wrote an interesting article¹ on this tree, if an incision is made in the trunk early in spring before the unfolding of the leaves, it yields a rich saccharine sap, nearly if not quite equal to that obtained from the sugar maple. The medicinal uses of the bark are fully explained in Bentley and Trimen's work cited above. (H. J. E.)

JUGLANS RUPESTRIS, TEXAN WALNUT

Juglans rupestris,² Engelmann, *Sitgreave's Report*, 171, t. 15 (1853); Sargent, *Silva N. America*, vii. 125, tt. 335, 336 (1895), and *Manual Trees N. America*, 129 (1905).

The typical form, with small leaflets, which has been introduced into cultivation in Europe, is a shrub or small tree; bark of young trunks smooth, pale, whitish, becoming in older trees deeply furrowed and scaly. Leaflets, seven to fifteen or more, small, one to three inches long, sub-sessile, ovate or lanceolate, never oblong, apex acuminate, base rounded and unequal-sided, crenulate-serrate and non-ciliate in margin; upper surface with scattered minute pubescence; lower surface green with scattered minute brown hairs and axil tufts. Rachis with numerous sessile yellow glands and glandular hairs. Young shoots with numerous sessile yellow glands, interspersed with glandular hairs and obcordate leaf-scars, which are notched above. Older shoots shortly pubescent.

Flowers: staminate, catkins slender, two to four inches long, scales three- to five-lobed, with ovate-lanceolate tomentose bracts; stamens twenty. Pistillate flowers few in a spike, tomentose, involucre irregularly divided into a lacinate border, slightly shorter than the ovate acute calyx-lobes.

Fruit: globose or rarely oblong, very variable in size, $\frac{1}{2}$ to $1\frac{1}{2}$ inch in diameter; husk glabrate or coated with rufous hairs; nut globose without ridges, often compressed at the ends, dark brown or black, grooved with longitudinal simple or forked grooves, four-celled at the base, two-celled at the apex.

Var. *major*, Torrey, *Sitgreave's Report*, 171, t. 16 (1853): usually a tree, attaining 50 feet in height with a trunk 15 feet in girth. In this form the leaflets are large, reaching 6 inches in length; the fruit is also larger. It would appear that this variety is the western form, the typical form being characteristic of the eastern part of the area of distribution of the species.

¹ *Woods and Forests*, 1884, p. 200.

² It is probable, as Rehder points out in *Cycl. Am. Hort.* ii. 846, that *Juglans longirostris*, Carrière, in *Rev. Horticole*, 1878, p. 53, fig. 10, belongs to this species.

IDENTIFICATION

The form of this species usually cultivated in England is distinguished in summer by its small leaves, bushy habit, and the other characters given above. In winter the following characters are available:—Twigs very slender, olive-green or brown, densely pubescent. Leaf-scars set obliquely on prominent pulvini, small, obcordate, notched above, without pubescent band above the upper margin; bundle-dots in three groups. Terminal bud elongated, slender, densely and minutely pubescent, the tips of the two outer scales slightly lobed. Lateral buds, arising at an angle of 45°, minute, ovoid, pubescent, usually solitary. Pith small, brownish, with wide chambers.

DISTRIBUTION

According to Sargent this species occurs on the limestone banks of the streams of central and western Texas, shrubby or rarely more than 30 feet high (var. *typica*); common and of larger size in the cañons of the mountains of New Mexico and Arizona south of the Colorado plateau. It is also met with in northern Mexico,¹ where it frequently leaves the mountain cañons, following the water-courses which are dry throughout most of the year. In such situations its average diameter is 12 to 18 inches, and its height 20 to 30 feet; the nuts, less than an inch in diameter, are scarcely edible.

CULTIVATION

This species was discovered in western Texas in 1835 by Berlandier. It was growing in 1868 in the Botanic Garden at Berlin, according to a note in Engelmann's Herbarium.² It does not seem to have been known in England till 1894, when seeds from Fort Huancha in Arizona were sent to Kew by Sargent. A tree grown from this seed has attained now (1905) about 12 feet in height. There is one nearly as large at Tortworth, and a seedling from Kew is planted at Colesborne, where it seems at least as hardy as the common species and ripens its wood earlier. A tree planted at Mount Edgcumbe, near Plymouth, in 1898 is 9 feet 4 inches high, with a spread of 10 feet. It has been cut back twice, and looks better as a bush than as a tree. (A. H.)

¹ *Garden and Forest*, 1888, p. 106.

² Sargent, *Silva N. America*, loc. cit. 126.

JUGLANS MANDSHURICA, MANCHURIAN WALNUT

Juglans mandshurica, Maximowicz, *Prim. Fl. Amur.* 76 (1859); and *Mél. Biol.* viii. 630, fig. (1872); C. De Candolle, in *D.C. Prod.* xvi. 2, 138 (1864); *Gard. Chron.* 1888, iv. 384, fig. 53.
Juglans regia octagona, in *Revue Horticole*, 1861, p. 429, fig. 106.
Juglans regia cordata, in *Garden*, 1896, p. 478, fig.

A tree attaining 60 feet in height and 5 feet in girth. Bark dark ashy in colour, furrowed in old trees. Judging from herbarium specimens, as I have not been able to examine living trees in England, this species differs little in character of leaves and branchlets from *Juglans Sieboldiana*. Maximowicz, who observed both species growing wild, states that he was unable to find any good distinctions between the two species except in the characters of the nut.

The fruit occurs in short racemes, six to thirteen in a cluster, and is globular-ovate to oblong, viscid, and stellate pubescent. The nut resembles that of *Juglans cinerea*, but is less sharply ridged, globose or ovate, rounded at the base, abruptly and shortly acuminate at the apex, eight-ribbed, with the intervals much wrinkled.

This species occurs in mountain woods in eastern Manchuria, between the Bureia range and the Sea of Japan, from lat. 50° to the Korean frontier. It is frequent along the river Amur in its lower part and on its tributaries. This species is also widely spread throughout Northern and Western China, where it is common in mountain woods at low altitudes, from Chihli through Hupeh and Szechwan to Yunnan. So far as I have seen it, both in Hupeh and Yunnan, it never makes a large tree, and rarely exceeds 40 feet in height, but Komarov informed us that in Mandshuria it attains 80 feet high by 19 to 20 in girth.

This plant was introduced¹ into the Botanic Garden of St. Petersburg by Maximowicz from seeds sent from the Amur. A tree² from seed planted in 1879 in the Arnold Arboretum bore fruit in 1883, which was large, more nearly spherical and less rough than the butternut, and of good flavour. The tree is described as being compact and handsome in habit, and likely to become of value as a fruit tree in the northern parts of the United States, where the common walnut cannot be grown successfully.

Specimens were sent to Dr. Masters³ in 1888 from a tree which had fruited in the nursery of Mr. J. van Volxem at Brussels, where the fruit ripens some weeks before that of the common walnut, and the tree seems less injured by spring frosts.

(A. H.)

¹ Bretschneider, *Hist. Europ. Bot. Discoveries in China*, i. 609 (1898).

² *Garden and Forest*, 1888, pp. 396, 443.

³ *Gard. Chron.*, loc. cit.

JUGLANS CORDIFORMIS, CORDATE WALNUT

Juglans cordiformis, Maximowicz, *Mél. Biol.* viii. 635, cum fig. (1872); Shirasawa, *Icon. Ess. Forest Jap.*, text 35, t. 17 (1899); Rehder, *Mittheil. Deut. Dendrol. Gesell.* 1903, p. 117; *Gardeners' Chronicle*, 1901, xxx. 292, Supplementary Illustration.
Juglans Sieboldiana, var. *cordiformis*, Makino, in *Tokyo Bot. Mag.* 1895, p. 313.

A tree attaining 50 feet in height and 6 feet in girth. Bark, according to Shirasawa, remaining smooth for a long time, becoming fissured with age.

Leaves with eleven to thirteen leaflets, which are sub-opposite, oblong with unequal sides, acute or acuminate at the apex, cordate at the base, sessile or subsessile, the petiole not exceeding $\frac{1}{16}$ inch, the base of the leaflet extending over the rachis so that the leaflet appears to be more sessile than is the case in *J. Sieboldiana*; serrations fine, shallow, irregular, directed forwards and ciliate; upper surface finely pubescent, with only tufted hairs; lower surface pale in colour, pubescent, with numerous stellate hairs, dense along the midrib on which the hairs are glandular; rachis with densely glandular long reddish hairs, sessile glands being absent. Young shoots covered with long white hairs, which are tipped with red glands and are much denser than in *J. Sieboldiana*; no sessile glands visible. Leaf-scar as in that species.

Flowers: male catkins twelve inches long or more; female catkins about five inches long, bearing seven to twelve flowers.

Fruit globose; nut heart-shaped, much flattened, sharply two-edged, with a shallow longitudinal groove in the middle of each flattened side, smooth over the surface, rather thin-shelled.

IDENTIFICATION

Readily distinguished in summer by the cordate leaflets and the young shoots densely covered with long white hairs, which bear red glands at the tips. See under *Juglans Sieboldiana*.

In winter the following characters are available:—Twigs stout, brown, covered with long glandular hairs, which tend, however, to fall off from the lower part of the shoot. Leaf-scar large, set slightly obliquely on pulvini which are scarcely elevated, obovate with two lateral lobes and notched above; the upper margin with a transverse raised band of pubescence; bundle-dots in three groups. Terminal bud conical, but compressed laterally, brown, densely pubescent, the two outer scales lobed at the apex. Lateral buds often two superposed, small, brown, ovoid, arising from the twigs at an angle of 60°, densely pubescent. Pith large, brown, with wide chambers.

DISTRIBUTION

According to Maximowicz, this species occurs in Nippon. Shirasawa says that it is spread along the banks of rivers in the temperate regions of Japan, being rare in

the mountains. The wood, according to this author, is light, with little difference between the sapwood and heartwood, and when well seasoned does not warp or split, and on this account it is much esteemed for making gun-stocks. Sargent¹ did not find this tree in Japan, and says that its peculiar nuts are considered by Japanese botanists to be merely extreme varieties of *Juglans Sieboldiana*. However, the species is kept up as distinct by Matsumura,² and cultivated specimens at Kew of the two species can be readily distinguished.

Rehder states in 1903 that a tree in the Arnold Arboretum raised from seed of true *Juglans cordiformis* fruited some years ago. The fruits, however, did not show the characteristic form of this species, and he doubted whether the tree in question was true *cordiformis*, or only a variety of *Sieboldiana* with aberrant fruit.

Nuts were obtained in 1862 by Albrecht,³ physician to the Russian Consulate at Hakodate, which were sown in the Botanic Garden at St. Petersburg, and produced healthy plants, which were about four feet high, in 1872. Maximowicz also found the nuts in the market at Yokohama. Sargent, who found them offered for sale by the Nurserymen's Association of Yokohama, was informed that they were collected on the slopes of Fujisan.

The tree has been recently sent out by Continental nurserymen, and is hardy in this country. A specimen at Kew, which was raised in 1899 from seed procured from Harvard, is now about twenty feet high. The male catkins, which are produced freely and expand in May, give the tree a striking appearance, but the fruit has not yet matured. (A. H.)

¹ *Forest Flora of Japan*, 60 (1894).

² *Shokubutsu Mei-I*, 155 (1895).

³ See Maximowicz, *loc. cit.*, and Bretschneider, *European Bot. Discoveries in China*, i. 622 (1898).

JUGLANS STENOCARPA, NARROW-FRUITED WALNUT

Juglans stenocarpa, Maximowicz, *Prim. Fl. Amurensis*, 78 (1859); and *Mé. Biol.* viii. 632, *cum fig.* (1872); Rehder, *Mittheil. Deut. Dendrol. Gesell.* 1903, p. 117.

A tree of which only the fruits are known in the wild state. The following description of the foliage is taken from a specimen cultivated at Kew.

Leaves with eleven to thirteen leaflets, of which the terminal one in well-developed specimens is much broader than the others, being obovate with a short acuminate apex (4 inches broad by 6 inches long). The lateral leaflets (2½ inches broad by 6 inches long) are oblong, acuminate at the apex, rounded and unequal at the base, subsessile, the petiolule being less than 1/8 inch; upper surface with scattered stellate pubescence; lower surface pale in colour, with similar pubescence; all the leaflets coarsely and almost crenately (not sharply) serrate and ciliate in margin. Rachis with very scattered stellate hairs and white sessile glands, there being no glandular hairs. Young shoots glabrous with numerous yellow glands, there being, however, a slight pubescence towards the base of the shoot. Older shoots glabrous, grey, shining, smooth. Leaf-scar broadly obcordate, notched at the summit, three-lobed, and without any band of pubescence on the upper margin.

The nuts, on which Maximowicz founded the species, are described by him as being shining, cylindrical or oblong-oval, slightly narrowed at the base, acuminate at the apex, eight-ribbed, with the intervals between the ribs deeply and obtusely wrinkled. The nuts are cinnamon brown in colour and are two-celled.

This species, having serrate pubescent leaflets and non-bearded leaf-scars, can only be confused with *Juglans nigra* and *J. rupestris*. It is readily distinguished in summer from these and all other species of walnut in cultivation by the broad terminal leaflet, which is always well marked in fully developed leaves.

In winter the following characters are available:—Twigs stout, yellowish brown, shining, minutely pubescent towards the apex, glabrous elsewhere. Leaf-scars large, on pulvini which are only slightly elevated, broadly obcordate, notched above and without any pubescent band along their upper margin; bundle dots in three groups. Terminal bud conical, brown, tomentose, the two outer scales slightly lobed at the apex. Lateral buds small, ovoid, tomentose, arising at an angle of 45°. Pith large, buff in colour, with narrow chambers.

The nuts of the tree were found in Russian Manchuria by Maximowicz. Nothing is known about the tree itself.

Specimens are cultivated in the Arnold Arboretum which were obtained from Regel and Keiseling's nursery at St. Petersburg. There are two small plants at Kew which were obtained under the name *Juglans mandshurica* from a Continental nursery. (A. H.)

JUGLANS SIEBOLDIANA, SIEBOLD'S WALNUT

Juglans Sieboldiana, Maximowicz, *Mél. Biol.* viii. 633 fig. (1872); Lavallée, *Arbor. Segrezianum*, p. 1, tab. I. et II. (1885); *Garden*, 1895, xlvii. 442.

Juglans ailantifolia, Hort. Sieb. ex Lavallée, *loc. cit.*; and Carrière in *Revue Horticole*, 1878, p. 414, figs. 85 and 86.

A tree attaining 50 feet in height and 5 feet in girth.

Leaves with thirteen to fifteen leaflets, which are sub-opposite, oblong, acuminate at the apex, with base rounded and unequal, sub-sessile, the petiolule being less than $\frac{1}{16}$ inch; serrations fine, shallow, and irregular, directed forwards, ciliate between the teeth; upper surface finely pubescent, with both single and tufted hairs; lower surface pale in colour, covered with numerous stellate hairs, denser close to the midrib on which there are glandular hairs; rachis with long brown glandular hairs and a few small glands near its base. Young shoots green, with long white glandular hairs and white sessile glands; lenticels at first white, becoming brown, conspicuous. Leaf-scars obcordate, three-lobed, deeply notched above, and with a transverse band of pubescence along the upper edge.

Flowers: staminate catkins very long, up to 12 inches, with bracts obtuse at the apex and very villous, scale five-lobed. Pistillate spikes, five to twenty flowered, the rachis and flowers covered with rufous tomentum.

Fruit in long racemes which are ten to twenty inches long; globose to ovate-oblong, shortly acuminate at the apex, viscid and covered with stellate hairs. Nuts ovoid or globose, rounded at the base and acuminate at the apex, with thick wing-like sutures, very slightly wrinkled and pitted, not ribbed, rather thick-shelled.

IDENTIFICATION

This species seems to be practically identical in leaves and shoots with *Juglans mandshurica*, and differs little in these respects from *Juglans cordiformis*, except that the leaflets of the latter are distinctly cordate at the base. All three species differ, however, remarkably in fruit, and must be kept distinct on that account. They belong to the section of walnuts with bearded leaf-scars, and are readily distinguished from *Juglans cinerea*, the other species of this group, by having the leaf-scars deeply notched above.

In winter the following characters are available:—Twigs stout, brown, glabrous except near the tip, where the pubescence of summer is retained. Leaf-scars large, on very slightly raised pulvini, obovate, two-lobed above; upper margin convex, with a central notch, and surmounted by a raised band of pubescence; bundle-dots in three groups. Terminal bud brownish, elongated, covered with a dense minute pubescence; outer pair of scales lobed at the apex. Lateral buds arising at an

acute angle, small, ovoid, pubescent; frequently two superposed. Pith large, brown, with narrow chambers and thick plates.

DISTRIBUTION

According to Maximowicz it occurs throughout the whole of Japan, there being large trees around temples at Hakodate. At Miadzi, in Kiusiu, it is wild on the sides of mountain streams, being a tree of about eighteen inches in diameter. It is also supposed to occur in the island of Saghalien, as nuts cast up by the sea were found there by F. Schmidt.

Sargent¹ says that *Juglans Sieboldiana* is a common forest tree in Yezo and the mountainous regions of the other islands of Japan. Specimens more than 50 feet high are uncommon. It is a wide-branched tree, resembling the butternut in habit and in the colour of its pale furrowed bark. The walnuts of this species are an important article of food in Japan, as the nuts are exposed for sale in great quantities in the markets of all the northern towns.

Elwes collected specimens at Asahigawa in central Yezo, and noted that it was always a small tree, 20 to 30 feet in height by a foot in girth. He also saw it near Nikko, but never of any size. It is called *Kurumi*. The wood, though used to some extent in Japan for gun-stocks and ornamental work, does not take a high place among the valuable timbers of the country. It was not included in the collection of woods exhibited at St. Louis.

CULTIVATION

Juglans Sieboldiana was introduced from Japan into Leyden about the year 1860 by Siebold, and was sent from there to Segrez in 1866, under the name of *Juglans ailantifolia*. At Segrez it passed unscathed through the severe winter of 1879-1880, which proved fatal there to the common walnut.

According to Sargent this species is perfectly hardy in New England, where it ripens its fruit. It is not worth growing there as an ornamental tree; but it will produce fruit in regions of greater winter cold than the common walnut can support, and may find some place in planting as a fruit tree.

The largest specimen we know of in these islands is at Belgrove, Queenstown, Ireland, the residence of W. E. Gumbleton, Esq. It was, in 1903, 24 feet in height by 2 feet 9 inches in girth. There are specimens at Kew about 12 feet high, which were grown from seed received in 1894. There is also a small plant at Gunnersbury House, Middlesex, which has borne fruit.

(A. H.)

¹ *Forest Flora of Japan*, 60 (1894).

COMMON OAK

THE following is an account of the three species into which the *Quercus Robur* of Linnæus has been divided:—*Quercus pedunculata*, *Quercus sessiliflora*, and *Quercus lanuginosa*. Brief notes are given also of certain Mediterranean and Oriental forms which are in cultivation. The generic character will be given in another part, with our description of the exotic oaks in cultivation in these islands. Plates 78 and 79 show the twigs and buds of the pedunculate and sessile oaks, as well as those of some other species which will be described in a later volume, and the leaves of the three species now treated and of some of their varieties.

Those wishing to have the latest information on the oak from a physiological point of view are referred to the late Prof. Marshall Ward's work,¹ which contains many details on points with which we do not propose to deal.

Loudon's account of the oak, covering over 100 closely printed pages, is also well worth study, especially with regard to the numerous historical trees, the quality of the timber, and the fungi, galls, and insects which live on or attack the tree.

QUERCUS PEDUNCULATA, COMMON OR STALKED-CUPPED OAK

Quercus pedunculata, Ehrhart, *Beiträge*, v. 161 (1790); Loudon, *Arb. et Frut. Brit.* iii. 1731 (1838),

Boswell Syme, *Eng. Bot.* viii. 145, tab. 1288 (1868).

Quercus Robur, Linnæus, *Sp. Pl.* 996 (*ex parte*) (1753).

Quercus Robur, L., sub-species *pedunculata*, DC. *Prod.* xvi. 2, p. 4 (1864).

Quercus Robur, L., var. *pedunculata*, Hooker, *Student's Flora of the British Isles*, ed. 2, 364 (1878).

A large tree, attaining a height of over 100 feet and a girth of stem of 20 to 30 feet, with the main branches large, long, and irregularly bent.

Bark, when old, irregularly fissured, and gradually increasing to a thickness of two inches or more. Branchlets in winter stout, glabrous, angled, grey, with a five-angled pith and small semicircular leaf-scars, which are set obliquely on prominent leaf-cushions and show three irregular groups of leaf-traces. Buds brown, clustered at the ends of the twigs, and arranged alternately (in 2/5 order) lower on the twigs, arising at an acute angle; blunt-oval, five-angled, with numerous imbricated scales (in five rows), which are glabrous on the surface and

¹ *The Oak*, by H. Marshall Ward, F.R.S. (1892).

shortly ciliate on the margin. The bud-scales are stipules, which fall off as soon as the leaves expand.

Leaves deciduous, sessile or with very short stalks, extremely variable in shape and size, but never symmetrical, generally with four to five pairs of entire, irregular, rounded lobes; obovate-oblong, diminishing in size to the base, which has always *two small emarginate auricles*; slightly silky pubescent when young, quite glabrous when adult; coriaceous in texture; dark green above, bluish green beneath. *Some of the lateral nerves run to the sinuses between the lobes.* The leaves from suckers which are very rare are usually entire or only slightly lobed, and are not auricled at the base. The fall of the leaves is very slow, often continuing for weeks, and frequently a part of the leaves remain on the tree till the close of winter.

Flowers appearing with the leaves; the male catkins being pendulous spikes (each bearing about a dozen flowers) arising from the preceding year's shoot and the lower part of the current year's shoot; the female inflorescences being long, obliquely erect spikes (each bearing one to five flowers at the upper end) arising in the axils of the two or three uppermost leaves. Male flower: calyx five- to seven-lobed, enclosing five to twelve stamens. Female flower: calyx six-partite, surrounded by a scaly cupule and enclosing an inferior ovary, surmounted by a cylindrical style terminating in a trifid stigma. Ovary three-celled, each cell containing two pendulous ovules.

Fruits: one to five, sessile on an elongated glabrous peduncle (1 to 6 inches long). Cup hemispheric, composed of many appressed, triangular, obtuse, glabrous or slightly tomentose imbricating scales. Acorn: variable in size and shape, flattened at the base where attached to the cup, and bearing the remains of the style at the apex, smooth and shining, containing one seed in one cell, five ovules and two cells being aborted and only visible as shrivelled remains at the base.

SEEDLING

The cotyledons remain enclosed in the coats of the acorn, and are not lifted above ground. The caulicle, stout and dark-coloured, gives off a long woody primary root. The plumule arises between the petioles of the two cotyledons, and develops into the young shoot, which at first bears only a few scattered scales, the first green leaf, small and obovate-oblong, coming afterwards; those succeeding are larger, obovate, and lobed. By the end of the first season the seedling has a long primary root with spreading lateral rootlets and a glabrous stem, averaging 6 to 8 inches high, bearing five or six sub-sessile glabrous leaves spirally arranged and ending in an ovoid glabrous bud. Each of these leaves has a minute stalk, with a pair of tiny linear stipules.

Seedlings,¹ according to Brenner, who made many observations, vary considerably in appearance, according to the soil in which they are grown, those in dry ground having leaves with deeper lobes, ending in sharp points; those in moist earth having shallow undulating round lobes.

¹ Brenner, *Flora* (1902), Band 90, p. 122.

VARIETIES OF *QUERCUS PEDUNCULATA*1. Var. *fastigiata*, Spach, *Hist. Vég.* xi. 151 (1842), Fastigate or Cypress Oak.

Quercus fastigiata, Lamarck, *Encyc.* i. 725 (1783).
Quercus pyramidalis, Gmelin, *Fl. Bad.* iii. 699 (1808).
Quercus cupressoides, Hort.

The Cypress Oak has the branches pointing upwards, which gives the tree an irregular fastigate shape; but in foliage and fruit it does not differ from the common oak. It has been found wild in the south-west of France, in the Landes and Pyrenees, in the provinces of Galicia and Navarre in Spain, and in Calabria. A famous tree of this variety stood in 1876 near the village of Hareshausen, close to Babenhausen in Hesse, which was supposed to be 280 years old, and it then measured 100 feet high and 10 feet in girth.¹ It had been celebrated in Germany since the middle of the eighteenth century, and stood originally in the forest, now cleared away. From this tree nearly all the German trees, and possibly many English and French trees of this variety, have been derived. This variety comes true from seed to some extent; of thirty acorns sown at Nancy, twelve produced pyramidal oaks, the remainder reverting to the ordinary type. At White Knights, of several hundred acorns sown by the gardener, only five came true to the fastigate type. Elwes has raised plants from seed which in youth at least are more or less fastigate. The tree at White Knights is a remarkably good specimen, being 81 feet high and 8 feet in girth, and is beautifully symmetrical in shape. Sir Herbert Maxwell tells us that there are two trees at Dawick, Peeblesshire. Other fine specimens are at Knole Park, Kent, where Elwes measured one 66 feet by 5 feet; and at Hardwick, Suffolk, where he saw one 61 feet by 4 feet 10 inches. A very well shaped tree of this variety at Melbury Park (Plate 80) measures 65 feet by 3 feet 8 inches, and has the form of a well-grown Lombardy poplar. But none of these are equal to a tree growing at the Trianon at Versailles, which Elwes saw in 1905, and which measures about 90 feet by 10 feet.² Several sub-varieties have appeared in various nurseries, and have received names, but as we have seen none of these in cultivation we do not think them worth recording.

2. Var. *pendula*, Loudon, *Arb. et Frut. Brit.* iii. 1732 (1838), Weeping Oak.—In this variety the branches are pendulous. The most famous tree of this kind is at Moccas Court in Herefordshire; but it has now almost ceased to weep, and Elwes would not have been able to distinguish it if it had not been pointed out to him. The present owner, the Rev. Sir George Cornewall, writes that "weeping oaks are far from uncommon in Herefordshire," and showed

¹ Petzold, *Deutschen Reichsanzeiger*, quoted in *Gard. Chron.* v. 51 (1876). See also *Gard. Chron.* xix. 179, fig. 26 (1883), where Mr. Wissenbach states that the oldest and finest specimens in Germany occur in the royal park at Wilhelmshöhe, near Cassel, the best measuring 100 feet high and 8 feet 6 inches in girth. It is 100 years old, being a graft of the original tree in the forest near Babenhausen. An earlier account of the latter tree is given by a correspondent in *Gard. Chron.* 1842, p. 36.

² A group of fine trees of this variety, said to be more than 100 feet in height, is reported to be growing in the park of Verdais in Haute Garonne. *Woods and Forests*, 105 (1884).

him a very striking one on the road from Moccas to Bredwardine, from the acorns of which seedlings have been raised. In 1884 there was a weeping oak at the King's Acre nurseries, Hereford, grafted at 3 feet up, which was planted by Cranston in 1785.¹ It bears acorns every year; but none of the seedlings, it is said, show a tendency to droop. The top of this tree is not pendulous; the weeping only occurs on the outer parts of the lower branches.

3. Var. *filicifolia*, Lemaire, *Illust. Hort.* i. t. 32, verso (1854), Fern-leaved Oak, also known as *asplenifolia*, *pectinata*, *pinnata*, *taraxacifolia*, etc. The leaves are stalked and cuneate at the base, long and narrow in outline, deeply and irregularly pinnatifid. This was found wild in the mountains of southern Germany; and was sent out by Messrs. Booth and Sons, Hamburg.

4. Var. *heterophylla*, Loudon, *Arb. et Frut. Brit.* iii. 1732 (1844), Various-leaved Oak. This variety has leaves varying greatly in shape; some are lanceolate and entire, others are cut at the edges or deeply lacinate; but all are cuneate at the base. It has received a variety of names, as *comptonæfolia*, *incisa*, *dissecta*, *laciniata*, *salicifolia*, *Fennessi*, *Fenzleyi*, *diversifolia*, *cucullata*, etc. Loudon's figure represents a branch from an accidental seedling, raised in 1820 in the nursery of Messrs. Fennessey, Waterford. There is a free-growing tree of this variety at Smeaton-Hepburn, East Lothian, which measured in 1905, 56 feet by 4 feet 8 inches.

5. Var. *hyemalis*, Bechstein, *Forstbot.* 333 (1810). In this variety the fruit stalk is very long, at least as long as the leaf itself. This is also known as *Quercus longipes*, Steven, *Bull. Soc. Nat. Mosc.* i. 385 (1857).

6. Var. *scolopendrifolia*, Hort. This form has leaves with short stalks and cordate bases, somewhat variable in shape. Most of the leaves are long and narrow, with short lobes; but others more angular in form have swollen bladder-like projections on their upper surface. Certain sub-varieties are distinguished as *bullata*, *cochleata*, *crispa*, etc.; all having leaves variously deformed and presenting bladder- or blister-like projections on their surfaces.

7. Var. *Concordia*, Lemaire, *Illust. Hort.* xiv. t. 537 (1867). Leaves yellow, much more brightly coloured than in the variety commonly cultivated under the name *aurea*, the colour persisting during the summer. This beautiful form, the *Golden Oak*, originated in the nursery of Messrs. van Geert at Ghent in 1843. The late Mr. Charles Ellis wrote in 1894 to Kew that some golden oaks occur at Inglewood, Hungerford, Berkshire, as bright as the golden elder when seen in May. Mr. Clarke, gardener to H. J. Walmesley, Esq., the owner, informs me that the trees are now in vigorous health, and measure at 6 feet from the ground 45 feet by 6 feet 2 inches and 40 feet by 4 feet 9 inches respectively.

8. Var. *purpurascens*, A.DC., *Flore Française*, vi. 351 (1815), Purple Oak.—This was found wild near Le Mans by De Candolle; and another wild tree was subsequently found in Thuringia. The young leaves, petioles, and branchlets are purple, the colour fading away later in the season. This form

¹ *Woods and Forests*, 794 (1884), with a full-page engraving of the tree, which was reported to be 72 feet high and 8½ feet in girth.

has received many names, as var. *purpurea*, Loudon, and var. *sanguinea*, Spach. There are slight sub-varieties which are known as *atropurpurea*, *atrosanguinea*, *nigra*, *nigricans*, etc. The purple oak was first described by Bechstein (*Forst. Bot.* 333) in 1810 as *Quercus sanguinea*.

9. Var. *variegata*, Endlicher. Oaks with variegated leaves are not uncommon in the wild state. There is a specimen at Kew of a curious form sent by Mr. J. Lindsay Johnston from Eastlodge, Crondall, Hants, in 1882. The Rev. W. Wilks has sent leaves of an oak at Shirley, which were of a beautiful pink colour in November 1902. There are many forms of variegated oaks in catalogues; but it must be remembered that there is often a tendency in them to revert to the green form in a short space of time. Some of these sub-varieties may be distinguished as follows:—*argenteo-marginata*, margin of leaves white; *argenteo-picta*, leaves with white streaks; *aureo-variegata*, leaves with yellow streaks; *rubrinervia*, veins red in the young leaves; *aureo-bicolor* and *tricolor*, leaves variously coloured yellow, white, and green.

Elwes has seen a very fine variegated-leaved oak at Haldon near Exeter, the seat of J. F. G. Bannatyne, Esq., and I measured one 57 feet high and 7 feet in girth, at The Grove, Teddington, which, according to Loudon,¹ was 37 feet high in 1837. This tree bears leaves, which come out variegated green, white, and pink, changing in autumn to a pure pink colour. The present owner, Charles E. Howard, Esq., informed me that it fruited only once to his knowledge, in 1887.

An account is given in the *Gardeners' Chronicle* of 14th September 1861 of a common oak which became variegated, the result of having been struck by lightning. This tree grew near Mawley, the seat of Sir Edward Blount, and contained about thirty feet of timber. It was struck by lightning on 26th June 1838, and did not appear to suffer at the time; but shortly afterwards the foliage, which was previously green, became beautifully variegated, and continued to produce variegated leaves and remained healthy.

10. Var. *cuprea*, Hort. This variety has bronze-coloured leaves when young, and is said to be a very distinct and vigorous form.

11. Var. *tardissima*, Simonkai, *Le chêne de juin*.²—This variety has more regular branching and denser foliage than the common form; but is chiefly remarkable for the lateness of its leafing, which occurs five to eight weeks after the common oak. It was discovered in France in the valley of the Saône, from Pontailler to Saint-Amour; and has since been found at various places in the departments of Loir-et-Cher and Cher, and also in Hungary. It appears from experiments made at Nancy to come true from seed;³ and the delay in the putting forth of the leaf is as marked in seedlings as in old trees. It grows vigorously; and apparently, in spite of the short period each season that it

¹ Loudon, *Gard. Mag.* 1837, p. 10.

² For interesting accounts of this variety, the following papers may be consulted:—Gilardoni, *Le chêne de juin* (1875); Jolyet, *Bull. de la Soc. des Sciences*, 1899.

³ But seedlings raised by Elwes at Colesborne from acorns sent from France by M. L. Pardé do not seem to retain the late-leafing habit.

carries foliage, it produces as much timber as the common form.¹ The variety is considered of some importance in France, as owing to the lateness of leafing it is never affected by spring frosts; and it is recommended for cold, damp situations where the common oak is injured by this cause.

Many other varieties doubtless occur, both in cultivation and in the wild state. Specimens were sent to Kew from an old oak tree at Springfield, West Wickham, Kent, which bore extremely large leaves all over the tree, measuring as much as 8 inches long and 6 inches wide, and similar leaves occur on a tree at Colesborne. At Tortworth there is an oak about fifty years old, which bears fruit on very long peduncles, and has remarkably glossy coriaceous leaves² somewhat variable in shape, but generally obovate-lanceolate, with quite entire or only slightly lobed margin. This is almost identical with a specimen at Kew, gathered near Arcachon in France by Mdme. de Vilmorin. Specimens collected in Wistman's Wood, Dartmoor, are also remarkable for their irregularly shaped and very slightly lobed leaves, which have a cuneate base.

The variation in the size and shape of the leaves in natural wild seedlings growing side by side is often remarkable. Elwes gathered from three trees growing on the rocks above Minard Castle, Lochfyne,³ leaves varying from about 2 to 8 inches long. Meehan⁴ narrates that when he settled in Germantown, near Philadelphia, he found a single *Quercus Robur* on the grounds of Mr. J. Hacker, from the acorns of which he raised hundreds of young seedlings, and has from these a second generation. He found amongst the seedlings numerous varieties, e.g. trees with leaves quite sessile, others with a petiole $\frac{1}{4}$ inch long, others with leaves as entire as those of *Quercus Prinus*, others with pinnatifid lobes; while in some cases the acorns were only a little longer than broad, in other cases cylindrical and twice as long as broad. Evidently here there was no possibility of hybridisation, as there was only one tree. This experiment of Meehan's, however, only goes to show the extreme variability of *Q. pedunculata*; and there is no evidence brought forward that any of the varieties became in the least like *Q. sessiliflora*.

In all the preceding varieties we are treading on safe ground, as there is no doubt that they are all derived from *Q. pedunculata*; but the case is different with certain forms from the Orient and southern Europe, which were considered by De Candolle to be varieties of *Q. pedunculata*, but by other authorities are treated as distinct species. A brief account of such of these as are in cultivation in England follows:—

Quercus Haas, Kotschy, *Die Eiche. Eur. u. Or.* t. 2 (1862); *Q. Robur, pedunculata*, var. *Haas*, DC. *Prod.*—This oak occurs in Cilicia and the Taurus, and in habit and size resembles the common oak; it differs in the following respects:—Young shoots white pubescent, puberulous when adult. Buds finely pubescent. Leaves on very short pubescent stalks, obovate, with cordate base, and four or five

¹ Mathcy, *Exploitation Commerciale des Bois*, 95 (1906), speaks of its timber as being excellent, with very little sapwood, and scarcely any defects.

² Figured in Plate 79, fig. 2.

³ *Bull. of the Torrey Bot. Club*, ix. 55 (1882).

pairs of rounded lobes, the lateral nerves reaching to the sinuses as well as to the lobes; coriaceous; under surface bluish green, with a stellate pubescence, often discernible only with a lens. Fruit: 2 to 6 on a long stalk, very large, the acorns being $\frac{4}{5}$ inch in diameter. The cups look very distinct from those of the common oak.

This species is considered by Zabel¹ to be a hybrid between *Q. pedunculata* and *Q. lanuginosa*, but it seems rather to be a geographical form of *Quercus pedunculata*. Elwes saw two stunted trees which may be this at Orton Hall, Peterborough, said to have been raised from acorns sent by the late Sir H. Layard from Kurdistan.

The following three species or geographical forms were considered to be varieties of *Quercus pedunculata* by De Candolle.

Quercus Brutia, Tenore, *Sem. Ann. Hort. Neap.* (1825), p. 12.—Occurs in southern Italy. The difference between it and some northern forms of *Q. pedunculata* is very slight, as the leaves are glabrous. The fruit is large and somewhat peculiar.

Quercus Thomasii, Tenore, *loc. cit.* This also occurs in southern Italy, and is a form with large acorns, having leaves pubescent on the under surface, and standing on short pubescent petioles.²

Quercus apennina, Lamarck, *Encyc. i.* 725 (1783).—This is a small oak which occurs on dry situations in the south of France, and is said to form considerable forests in the Apennines in Italy. It has hoary, tomentose shoots and small leaves, with the under surface pale pubescent, and shorter stalks than *Quercus lanuginosa*, which it otherwise much resembles. The fruit is crowded on thick grey tomentose axes, and the cupules are greyish tomentose with appressed scales.

Hybrid or Intermediate Forms.—Hybrids between *Quercus sessiliflora* and *Q. pedunculata* occur; but they seem to be rare in the wild state in England, and I have only seen two or three specimens which could not at a glance be referred to one or other species without doubt. The best name for the hybrid is *Quercus intermedia*, Boenn, in *Rchb. Fl. Germ.* 177 (1830). The type specimen of *Q. intermedia*, Don, obtained by Leighton in Wyre Forest, Shropshire, is true *sessiliflora*. Another specimen in the British Museum labelled *intermedia*, gathered in 1843 in Surrey, is *pedunculata*; in this some of the peduncles are rather short, but there is one fully developed peduncle of the usual length, and the leaves in no way differ from ordinary *pedunculata*. What is often supposed to be *intermedia* is, however, the common oak, bearing leaves with stalks of a moderate length. The word *pedunculata* is apparently a trap to deceive all but the practised botanist. In *Q. pedunculata* the acorns are sessile on a long peduncle, which is distinct from a shoot, as it bears only acorns, never buds or leaves. I have received specimens from professional foresters, labelled "*sessiliflora*, intermediate form," in which the

¹ *Laubholz-Benennung*, 78 (1903).

² Elwes has received seedlings of both these forms from Herr Sprenger of Naples, and has sent some of them to Kew; but they do not at present show any appreciable difference, which was the case also in the oaks which he saw growing in the Sila mountains in Calabria.

peduncle bearing the acorns overtopped the end of the shoot, and was mistaken for it, and the acorns in consequence were considered to be sessile on the shoot. I think that the alleged occurrence of numerous intermediate forms is due to an imperfect appreciation of the real distinctions between the two species; and specimens to support the common occurrence of hybridity are not as yet forthcoming. The first writer who tried to break down the distinctions between the two species in England—Greville¹—was not at all sure that he had succeeded; and in view of the important sylvicultural differences between the two trees the subject is one of more than academic interest.

Certain cultivated forms may be hybrids, as, e.g. *Quercus falkenbergensis*; and *Q. armeniaca*, Kotschy, from Armenia, is an undoubted hybrid. (A. H.)

The question of the distinctness of the sessile and pedunculate oaks in England has been discussed at great length on many occasions, but is one on which opinions, even among careful observers, always have differed, and differ still. Perhaps the best account of their peculiarities and merits is given by Loudon, pp. 1737-46, and in the *Gardeners' Chronicle* (1900), when a discussion was opened by Prof. Fisher, and continued by other well-known authorities.

Prof. Fisher describes the physiological difference, and maintains the opinion, which, largely based on French experience, is confirmed in some parts of England, that the pedunculate oak is naturally adapted to a wet soil, while the sessile will thrive in comparatively dry situations, and says that these peculiarities are of great importance to planters in selecting seed. As nurserymen rarely distinguish them and are, as a rule, careless of the source from which their seed comes, provided it will produce good nursery plants, I should strongly advise all oak planters to select and grow their own oaks from the trees which thrive best on similar soil in their own district, or in places with similar soil and climate.

Mr. A. C. Forbes says that in many localities the sessile oak is quite rare, and in Wilts "probably the rarest indigenous tree that we have." He accounts for this by the fact quoted from a paper² by Mr. J. Smith of Romsey, that at the time when oak timber was in demand for the navy, the durmast oak was not considered fit for that purpose, being, as it was said by the purveyors for the navy, more liable to dry rot, and this tradition still lurks in the minds of the older woodmen, tales being told of how they deceived those worthy gentlemen into passing the durmast oak for the dockyards.

There is a great deal of very interesting information in this paper both on the rate of growth and effects of transplanting of oaks, on their insect enemies and fungoid diseases, and a list is given, with many particulars and measurements of many of the most celebrated oaks of England. No one who is interested in oaks should fail to read it, but it is too long to quote from as freely as I should wish.

Sir Herbert Maxwell, in *Gardeners' Chronicle*, Nov. 10, 1900, says: "The long correspondence in your columns relative to the merits of the durmast or sessile-flowered oak will probably leave most people of the same mind as they were when it

¹ *Trans. Bot. Soc. Edin.* i. 65, tt. 4, 5 (1841).

² *Trans. Scot. Arbor. Soc.* xiii. 21 (1891).

began"; and goes on to say, "What is important is the fact that the durmast will thrive and ripen its season's growth in moist northern and western latitudes, which are unfavourable to the development of the pedunculate kind. In our salt-laden atmosphere upon the western seaboard much of the growth made by the pedunculate oak during one season fails to ripen before it is nipped by frost, and the tree is much more subject than the durmast to galls—a sure sign of debility; and it never carries with it the wealth of glossy foliage that never fails to distinguish the latter."

He then speaks of the fine oaks at Merevale Park, which are described on p. 318, as being of the sessile variety, and says that at Knole Park, Kent, on the other hand, the general growth is pedunculate; but there is a magnificent avenue of durmast oaks, leading to the house from the direction of the Wilderness, and these tower far and straight above the gnarled and twisted veterans in the rest of the park.

Another peculiarity of the sessile oak is referred to in a letter from the Hon. Gerald Lascelles to Mr. Stafford Howard, in which he says: "I doubt whether there is much difference between the timber of the sessile and pedunculate oaks, but I think that the sessile is straighter and cleaner in growth, and one thing is certain—that it is almost immune from the attacks of the caterpillar (*Tortrix viridana*) which so often destroys every leaf on the pedunculate oak in early summer. Whether this does any real harm or not is a moot point, but I think it must be a check to growth, and that the trees would be better without it. I have seen a sessile oak standing out in brilliant foliage when every tree in the wood around was as bare of leaf as in winter."¹

Mr. J. Smith, in the paper above referred to, pp. 29-30, confirms Mr. Lascelles' observations, and says that in 1888, which was the worst year for these caterpillars that he remembered, he passed through a wood composed of *Q. sessiliflora* in which, though it had been attacked by the caterpillars, they had left off, evidently either poisoned or starved. He also quotes a resident in the Forest of Dean who, writing in 1881, says: "It was strikingly evident last summer that the *Q. Robur pedunculata*, or old English oak, was attacked by blight (? caterpillars) more severely than *Q. R. sessiliflora*"; and Mr. Baylis, who now has charge of Dean Forest, writes to me on the subject as follows:—"I can confirm the statement that the larva of the green oak moth defoliates *Q. pedunculata*, very much more than *Q. sessiliflora*, and I think the reason is this: the latter is the first to come into leaf, and the leaf has time to get fairly tough before the caterpillar has reached its most destructive stage, which is about the time that *Q. pedunculata* is coming into leaf."² I have very frequently noticed this fact that the oak with more decided pedunculate characters is almost invariably attacked rather than the other."

The only published exact observation that I know of with regard to the relative rate of growth of the two forms on the same soil is by Mr. H. Clinton Baker of Bayfordbury.³ Near his house are growing on sandy loam, close to each other, a pedunculate oak raised in 1811 from the celebrated tree at Panshanger, and a sessile

¹ Sir Herbert Maxwell remarks, *in litt.*, that though visitations of *Tortrix* are not common in Scotland, yet in June 1905 the oaks on the shore of Loch Awe and Loch Lomond, which are sessile, were stripped of their leaves by this pest.

² Usually *Q. pedunculata* is the first to come into leaf. Cf. p. 292.

³ *Gard. Chron.* xxxvii. 132 (1905).

oak raised in 1840 from a tree at Woburn Abbey. Measurements show that the former was 6 ft. 7 in. in girth in 1865, and is now 9 ft. 4 in.; whilst the latter, only 1 ft. 8 in. in 1865, is now 8 ft. 7 in. Mr. J. Hopkinson in *Trans. Hertfordshire Nat. Hist. Soc.* xii. pp. 249, 250, gives diagrams showing the comparative annual increase during two periods of these trees. I may add that the habit of the two trees differs but little, and the soil is more suitable to the sessile oak.

Mr. Sharpe,¹ forester at Monreith, where Sir Herbert Maxwell planted in 1898 a quantity of oaks of the two species, on a fairly deep loam soil, measured ten of each sort in 1905, and informs us that the sessile oak averaged 13½ feet in height, and the pedunculate oak only 10½ feet. (H. J. E.)

QUERCUS SESSILIFLORA, SESSILE OR DURMAST OAK

Quercus sessiliflora, Salisbury, *Prod. Stirp. Hort. Chap. Allerton*, 392 (1796); Loudon, *Arb. et Frut. Brit.* iii. 1736 (1838); Boswell Syme, *Eng. Bot.* viii. 157, tab. 1289 (1868).

Quercus sessilis, Ehrhart, *Beiträge*, v. 161 (1790).

Quercus Robur, Miller, *Gard. Dict.*, vii. 1 (1759).

Quercus Robur, Linnæus, var. β ; *Mantissa*, 496 (1771).

Quercus Robur, L., sub-species *sessiliflora*, DC. *Prod.* xvi. 2, p. 6 (1864).

Quercus Robur, L., var. *sessiliflora*, Hooker, *Stud. Flora Brit. Isles*, ed. 2, 364 (1878).

A tree resembling *Q. pedunculata*, but with more regular branching, resulting in a denser crown of foliage. It differs somewhat in the characters of the branchlets, buds, leaves, pistillate flowers, and fruit, as follows:—

Branchlets pubescent, especially near the top. Buds more sharply pointed, with scales pubescent on the outer surface, especially near the apex, and having long marginal cilia.

Leaves with a long petiole; symmetrical, obovate-oblong, widest at the middle and gradually diminishing to the base, which is cuneate and generally without auricles; firm, almost coriaceous in texture; sinuately lobed or pinnatifid, the lobes being oblong or triangular, entire, occasionally apiculate; upper surface glabrous and shining, dark green; lower surface brighter even glaucous green and always more or less pubescent. *Lateral nerves running to the sinuses are very seldom present.* Pistillate flowers with stigmas almost sessile. Fruit solitary or crowded, inserted on the branchlets, or borne sessile on an erect, stout, short pubescent peduncle. Cups pubescent, with scales more numerous and more closely crowded together than in *Q. pedunculata*.

This species is quite distinct from *Q. pedunculata*, and the characters given above are very constant. The pubescence, which is visible in this species throughout, on the top of the twigs, buds, stalks, peduncles, cups, and under surface of the leaves, is not so pronounced in specimens occurring in rainy districts; but it can always be made out by a lens. The physiological differences are well marked. The sessile

¹ Cf. Sir Herbert Maxwell's account in *Gard. Chron.* xxxvii. 82 (1905).

oak comes into flower and leaf later by some days than the other species, and it is less liable to attacks of the roller moth. It bears shade better, and on this account can be grown closer as a forest tree. It grows naturally on drier soils, and on the Continent ascends to higher altitudes than *Quercus pedunculata*. It is different in habit, the terminal bud being stronger than the others, so that the shoot is continued in the same direction, and the branches keep straight; whereas in *Q. pedunculata* the lateral buds at the apex often develop more vigorously and a crooked branch results, with the leaves much more tufted.

SEEDLING

At first the seedling differs little from that of *Q. pedunculata*, though the young leaves are more distinctly stalked; but towards the end of the first year, the characters shown in the adult stage are well marked, namely:—the stem, leaves, and terminal bud are pubescent, and the leaves have a cuneate base and short but distinct stalks.

VARIETIES OF *QUERCUS SESSILIFLORA*

1. Var. *longifolia*, Dippel, *Laubh.* ii. 67 (1892).—This is also known as *macrophylla*. The leaves are variable, but are as a rule very long, as much as eight inches, and narrow in proportion to their length, the lobing being never constant. The base of the leaf is always cuneate.

2. Var. *laciniata*, Koehne, *Dendrol.* 130 (1893).—Leaves small with deeply-cut segments, which are directed forwards; base cuneate.

3. Var. *mespilifolia*, Wallroth, *Sched. Crit.* 494 (1822).—Leaves, with a petiole of one inch, lanceolate, long, and narrowed at both ends, averaging five inches long by one inch broad at the widest part; quite entire in margin or very slightly lobed. This form has been found wild at Nordhausen in the Harz mountains, at Wolgast in Pomerania, and in various places in Austria and Hungary. Var. *Louetti*, is a somewhat pendulous sub-variety, which is considered by most authors to be identical with var. *mespilifolia*.

4. Var. *sublobata*, Koch, *Dendrol.* ii. 2, 32 (1873). *Quercus sublobata*, Kitaibel, in *Schult. Oest. Fl.* i. 619 (1814).—This is nearly the same as the last variety, but the leaves are slightly and regularly lobed. It came into commerce from the Royal nursery at Geltow near Potsdam, and hence is often known as var. *geltoviana*.

5. Var. *cochleata*, Petzold et Kirchner, *Arb. Musc.* 630 (1864).—This resembles the common form, except that the edges of the leaf are curved upwards, so that the centre of it is rendered concave. It is said to be a free-growing variety.

6. Var. *afghanistanensis*, Hort.—This variety, as cultivated at Kew, has obovate leaves very similar to the common form, except that the lobes of the leaf are more shallow and more numerous, and its bluish under surface is covered with a fine pubescence which extends to the petioles. It is considered by Zabel¹ to be a hybrid between *Q. lanuginosa* and *Q. sessiliflora*. It was sent out by Messrs. Booth of

¹ *Laubholz-Benennung*, 77 (1903).

Hamburg, who stated in their catalogue that it came from Afghanistan; but Petzold and Kirchner, *loc. cit.*, consider this origin to be improbable. What is sold under this name in some nurseries is *sessiliflora* or *Mirbeckii*.

7. Var. *iberica*, Hort.—This variety, as cultivated at Kew, has small oblong-ovate leaves, broad and cordate at the base, acute at the apex, with numerous small deltoid lobes, each terminating in a callous acute tip, the margins of the lobes being often turned downwards and inwards.

8. Var. *falkenbergensis*, Hort.—This has small dark-green leaves, broadest in diameter in their upper third, lobes few and broad, and the base generally cordate and auricled. The fruit is sessile or on short peduncles. It is very probably a hybrid between *Quercus pedunculata* and *Q. sessiliflora*.¹ This variety was found in 1832 in a wood at Falkenberg in Hanover, and was put into commerce by Messrs. T. Booth and Sons in 1837.

9. Var. *alnoides*, Hort.—This variety, as cultivated at Kew, has small leaves, not exceeding 2 inches in length, with about eight pairs of small lobes, the apex of the leaf being generally acute, the base cordate or cuneate.

10. Var. *pinnata*, Hort.—Leaves deeply pinnate, the sinuses extending almost to the midrib.

11. Var. *rubicunda*, Hort.—Leaves deep red, more especially in the early part of summer.

12. Var. *purpurea*, Hort.—Leaves purple, becoming green with reddish nerves in early autumn. This variety, according to Mr. Nicholson, is a thoroughly distinct and valuable ornamental tree.

13. Var. *variegata*, Hort.—Leaves variegated either with white or yellow tints.

14. Var. *aurea*, DC. *Prod.* xvi. 2, p. 9 (1864). *Quercus aurea*, Kitaibel, in *Reichb. Icon.* xii. 8, t. 645 (1850).—The leaf has generally six pairs of deeply cut lobes, rounded at the top. The young shoots bear yellowish leaves, and are themselves deep yellow. This occurs wild in Austria, and is considered by Zabel² to be a hybrid between *Q. conferta* and *Q. lanuginosa*; but a type specimen at Kew does not show evidence of *Q. conferta* parentage.

15. Var. *dschorochensis*, Hort.—The variety which is cultivated under this name does not seem to be the species³ found by Koch on the Dschoroch range of mountains near Trebizond in Asia Minor; and at Kew is apparently a form of *sessiliflora* with oblong-oval leaves, which have eight or nine pairs of very shallow sinuate lobes.

¹ Zabel, *loc. cit.* 79.

² *Ibid.* 77. It is *Quercus aurea*, Wierzbicki, of Kotsehy, *Eichen*, t. 4 (1862).

³ *Quercus dschorochensis*, C. Koch in *Linnaea*, xxii. 328 (1849); *Quercus sessiliflora*, var. *dschorochensis*, DC. *Prod.* xvi. 2, p. 9 (1864).

QUERCUS LANUGINOSA, PUBESCENT OAK

Quercus lanuginosa, Thuillier, *Flora Envir. Paris*, ed. 2, 502 (1799).

Quercus pubescens, Willd. *Sp. Pl.* iv. 450 (1805).

Quercus Robur sessiliflora, var. *lanuginosa*, DC. *Prod.* xvi. 2, p. 10 (1864).

Quercus sessiliflora, Salisbury, var. *pubescens*, Loudon, *Arb. et Frut. Brit.* iii. 1736 (1838).

A small tree, rarely attaining 60 feet in height, and often, in the wild state, a dense shrub with a twisted stem. Bark rather rougher and more scaly than that of the common oak. Twigs and buds densely pubescent, the scales of the latter being ciliate on the margin and pubescent all over their surface. Leaves small, about 3 inches long, variable in shape, wrinkled in margin, cuneate or cordate at the base, with four to eight pairs of rounded lobes variable in depth; always densely pubescent underneath; petiole tomentose, $\frac{1}{2}$ to 1 inch long. Axis of male flowers pubescent. Female flowers with sessile stigmas and tomentose ovary. Fruits, one to four, crowded on a short thick stalk, or sessile; cups tomentose and often tubercular.

This oak occurs on dry soils, especially those of limestone formation, in the south of France, Corsica, Spain, Portugal, Italy, Alsace, south Baden, Thuringia, Austria, Hungary, southern and western Switzerland, Turkey, Greece, Crimea, Caucasus, and Asia Minor. In Provence it forms dense, low thickets covering extensive areas of the very dry lower parts of the limestone mountains. In Corsica it appears to be the only deciduous species of oak; and was seen by me forming scattered groves in the mountains below the zone of *Pinus Laricio*, at about 2000 feet elevation. I observed no trees larger than a foot in diameter; and it is evident that it is very distinct from *Q. sessiliflora*, which, if it occurred, would grow to a large size in the Corsican humid climate. The tree is of no importance in Corsica as a source of timber; and Mr. Rotgès of the forest service considered that it should always be treated as coppice.

It produces hybrids with both *Q. sessiliflora* and *Q. pedunculata*, and differs markedly from both these species in its habit of producing root-suckers, and moreover the bark is different.

Loudon incorrectly states that it occurs in the New Forest, and Sussex. There is a tree of this form growing at Syon with a remarkably curved bole of about 18 feet long and 5 feet 10 inches in girth. If upright this tree might have been 50 feet high. Elwes has seen this species growing wild in the forest of Fontainebleau, which Hickel informed him was about its northern limit as a wild tree; here it is usually small and stunted, so far as he saw, and of no economic value.

VARIETIES OF *QUERCUS LANUGINOSA*

1. Var. *Hartwissiana*, Hort.¹ Leaves with six or seven pairs of lobes, which are mucronate at the tips.

¹ According to Schneider, *Laubholzkunde*, 194 (1904), the plant so named by Steven in *Bull. Soc. Nat. Mosc.* 1857,

2. Var. *dissecta*, Hort. Leaves deeply cut.

3. Var. *Dalechampii*, Koch, *Dendrol.* ii. 2, p. 38 (1873); *Quercus Dalechampii*, Tenore, *Ind. Sem. Hort. Neap.* 1850, p. 15; *Quercus sessiliflora*, var. *Tenorei*, DC. *Prod.* xvi. 2, p. 7 (1864).

This form, which is considered by some to be a distinct species, occurs in southern Italy. It is in cultivation at Kew, and has leaves 3 to 4 inches long on short stalks. The leaves are oblong-oval, with bases cuneate or truncate, often auricled, coriaceous in texture, shining green above, bluish and only slightly pubescent beneath, with six to eight pairs of acute shallow lobes, which have their margins curved inwards and backwards. The bark of the tree is very rough and scaly.

i. 387, is either a form of *Q. macranthera* or a hybrid of that species. The plant, however, usually cultivated as *Hartwissiana* is probably a variety of *Q. lanuginosa*, which Steven collected and described as *Q. crispata* (*Bull. Soc. Nat. Mosc.* 1857, i. 386).

DISTRIBUTION OF THE COMMON OAK

Owing to the general opinion of English botanists that there is only one indigenous species of oak, with two inconstant varieties, there are few accurate records of the distribution of the two species, and in the majority of cases it is impossible to say whether the specimens in our great herbaria are from wild or cultivated trees. Moreover, owing to the great changes caused by the spread of cultivation and the cutting down of most of the original woodland, the correct distribution of the two species can scarcely be made out. It is probable, however, that in ancient times the pedunculate oak occupied the alluvial lands and the better soils, now almost entirely devoted to agriculture and pasture. Hedgerow trees are invariably of this species. The sessile oak occupied the hilly land and the poorer soils; and in existing oak-woods occurring in such situations, which have never been touched by the plough, it is always the species met with, as in the Wyre Forest, the Forest of Dean, in the district about Burnham Beeches, in Lord Cowper's woods near Welwyn, Herts, which are on high-lying poor gravel soil, etc. In Scotland, judging from a specimen at Kew, the famous Birnam wood consisted of *Quercus sessiliflora*.¹ In Ireland, the ancient wood of Shillelagh, in Wicklow, of which a remnant still exists, was the same species. The Cratloe wood near Limerick is of pure sessile oak; and it is the only species in the wilder parts of Kerry. All the specimens of *Q. pedunculata* which I have received from Ireland, are from planted trees.

In England the oak ascends to 1200 feet in Yorkshire. In an interesting paper by H. B. Watt on the "Altitude of Forest Trees in the Cairngorm Mountains"² in Scotland, 700 to 800 feet is given as the highest level at which the oak was observed; but Mr. Watt says, in a MS. note, that he found in July 1903 a small oak at Corriemulzie at an elevation of 1200 feet. The same author gives many interesting particulars of the oak in Scotland, in a paper published in the *Annals of the Andersonian Naturalists' Society*, ii. 89 (1900). In Ireland the oak ascends in Derry to 1480 feet. There are remains of virgin forest in Donegal, on Sir Arthur Wallace's property near Lough Esk; and a very large oak wood, which is of great antiquity, occurs at Clonbrock, the seat of Lord Clonbrock, in Co. Galway, on the limestone formation. There are smaller woods in many of the mountain glens, and Mr. Welch of Belfast says that where these primitive bits of forest have never been touched by tillage, peculiar and local forms of land-shells occur, and the Clonbrock oak forest contains rare plants, moths, etc., unknown elsewhere. The oak was in early times much more widely spread; it has been found, *e.g.*, in a peat moss in the Orkneys. Mr. T. T. Armistead³ found a young oak growing in a sheltered ravine on the coast

¹ Mr. Stuart Fotheringham of Murthly confirms this by leaves from the large oak behind the Birnam Hotel at Dunkeld, which Hunter says is one of the few survivors of the Great Birnam Wood.

² *Cairngorm Club Journal*, iv. 111 (1903).

³ *Zoologist*, 1891, p. 19.

of Hoy, Orkney, and the acorn from which it sprang must have been brought from the mainland by a rock-dove or rook.

Remains of oak are found in all the later geological deposits; in the pre-glacial deposits in the Cromer forest-bed; in inter-glacial deposits in Hampshire, Sussex, Hertford, Middlesex, and Suffolk; in neolithic deposits; common in "submerged forests" everywhere; at the base of peat-mosses in many localities (ascending in them up to 1000 feet in Yorkshire).¹ Mr. S. B. J. Skertchley describes² the growth of five successive oak forests in the valley of the Ouse, and considers the oldest of them to be some 70,000 years old. These forests spread downwards towards the fen till checked by water and peat moss, the latter eventually burying and preserving them. The trees in thousands lie to the north-east, having been blown down by the south-west, which is still the prevailing wind. The word oak occurs in place-names both of Celtic and Saxon origin, the Saxon forms in names being ac, oak, wok, and auch. These forms are illustrated by names like Auchley, Auckland, Acworth, Wokingham, Oakingham, Oakham, Oakfield, Oakley, Martock, Holyoak, and Selly-oak. The Gaelic name is *dair*, as in Derry, Edenderry, Ballinderry, Kildare, Adare, Darnock, Kildarragh, Auchindarroch, Craigandaroch.

Quercus pedunculata, according to Willkomm, occurs throughout the greater part of Europe, Asia Minor, and the Caucasus. Its northern limit reaches, on the west coast of Norway, 62° 55', on the eastern side of Norway 60° 45', in Sweden 60°, in Finland 61° 30' at Björneborg and 60° at Helsingfors, then passes along the coast of Esthonia to St. Petersburg, and crosses Russia south of Jaroslav and Perm, then descends southwards, reaching the Ural river between Orenberg and Orsk, and descends along that river to Iletzkoi. Its distribution in the Caucasus and Asia Minor is not known with exactness, owing to the conflicting opinions about the oaks of these regions. In Europe it occurs as far south as Greece, Sicily, and in the Peninsula reaches its southern limit in the Sierra Morena range. The western limit, beginning at the western part of this range, includes the northern part of Portugal and Galicia, and continues up along the coast of France, ending in Ireland and Scotland. It is essentially a tree of the plains and low hills, but it ascends in Southern Scandinavia to 993 feet, in the Berne Oberland to 2530 feet, in the Tirol to 3160 feet, in the Jura to 2216 feet, and in the Pyrenees to 3300 feet.

It is, according to Max von Sivers,³ a much scarcer tree than it formerly was in the Baltic Provinces of Russia, and only exists in pure forests of any extent in Kurland, where it attains in river valleys and loamy soil very large dimensions, as much as 9 metres (about 30 feet) in girth. Some of the best trees produce logs free from branches over 60 feet long and 5 feet in girth at the top. He attributes its comparative scarcity at present to over-felling during the last two centuries, but states that replanting has been recently carried on to some extent.

Quercus sessiliflora occupies a more restricted area than the other species. Its northern limit is 60° 11' in Norway, 58° 30' in Sweden; it then passes through east Prussia, Lithuania, and crosses the central provinces of Russia, Minsk, Mohilev,

¹ C. Reid, *Origin of the British Flora*, 145 (1899).

² *Fenland, Past and Present*, chap. xv. (1878).

³ *Die Forstlichen Verhältnisse der Baltischen Provinzen*, 1903.

Tula, and Penza, to Sergievsk near the southern Ural, in lat. 54°. The eastern limit commencing here, extends southwards, taking in the Crimea and Cilicia in Asia Minor. The southern limit extends through Greece, southern Italy, Sardinia, Catalonia, and the northern provinces of Spain to Asturias.

As a wild tree it does not occur in low-lying plains and alluvial ground; but is met with on the hills and lower ranges of the great mountain chains of Europe. It ascends in Hanover to 1900 feet, in the Alps to 3900 feet, in the Carpathians to 3300 feet, and in the Pyrenees to 5300 feet. In all these localities it ascends considerably higher than the pedunculate oak, reaching, *e.g.*, in the Alps 1500 feet higher than that species. (A. H.)

PROPAGATION AND CULTURE

The oak produces acorns in great abundance in some seasons,¹ generally about one year in three; but this varies very much in different parts of the country; and, so far as I have noticed, fruit occurs oftener and more abundantly in the south and west of England. It begins to bear at a very early age in some cases; and I received, in 1906, a packet of acorns from Miss Woolward, which she assured me were taken from oaks only ten years old from seed. Mr. Emerton, the head gardener at Belton Park, Notts, where they grow, confirms this. In the same season I saw acorns on the Billy Wilkin's Oak, which must be 700 to 800 years old; and was told that the Cowthorpe Oak, which is possibly much older, still bore a few. Acorns are greedily eaten by all domestic animals, but are injurious to cattle if taken in very large quantities.² Pheasants and pigeons also consume a great many, and rooks are credited with dropping most of the acorns which so often spring up as seedlings in places far from their parent tree.

The raising of oaks from seed is so easy, and the plants obtained are, as a rule, so much superior to what one can buy, that no one who wishes to plant them should fail to try the experiment by selecting acorns from the best oaks in the neighbourhood. These ripen in October, and should be gathered from the ground as soon as they fall, as dry as possible. They will not keep if stored damp, and my own experience is that they make stronger growth the first year if sown as soon as gathered, because the radicle will then bury itself deep in the ground before winter, and the germination will take place earlier. But if it is desired to sow the acorns where the tree is to grow, they must be protected against mice, rooks, pheasants, and wood-pigeons, all of which are very fond of them. Red lead or paraffin is sometimes used, but the latter is liable to injure the acorn, and it is said that chopped furze placed over the acorn is the best means of protecting them against mice. They should be covered with at least an inch of soil, and, if dibbled, care must be taken that they do not fall in the hole end downwards, but lie on their side in their natural position.

In 1901 I made experiments on the growth of oaks from acorns produced by

¹ I saw a large oak on the lawn at Marks Hall, Essex, which produced no less than 31½ bushels of acorns in 1906.

² Mr. T. P. Price, of Marks Hall, told me that in 1904 ten bullocks died there from this cause.

many trees in different parts of England, in order to learn whether the size of the acorns and the vigour of the parent tree had much influence on their strength. I have now watched the growth of these young trees for six seasons, and have arrived at no definite conclusion, though I am much surprised by two facts which have become evident. Lord Ducie has an oak in his park which usually produces acorns of unusual size, some that he has weighed being only 36 to the pound. The plants from these were no stronger than those of normal acorns; and some of the very finest plants that I raised were produced by the small acorns of a very stunted grafted tree with variegated leaves, which I only sowed to see whether any variegation would appear in their leaves. I found, however, that on the average the acorns gathered on my own place on similar soil gave the best results, and that those from Hants and Kent did not produce such good seedlings as those from Nottinghamshire.

The shoot appears above ground about the time the oak comes into leaf, or rather sooner, and the first growth is completed in three weeks or a month. A second growth, corresponding to the summer shoots of the parent tree, is produced in July or August, and sometimes even a third shoot. If sown in a nursery-bed they will be 4 to 12 inches high at the end of the first season, and should be transplanted in the following spring before they are a year old. For if the tap root is not cut early it will become so long and strong in good soil that the transplantation is a severe check to the young tree.

When lined out in the nursery they must remain two years longer, in good soil kept clean, after which the best of them should be 2 to 3 feet high and fit to plant out permanently, except where the herbage is long and coarse. They are sometimes left three years, but this is too long, though, where the land they are to go to is good and not too heavy, liberties may be taken with oaks which could not be risked on poor soil. If not planted out at three years they should be transplanted once more in the nursery, and at five or six years old ought to be 4 or 5 feet high, whilst oaks sown *in situ* in land covered with herbage or weeds will at the same age often be not more than a foot high and much less strong. In the long run, however, those which have never been transplanted will probably pass the others when once they have established a good root system, which in poor soil is a very slow process. Transplanted oaks, if they do not come away with good straight leaders, are best cut down to the ground the second or third spring after they are planted, when their roots are sufficiently established to throw up a strong leader. Some say¹ that this should not be done until the beginning of June when the sap is running strongly, but experiments which I have made seem to prove that April or May is better. Mice are the worst enemies of young seedling oaks, and where they are numerous cause an immense deal of damage by barking and biting them off close to the ground.

¹ Hayes states, *Planting*, 160 (1794), that from long observation he can aver that the root of an oak never produces a growth of finer young wood than when the tree is felled about the first week in June, when the sap is flowing most freely, and refers to Marshall's *Minutes of Agriculture and Planting in the Midland Shires of England* for evidence in support of this opinion.

Billington's account of the immense losses which were caused by mice to the oaks sown in the Forest of Dean, which is quoted at length by Loudon, pp. 1805-7, shows that in places where mice are numerous it is more economical to plant than to sow; and I have on my own property failed to get anything like a good stand of young oaks by sowing, on account of the ravages of mice and rooks, though every precaution which experience could suggest was taken. I tried dibbling in wheat, and sowing in lines and patches, both on cultivated and uncultivated ground, and have only partial or complete failures to record. In better and lighter soils, and especially in woods of large size where rabbits are kept down, I have seen splendid results from self-sown acorns; and Mr. A. C. Forbes's prize essay on the natural reproduction of woods from seed, published in the *Transactions of the English Arboricultural Society*, v. 239, should be consulted, as well as Loudon's remarks on the same subject, pp. 1804-5.

Mr. Stafford Howard, C.B., who probably knows more about forestry and has done more to improve the management of the Royal Forests than any Commissioner who preceded him, except, perhaps, Lord Glenbervie, has sent me an excellent photograph of a grove of self-sown oaks on his property at Thornbury Castle, Gloucestershire, which has originated from acorns, self sown, in what used to be an osier bed, and which are now about thirty to forty years old. Plate 81 shows their present appearance. On December 29, 1904, Mr. Howard showed me this grove, of which about an acre, containing 139 trees, has been wired in and under-planted with beech at about 6 feet apart. Six trees have been measured and marked with the object of showing whether the future increase of the oaks will pay for the cost of under-planting. As I am not aware that this practice, which in Germany and France is considered good forestry, has ever been properly tested in England, I hope that the results of this experiment will be recorded.

The best illustration of the possibility of converting coppice with standards, into pure oak wood, was shown me in 1900 by Mr. A. C. Forbes in a wood called Derry Hill, on the property of the Marquess of Lansdowne, three miles from Chippenham. In this case the coppice was cut early in the winter, after a good crop of acorns, and completely cleared before the following May. The constant presence of workmen faggoting and cleaning the coppice, not only kept away pheasants and pigeons, but also buried a good many of the acorns; and the soil being suitable for oaks, their growth was so good in the next three years that by cutting away the shoots of the coppice wherever it crowded and overgrew the young oaks, a stand was obtained far thicker, cleaner, and more vigorous than I have ever seen from planted trees. If carefully attended to until the seedlings overtop and smother the remains of the underwood, and provided also the remaining standards are cut and removed before they damage the seedlings, I should expect this wood to become one of the best of its sort in England.¹

On the property of Dr. Watney, at Buckhold, Berks, I have also seen some

¹ On revisiting the place seven years later I found that the growth had not been so good as it promised to be, owing perhaps to the underwood being cut too hard, and the soil having become overgrown with grass.

admirable illustrations of the growth of young oaks from seed, and of the result of converting oak coppice wood into standards, by leaving all the best poles uncut, and carefully thinning out the weakest at intervals. This process, owing to the great fall in the value of oak bark, to the production of which large areas of oak coppice in the west and south-west of England were mainly devoted, has become very generally desirable; but if the stools are old, it is best to grub them, and replant the ground with seedlings mixed with other trees, as has been largely done on the estates of the Duke of Bedford near Tavistock.

With regard to the effect of transplanting oaks on their future growth and height, opinions differ as much as on any subject. The late Sir James Campbell, who managed Dean Forest for many years, often told me that the oftener you transplanted an oak the better it grew, and he communicated a paper with measurements of some trees in Dean Forest to the International Forestry Exhibition at Edinburgh in 1884 in proof of this; but Mr. Smith, who quotes and refers to these measurements in the paper on oaks above referred to, agrees with me that they do not prove the case; and Mr. Philip Baylis,¹ who succeeded Sir J. Campbell at Dean Forest, writes me as follows:—

“At one time I was of the opinion, founded on the above measurements, that trees were benefited by being transplanted, but have long ago given up that opinion. It is true that for a time after the tree has recovered from the shock of moving, you may, in consequence of the greater number of fibrous roots produced by the moving, get a stimulated growth; but I am convinced that the tree which eventually produces the finest timber tree is the one which is never moved from the place where the seed first germinated.”

In this opinion I entirely agree, and believe that though oaks, like other trees, may be drawn up to a considerable height when surrounded closely by other trees, especially the beech, yet that their straight upward growth largely depends on the depth to which the main roots can descend. I do not know that it has ever been proved at what age the tap root decays, and this no doubt depends very largely on the subsoil; but though one may see very large spreading oaks on a thin soil, I never saw a very tall and straight one except on deep land.

In an appendix to the First Report of the Commissioners of Woods and Forests, published as a blue-book in 1812, will be found (p. 143) some very interesting and valuable observations on the sowing and transplanting of oaks, in which instances are quoted from several places which go to show that oaks on some soils at least, as at Moccas Court, in Bere Forest, and in the Forest of Dean, will grow as fast or faster when transplanted at 8 to 10 feet high, or even more, than when sown *in situ*.

In another appendix to the same report, on page 141, are some further observations, made by men of great experience on the growth of oaks from the stool, which prove that when the stools are young and sound and the land good, sound oak trees of as much as 160 cubic feet may be so produced; but that when the stool has

¹ Mr. Baylis sends me a very interesting photograph showing the difference between the roots of transplanted and untransplanted oaks.

become old and partially decayed, or when the land is poor, such shoots are not likely to attain any size. The best example I know of an oak wood produced entirely from stools is one below the approach to Carclew in Cornwall, which the late Colonel Tremayne showed me in 1902. Here the trees average 15 to 20 feet apart, and have clean boles 25 to 30 feet high, and are about 4 feet in girth.

Marsham's opinion on the growth of oaks, taken from a paper printed in the *Philosophical Transactions*, are so much to the point, and his personal experience was spread over such a very long period (from 1719 to 1795) that I quote him as follows:¹—

“In 1719 I had about two acres sowed with acorns, and from 1729 to 1770 I planted oaks from this grove, always leaving the best plants standing for the future grove; but most of the transplanted trees are already larger than those that were not removed; the largest of which is now (1795) but 5 feet 6 inches 8 tenths in circumference; and the largest transplanted tree (which was planted in 1735) is 8 feet 8 inches 7 tenths, viz., near 38 inches gained by transplanting in 60 years. And in beeches from seed, in 1733, the largest is now (1795) but 6 feet 9 inches; and the largest transplanted beech is 7 feet 5 inches 1 tenth, viz., 8 inches larger, although the transplanted beech is eight years younger than that from the seed. This proves that it is better to plant a grove than to raise one from the seed. The expense of planting is inconsiderable, and the planted trees are full as good and handsome, and many years are saved, besides the extra growth of planted trees. But this extra growth will not prove near so great in groves as in single trees. The first grove I planted from these acorns of 1719, was in 1731. In 1732 I made another grove from them, and in 1735 I planted a third grove from them, and in 1753 the last considerable number of plants were taken from the grove, and these are very good trees: so thirty-four years may be saved. But I would by no means advise the planting trees so large, as the trouble and expense will be too much, unless where a shelter or screen is wanted.

“Whether a grove is to be raised from seeds or planted, it is advisable to shelter it round; if from the seed, with such sorts as will grow quicker; and if by planting, with larger and taller trees. The soil in Norfolk is unfavourable to elms; therefore in planting I will venture to recommend hornbeams, as they may be planted large trees. I planted some hornbeams (rather large) in 1757, and, disliking their situation, in 1792 I removed them when they were about three feet in circumference, and did not lose one tree; and they made shoots of near half a yard that year; but I ought to say I cut off their heads.

“Before I quit this subject, I will presume to recommend, if young oaks are unthriving, there is reason to hope they may be helped by cutting them down to a foot or six inches; for in 1750 I planted some oaks from my grove of 1719 into a poorer soil, and although they lived they were sickly; so in 1761 I cut most of them down to one foot, and then by cutting off the side shoots, in three or four years led them into a single stem, and most of them are now thriving and handsome trees, and you

¹ *Phil. Trans.* 1797, pp. 128-152.

can hardly see where they were cut off, and some are four feet round; and I have used the same method with unhealthy chestnuts, beech, hornbeam, and wych elm, and with the same success.”

RATE OF GROWTH

The rate of growth in the oak is principally governed by the soil and situation, and varies so much that any estimates of its possible increase are of little value unless based on local experience. We often read calculations of the profits of planting, drawn from Continental experience or from exceptionally favourable cases in England, which are very misleading and greatly in excess of reasonable expectations, and there is no tree to which these remarks apply more strongly than to the oak.

Few plantations give more ample proof of this than those made by the Government in the woods at Alice Holt, which were planted between 1810 and 1830, with the object of providing timber for the navy, and which were no doubt done by experienced planters. But the growth has been so poor that, when I visited them in 1905, in company with Mr. Stafford Howard and Mr. Lascelles, we saw but few oaks which looked as if they would ever be fine trees, and their average value was not much over 10s. per tree. In one place, called Willow Green, oaks of seventy years old were not over 30 or 40 feet high and not thick enough for gate-posts.¹

In many parts of the Forest of Dean the results are not much better, and are largely attributed to over-thinning, and to the fact of the ground being thrown open to grazing too soon; but the soil and spring frosts must also have had a good deal to do with it.

In the New Forest the results are better, but not at all equal to what might have been expected. I am indebted to Mr. Stafford Howard for the following information on some of these plantations and the way in which they were made:—

Planting in the New Forest.—In order to make provision for the future needs of the navy, in view of the fact that planting had been greatly neglected in the New Forest, an Act was passed, 9 & 10 Will. III., for that purpose. Under this Act it was provided that 2000 acres should forthwith be enclosed and planted with timber for the use of the navy only, underwood and all other produce being excluded; that 200 acres should be enclosed annually for twenty years following, and that as soon as any of the land thus enclosed was safe from damage from cattle, it should be thrown open and a like area enclosed in its stead. The plantations described were made under the powers of this Act.

The precise form of cultivation employed was as follows:—

“Pits or beds of three spits of ground each were dug a yard apart, and three acorns planted triangularly in each bed. Half a bushel of acorns was allotted for each person to plant in one day. Two regaders attended every day during

¹ Mr. Howard says that in the lower part of the Goose Green enclosure, and in the Straights, there is much better timber, and that in Dr. Schlich's report on these woods over 300 acres were classified as good, where the trees attain a mean height of 60 feet.

the time of planting to see that it was properly done; and after the ground was fully planted with acorns it was sown with haws, holly berries, sloes, and hazel nuts, drains were cut where necessary, and traps were set to catch mice, and persons attended daily to reset the traps and to keep off crows and other vermin."

Whether from subsequent neglect or not, the plantations thus formed were never thinned at all, but allowed to grow up like a nursery quarter. Although contrary to every theory of plantation management, it cannot be denied that they were in this bad soil successful in growing a heavy crop of oak timber on moderate land.

Denny Enclosure.—There are some very good examples of natural regeneration in places in this wood, which was reinclosed in 1870. A photograph was sent which contrasts the young growth inside the fence of the enclosure with the bareness of the outside where the cattle graze.

Salisbury Trench.—This plantation was made in or about the year 1700, and measures about 100 acres. It was thrown open under an order dated 20th August 1807. It is calculated that there are now left after frequent thinning about sixty trees to the acre. Two years ago it was reinclosed with a view to its gradual regeneration, and there is already a large number of young oak and beech coming up in the open spaces.

North and South Bentley.—These plantations were made about the same time, probably just before that of Salisbury Trench, and are of the same character, except that there is some beech here and there in North Bentley. During the past twenty years the trees felled in Salisbury Trench, being for the most part the poorest ones, have averaged $23\frac{1}{2}$ cubic feet; and there now remain about sixty to the acre. In North Bentley they have averaged about 25 cubic feet, in South Bentley 29 cubic feet, and about sixty trees to the acre remain standing.

One of the best private oak plantations of which the exact age is known is on the property of Lord Kesteven at Banthorpe, near Casewick, Lincolnshire. It was made by Sir John Trollope, grandfather of the present owner, in 1800, with acorns which had to be sown a second time, as they were eaten by mice in 1799. It is on good soil, and, as near as I could judge by the eye, contains about sixty trees to the acre, straight for the most part, and clean up to 30 to 40 feet. In 1905 twelve average trees in the plantation had an average timber length of 34 feet, an average quarter girth of 18 inches, and contained 903 cubic feet without tops or branches, which would make my rough estimate of 5000 feet to the acre very nearly correct, and if profit alone were considered I should say that these trees had now reached the proper age for felling.

The late Mr. John Clutton, who valued timber for the Crown for many years, gave,¹ in 1873, particulars of the size of oaks.

¹ *Transactions of the Surveyors' Institution*, 1873-74, vol. vi.

In New Forest, Aldridge Hill, planted 1813:—

	Number.	Contents.	Value.
1st acre	75	742	£90
2nd „	79	559	67
3rd „	77	641	78
4th „	72	683	84

In Alice Holt Woods:—

Lodge Enclosure	40	837	100
Goose Green	50	812	97
Berewoods, planted 1816	54	771	93
„ „ „	70	618	74

In Dean Forest:—

Blakeney Hill, South, planted 1814	72	720	87
Nag's Head Plantation „ „	97	425	57
Bromley Hill Plantation „ 1812	67	700	84
High Meadow Woods (no date stated), 1st acre	30	1528	214
High Meadow Woods (no date stated), 2nd acre	50	1480	207

In Richmond Park:—

Upper Pond, planted 1824	60	672	81
Kingston Hill, „ 1826	46	628	75
Isabella, „ 1831	68	450	54
Isabella, „ 1845	110	406	49

In the same volume Mr. Ralph Clutton, in an excellent paper on the self-sown oak woods of Sussex, gives many exact details of the growth of oak without underwood, with measurements and valuations, which should be consulted by all landowners in that part of England.

Under more favourable circumstances, however, oak plantations may yield a good profit, as shown by the following extract from the *Norfolk Chronicle*, sent me by Sir Hugh Beevor, and printed in Grigor's *Eastern Arboretum*, p. 360.

“Being enabled from old memoranda of undoubted authority, and from information received several years ago from different persons, who remembered or who assisted in the work, to give you, perhaps, an unusually accurate account of the produce of a piece of land measuring eight acres, planted with acorns in the year 1729, I take the liberty of so doing, and of requesting your insertion of it in your paper whenever you may have the best opportunity. The piece was under the plough at that time, cold and unprofitable, from the practice of underdraining not being then introduced; at Michaelmas 1729 it was sown with wheat, and acorns dibbled in; when reaped, the stubble was left very long, which is supposed to have caused the plants to run up very straight.

“ Besides a great many used on the ground, from 1729 to 1763, plants were drawn out and sold to the amount of . . . £100 0 0

In the year 1764 by 1500 poles sold	50 0 0
„ 1765 by 1374 „	50 0 0
„ 1767 by 468 „	30 0 0
„ 1770 by 501 „	39 18 0
„ 1771 by 440 „	21 0 0
„ 1777 by 280 „	21 0 0
„ 1781 by 150 „	80 0 0
„ 1793 by 101 „	21 0 0
„ 1794 by 150 „	105 0 0
„ 1797 by 30 trees sold	20 0 0
„ 1799 by 100 „	60 0 0
From the year 1800 to 1810 by 307 trees sold	389 12 0
„ 1811 to the year 1821 by 94 „	219 0 0
„ 1821 „ 1833 by 36 „	108 0 0

£1314 10 0

The underwood never came to perfection, but was stubbed up in the year 1767, and the feed of the ground let for 10s. an acre for thirty years . . . 120 0 0

Value of the feed at the same price to the present time 144 0 0

There are now 320 trees standing, worth if now felled 1200 0 0

£2778 10 0

“ The expenses of felling cannot be now correctly ascertained, but the topwood is not included in the above account of receipts, nor a great many trees which have been used on the premises from the year 1763 to the present time, and at a moderate estimate must have much more than paid for the expenses of the labour.—TIIOS. HOWES, Morningthorpe, April 22nd, 1834.”¹

The Earl of Darnley showed me an oak in “Mount Meadow,” near Cobham, planted by Lady Elizabeth Brownlow, who was born in the year 1800, which therefore could not be much over 100 years old. It has a straight clean bole measuring about 40 feet by 12 feet 10 inches, and a small spreading top.

The following extract from a letter of Robert Marsham to Gilbert White is worth quoting, though I could not identify the tree when I visited the place recently.

“Stratton, 24th July 1790.—I early began planting, and an oake which I

¹ Sir Hugh Bevor in 1902 measured eleven of the oaks remaining in this grove, which was nearly all felled in 1885, and found that they averaged 80 to 90 feet high by 8 feet 2 inches in girth at 6 feet, the cubic contents being about 145 feet each.

planted in 1720 is at one foot from the earth 12 feet 6 inches round, and at 14 feet (the half of the timber length) is 8 feet 2 inches. So measuring the bark as timber gives 116½ feet buyer’s measure. Perhaps you never heard of a larger oak, and the planter living. I flatter myself that I increased the growth by washing the stem, and digging a circle as far as I supposed the roots to extend, and spreading sawdust, etc., as related in the *Phil. Trans.* vol. lxvii. p. 12.”

Blenkam¹ mentions a remarkable instance of rapid growth:—“Three thriving oaks, growing on a hard gravelly and poor soil, were felled in Nottinghamshire, which on an average girthed 15 feet at three feet from the ground, and each tree contained about 430 cubic feet. The trees were planted in 1692 or 1693, and were about 149 years old when felled. They were perfectly sound and yearly increasing in size.”

In a paper by Mr. Clayton² a photograph is given of a section across the butt of an oak felled at Ravenfield Park between Doncaster and Sheffield in 1885, which had a butt 36 feet long without a branch, and an average diameter of 5 feet, and which showed only 212 annual rings on a radius of 27¾ inches. If the actual age of this tree was only 212 years, its growth must have been unusually rapid, and a comparison of this with the section of the oak from Wistman’s Wood (cf. p. 326) shows how remarkably the growth of trees depends on their situation.

As an illustration of the possible value of a hardwood plantation about forty acres in area in the Sherwood Forest district, I am able to give the following particulars, for which Mr. Doig, forester to Earl Manvers is my authority. In White’s *History of Sherwood Forest* the land in question is called “Robert Fitzorth’s land.” It now goes by the name of Osland. It had been in cultivation previous to 1730, about which time it was planted, or perhaps sown, with beech, oak, ash, chestnut, larch, and spruce. The conifers had mostly been cut previous to 1846, before which time there are no records of the value of the thinnings taken from it. Since then the following have been cut or blown down:—

	Number.	Cubic Contents.	Value.
Oak	1801	38,735	£3,732 2 9
Oak poles	1628	8,696	371 5 1
Beech	2054	74,213	3,756 0 8
Ash, elm, etc.	63	2,215	123 2 5
Chestnut	43	1,289	102 4 4
Larch and spruce	117	660	26 9 1
	5706	125,808	£8,111 4 4
Standing in 1903:—			
Oak	182	18,200	1,820 0 0
Beech	701	63,090	3,154 10 0
Chestnut	14	1,336	88 10 0
Larch	5	400	23 6 8
Total	6608	208,834	£13,197 11 0

¹ *British Timber Trees*, 42 (1862).

² *Trans. Bot. Soc. Edin.* xxii. 396.

This shows an average number of trees per acre (omitting the oak poles) of about 125, and a value of £320 per acre.

Perhaps the greatest increase of girth on record in the oak is cited by Gadeau de Kerville¹ of three oaks which were felled at Neauphe-sur-Dives (Orne) in Normandy in 1894. Their exact age was not possible to decide, as they were already trimmed and barked and part of the sapwood taken off, but the rings counted by M. de Kerville were 115 to 120, and the girths 6.16, 4.98, and 4.28 metres respectively. He thought that they might be from 150 to 200 years at most, and this would make the average annual increase of the largest, on the section measured, over 5 centimetres per annum.

REMARKABLE TREES

The mass of information on the oak which exists in English literature, is so great, so scattered, and often so impossible to verify, that I have had great difficulty in making a selection of what is really valuable and authentic, and have preferred rather to speak of trees and woods that we have seen ourselves, and to quote from the letters of living correspondents, than to repeat what has been written by Evelyn, Hunter, Strutt, Selby, Loudon, and other writers, whose works can always be consulted by those desirous of more detailed particulars than our space will allow.

Some of the most wonderful oaks of England, which we have seen and now figure, must be described more particularly, and among these I think the oaks of Powis Castle come first. Robert Marsham, in a letter communicated by Sir T. Beever to the *Bath and West of England Societies' Transactions*, i. 78 (1783), says:—"The handsomest oak I ever saw was in the Earl of Powis' noble park by Ludlow in 1757, though it was but 16 feet 3 inches. But it ran straight and clear of arms, I believe, near full 60 feet, and had a large and fine head."

In April 1904 the Earl of Powis showed me some trees growing in his ancient park at Powis Castle, near Welshpool, Montgomeryshire, which I believe to be actually the champion oaks of Great Britain at the present time. They grow on a Silurian formation at about 300 to 400 feet elevation, with an east aspect, and are, as far as one can judge, perfectly sound in the butt, though one of them lost several branches during the dry seasons between 1893 and 1903, and another has a large decayed limb which, if not taken off, may cause the butt to decay.

The measurements which I give were made most carefully by Mr. W. F. Addie, agent for the Powis estates, who used a long ladder and a man to climb nearly all over them and take the length and girth of the principal branches down to 6 inches quarter-girth. I checked the height and girth of the trunks myself as carefully as possible, and believe that the following is a very accurate estimate.

¹ *Les vieux arbres de la Normandie*, iii. 373 (1895).

	Girth at Ground.		Height of Bole.	Girth at 4 Feet 6 inches.		Height of Tree.	Cubic Contents.
	Feet.	Inches.	Feet.	Feet.	Inches.	Feet.	Feet.
No. 1. The Champion Tree, by middle gate (Plate 82) ¹	31	7	25	23	6	105	2026
No. 2. Near the Park Plain (Plate 83) ¹ The girth of this tree at the top of the trunk, where the tall straight branches begin is 38 feet 3 inches.	40	0	12	29	7	95	1925
No. 3. By Pochfield gate (Plate 84) ²	32		20	22	6	95	1617
No. 4. In Gwen Morgan Wood	30		31	19	4	93	1432

Of the extraordinary size to which oaks have attained in this district we have a record which is without parallel in this or any country. My attention was called to it by the Earl of Powis, who, knowing the locality, believes it to be true. It is taken from a work called *Collections Relating to Montgomeryshire*, xiii. 424-425 (1880), published by the Powysland Club at Welshpool, and runs as follows:—

"In 1793 and 1796 a large fall of oak timber took place at Vaynor park in the parish of Berriew, when some trees of enormous dimensions were cut down. Major Corbett Winder has kindly favoured us with a copy of the following memorandum of the particulars of the contents of some of the largest trees:—

"Dimensions of twenty-six of the largest oaks cut down in Vaynor Park in 1793 and 1796.

No. of Tree.	Feet.	No. of Tree.	Feet.	No. of Tree.	Feet.
1.	1127	10.	1523	19.	1516
2.	1121	11.	1859	20.	1428
3.	2501	12.	1328	21.	1298
4.	2202	13.	1808	22.	1077
5.	1713	14.	1793	23.	1161
6.	1106	15.	1289	24.	1018
7.	1453	16.	1101	25.	1170
8.	1953	17.	1467	26.	1322
9.	1192	18.	1246		

Total: 37,772 cubic feet, averaging 1452½ cubic feet per tree."

The counties of Hereford, Worcester, Shropshire, and Stafford have produced and perhaps still contain the largest oaks in England, next to those I have just mentioned, but the long years of agricultural depression which have impoverished so many of the squires of England, have caused the felling of many of the finest. Among these the most celebrated was the Hereford Monarch which grew at Tyberton, near the house of Chandos Lee Warner, Esq., to whom I am indebted for two copies of a print taken from drawings which were made by G. L. Lewis, and published in a scarce work called *Portraits of British Forest Trees*.³ One of

¹ The photographs from which these plates are reproduced were taken in June 1904 by Mr. R. G. Foster of Burlord.

² This plate is from a photograph taken in 1906 by Lord Powis.

³ Vale, Hereford, 1837.

these shows the tree in summer, the other in winter, and prove it to have been a tree of faultless shape and beauty, if not quite equal in bulk to the Champion Oak at Powis Castle. I visited the site of this tree in 1905, but the stump was no longer visible, and the soil, though a good deep red loam, did not show in the other trees any striking evidence of unusual fertility.

Its measurements, as given me by Messrs. Openshaw of Woofferton Court, to whom I am indebted for many particulars about trees in their district, were as follows:—

Butt	30 feet by 55½ inches quarter-girth	}	923 feet.	
Second length .	60 " " 26 " "			
One branch .	18 " " 42 " "			220 "
Other branches more or less damaged by lightning, about .	400 "			
			<u>1543 feet.</u>	

A record of the tree was sent me by Messrs. Stooke and Sons of Palace Yard, Hereford, as follows:—"The Hereford Monarch.—An Oak tree, containing 1200 cubic feet, felled in Tyberton Park, ten miles from Hereford, April 1877. Length of tree, cut off at 18 inches diameter, 88 feet. Length of butt only 29½ feet. Height of tree when growing 130 feet. Circumference at 5 feet from the ground 22 feet 8 inches. Photograph taken of tree as felled, and showing the larger bough as shattered by lightning. Purchased by Messrs. R. and T. Groom and Sons, Wellington, Salop."

Mr. T. E. Groom of Hereford, whose firm bought it, informed me that though the tree would have been worth about £300 before it was struck, it did not actually cost them more than £200. It was felled in consequence of its having been disfigured by a stroke of lightning. Before this it was a perfectly sound tree with over 1500 feet of timber in it. It was still growing and might have become much larger. The butt was quartered and sold to a vat maker who cut it all into thin rims. At the end of the 30 feet of butt were two parallel spires each containing several hundred feet. The larger one was so much broken that it had but little useful timber left in it. The smaller was 60 feet long and about 2 feet in diameter at the top end. This was cut up into railway planking. The tree also made several thousand keys and trenails used on the railway.

Another immense tree was felled in Staffordshire on May 29, 1786, of which Messrs. Openshaw give me the following particulars:—"It grew in the middle of the Grove field on Bath farm, Chillington estate, and measured as follows:—

Butt, 30 feet by 60 inches = 750 feet at 5s.	£187 10 0
Limbs (22), 560 at 1s. 8d.	46 13 4
Thirteen cords of wood at 10s. 6d.	7 7 0
The root	2 10 0
2½ tons bark	8 8 0
	<u>£252 8 4</u>

"No branches under 9 inches quarter-girth were included in the above. Twelve men worked twelve hours each in felling this tree."

One of the tallest oaks which I have ever measured in England is a comparatively young tree in perfect health and vigour, which, though not shut in by other trees, appears to be still growing, and may even attain a greater height. It stands on the edge of a plantation at the bottom of a steep slope facing north-east in Whitfield Park, Herefordshire, the seat of Capt. Percy Clive, who showed it me in 1906. A careful measurement from both sides made it 130 feet high, or perhaps a little more, by 11 feet 10 inches in girth, with a straight bole of 55 feet free from branches, though two or three small ones had been cut off four years ago. For symmetry and height combined I have not seen its equal in England, and the photograph of it taken by Mr. Foster, though under the circumstances a very good one, fails to give a correct idea of its great height (Plate 85). The soil is old red sandstone, and the tree is of the sessile type.

At Foxley, near Hereford, the seat of the Rev. G. H. Davenport, are many fine oaks, all of which, so far as I saw, are sessile. The best is about 104 feet high by 20 feet girth, with a bole of 20 feet. In the Nash Wood there is a superb lot of young oaks with the tallest and cleanest stems in proportion to their thickness I have seen in England. They may average 90 feet high, and one which I measured was clean and straight to 62 feet and only 3 feet 4 inches in girth. Mr. Davenport believes them to be sixty to seventy years old, and if well taken care of they should in a hundred years be some of the finest of their type in England.

The largest oaks now standing in Herefordshire that I know of are at Holm Lacy, one of which, a short-boled spreading tree now much decayed, was in 1905 75 feet by 30 feet 2 inches, and 125 yards in circumference of the branches. The other, 90 to 95 feet high, with a bole 25 feet by 23 feet 9 inches, is vigorous and healthy, though perhaps not quite sound.

In Lord Leigh's park at Stoneleigh Abbey, Warwickshire, are many fine old oaks, relics of the Forest of Arden, which grow on a red sandstone soil, and are in many cases long past their prime. The largest stands near the Abbey, and is 28 feet 3 inches in girth; though the top is much broken and decayed, the butt seems sound. Another, just outside the Tantarra Lodge, is a vigorous tree of later date, and measures 22 feet 10 inches in girth, with a fine spreading crown; a third, near the river, is 27 feet 5 inches in girth. The most interesting, however—of which I hope to give an illustration later—is Shakespeare's Oak, so called from the tradition that Shakespeare used to sit and write under it. It grows on the top of a low sandstone cliff, over which at least half the thickness of its trunk projects, and is supported entirely by the roots on the other side to which it leans; it measures no less than 25 feet in girth, and though deeply cleft on one side and hollow, has vigorous branches.

The oak grove at Kyre Park, Worcestershire, the property of Mrs. Baldwin Childe, was first noticed by the Woolhope Club, who visited it in 1893, and described later by Sir Hugh Beevor, who published a short account of it.¹ I had the pleasure of visiting this wonderful grove in March 1904, when some

¹ *Trans. of the English Arboricultural Society*, v. 473.

photographs were taken (Plates 86 and 87), which give a good idea of the remarkable size and height of the trees. The soil is a good deep loam on the red sandstone formation. The grove is unfenced and has been open to cattle for many years, and there is no visible evidence of the trees having been drawn up by beech. The majority of them are of the sessile variety, though some are pedunculate oaks, as proved by specimens kindly sent me by Mrs. Baldwyn Childe and by the observation of her very obliging agent, Mr. J. W. Openshaw, who found six trees of the pedunculate to about twenty-four of the sessile form. Sir Hugh Beavor speaks of them as sessile, and at the time I was there it was difficult to distinguish one from the other. As to their age, Mr. Openshaw writes that he could not count the rings because they were so minute, but from the evidence of Habingdon's *History of Worcestershire*, written in the time of Queen Elizabeth, they must be very old. Habingdon says:—"The Parcke of Cure Wyard is not to be shutt up in silence, for it is adorned with so many tall and mightie oakes as scarce any ground in England within that quantity of akers can shoue so many." Most of these trees do not show decay in their tops like so many of our great park oaks, and may thrive for centuries to come.

Sir Hugh Beavor's measurements of their height agree very fairly with my own, but exact measurements of the heights of such trees are difficult to obtain, and they are not so remarkable for their girth as for the way in which they run up with clean stems to a great height. The two tallest are certainly over 130 feet by my own measurements in 1907. Sir Hugh Beavor gives 78 and 79 feet as the first length of two, and one which was blown down in 1897 was 82 feet to the first limb, though only 16 inches in quarter-girth, and with no measurable tops. These trees show very few burrs, but some have large buttresses at the base.¹ The largest, according to Mr. Openshaw, has a stem 83 feet long by 17 feet 8 inches in girth at 5 feet, and contains 1031 cubic feet of timber. Fourteen of them contain over 600 feet, and the smallest tree in the grove has 97 feet, which is considered a big oak in many districts. The tree I have figured (Plate 86), with Kyre House in the background, is on the outside of the grove, and of different type from most of them. It is the third largest tree in contents, having 694 cubic feet in the butt and 150 cubic feet in the tops. I made it 115 feet high by 18 feet 6 inches at 5 feet, and it looks vigorous and is growing fast. The other tree figured (Plate 87) is 85 feet to the first limb, 13 feet 6 inches in girth at 5 feet, and contains 604 feet in the butt, and 112 in the tops. The measurements given below, taken by Mr. Openshaw, may be thoroughly relied on. They were taken in the usual way by strap, and good allowance made for taper. The heights were taken with the help of a long pole; and both Mr. Openshaw and his father, who has probably as much experience in measuring big oaks for sale as anyone in England, are confident that the grove contains more than they have estimated, though no doubt a quantity of the timber would be broken in falling if cut. Of this, however, there is not the least risk in the lifetime of the present owner, who is much interested in, and very proud of her trees.

¹ One of these measures no less than 44 feet round the base, and at five feet from the ground is 20 feet in girth.

"*Kyre Park*.—Measure of oak trees in Woodpatch grove made by John W. Openshaw, November 1904. The tape girths are over bark taken at 5 feet. The quarter-girth is the middle of first length taken under bark. Eleven trees removed (1883, 1887, 1897) contained 2990 feet, average 272 feet. Ninety-seven trees now standing contain 38,365 feet, growing on 5 acres, 2 roods, 19 poles of land; an average of 395 $\frac{2}{3}$ feet per tree. A hundred and eight trees contained 41,365 cubic feet, an average of 383 feet per tree. There remain distinct traces of sixty and indistinct traces of ten trees having been removed, including the eleven referred to above."

Number (in Mr. Openshaw's Table).	Girth at 5 Feet High.		Length of Stem.	Quarter-Girth.	Contents.		Total Content of Tree.	Remarks.
					Trunk.	Tops.		
No.	Feet.	Inches.	Feet.	Inches.	Feet.	Feet.	Feet.	
10	21	6	65	54	644	129	773	Very large spurs at base.
13	15	0	61	40	538	83	621	
16	17	6	49	45	447	156	603	Blown down, 1904. Forks.
23	19	6	72	30	450	200	650	
25	17	0	28	45	393	258	651	Forks. Tree in group.
57	18	0	73	45	421	249	670	
60	13	6	85	32	604	112	716	Tree in group.
62	17	5	60	40	666	224	890	
63	19	6	45	46	447	184	631	Single tree in photo., facing Kyre House.
72	15	9	88	42	573	60	633	
78	15	2	62	36	558	145	703	Leans, large top.
79	18	9	75	50	694	150	844	
81	16	6	69	41	532	160	692	Ivy growing, largest tree. By holly tree.
82	14	0	82	35	522	110	632	
91	17	8	83	47	851	180	1031	
97	14	5	95	34	633	100	733	
							11,473	

There is an oak of remarkable size in another part of the Kyre estate called the Hannings, growing on high ground exposed to the north, in a rough pasture overgrown with trees, which no doubt have drawn it up in youth. It is 113 feet in total height, with a trunk nearly straight to about 90 feet high, where the head begins, and 15 feet 10 inches in girth. Mr. Openshaw and I estimated its contents as follows:—

1st length 18 feet by 48 inches = 288 feet.
 2nd ,, 20 ,, 40 ,, = 222 ,,
 3rd ,, 50 ,, 24 ,, = 200 ,,

710 feet.

£100 was refused for this tree a few years ago.

There is also in the deer park a circle with a diameter of fifty yards formed by ten (formerly twelve) oaks of great age and very spreading in habit, and a very

ancient oak near by, called the Gibbet Oak, on which tradition says that criminals were formerly hung in chains.

Of the difficulty and risk of removing some of these immense trees when steam traction engines were not in use by timber merchants, Mr. Openshaw gave me an excellent instance which he actually saw himself. A very large oak was felled in a field near Woofferton and sold to a naval timber buyer at Exeter. It was so long and heavy that two of the largest timber carriages were fastened together, and 28 horses brought to get it away. In rolling it up on to the carriage one of the chains got round a horse's leg, but they dared not stop to clear it, and the horse was killed. Mr. Openshaw saw the carriage coming down the road with the log on it, and, believing that it could not pass through the turnpike gate, warned the woman who kept it, to get out of the house, as if the log touched it the house would certainly come down. The man in charge of the team, however, ran on in front and steered the leaders so accurately through the gate that, with an inch to spare, it got past in safety.

It seems probable that many of the great oaks in England which are now decayed, owe their lives to the cost and risk of converting and removing them in the days when there were no railways, and good roads were scarce or absent.

The Nunupton Oak.—The remains of a very large fallen oak, not, however, so big as the one at Croft Castle, is described in the *Transactions of the Woolhope Naturalists' Field Club*, 1870, p. 307. It had long been hollow, and was large enough to contain forty-two sheep at once. It was alive and covered with leaves up till about 1851, when it was set on fire by accident, and was felled soon afterwards, with what object I do not know. In 1870 it was 60 feet long and 26 feet 8 inches in girth, and was still lying in much the same condition when I visited it in 1904.

According to the late Mr. Edwin Lees, whose knowledge of the botany of Worcestershire was very accurate, and whose sketches of old trees, some of which I have, through the kindness of his widow, been allowed to copy, the finest old oak in the county known to him in 1867 stood in a field near the Severn, below Holt, and was known as the Boar Stag Oak. It measured about 34 feet in girth at 3 feet from the base, and might be roughly calculated at 800 years old.

Other remarkable oaks in Worcestershire were described and figured by W. G. Smith, in the *Gardeners' Chronicle*, 1873, p. 1497. They grew in the Lug Meadows, near Moreton, and were known as Adam and Eve. When the Shrewsbury and Hereford Railway was made, Eve, which measured 25 feet in girth, and was quite hollow, was converted by the navvies into a residence: the top was thatched in, a brick fireplace built, and a door fitted, and for months after the line was opened this tree was the only residence of the stationmaster, and was afterwards converted into a lamp-room and so used for fourteen years.

The finest oaks that I know of in Somersetshire are at Nettlecombe Court, the seat of Sir Walter Trevelyan, Bart. When staying at Dunster Castle, in March 1904, Mr. Luttrell was good enough to give me an opportunity of seeing them. He told me that at a previous time, which, from the information received from the agents for the property, I gather to have been about 1847, but Mr. Luttrell thinks it was

earlier, £40,000 was offered for about forty acres of oak timber on this property; and an old man at Nettlecombe said that the tools were actually brought to the place ready to fell them, when the owner changed his mind and they were allowed to stand. A considerable part of these oaks have been since felled, but a magnificent grove still remains on the slopes of a combe, at an elevation of five to six hundred feet on the south-west side of Nettlecombe Park, facing to the north and east, and on a soil locally called "shiletty," which is a reddish rocky formation, overlaid by a thin layer of rubbly stone, probably old red sandstone, which would appear too thin and dry to produce big oak timber. The age of these trees, so far as I could judge by counting the rings of one which had been blown down, is not more than 200 to 250 years, but some may possibly be much older.¹ The majority are very clean and free from limbs to from 40 to 60 feet up, and average 10 to 12 feet in girth. One, about 210 years old and over 100 feet long, was 3 feet in diameter at the butt, and had fifty annual rings in a radius of 9 inches near the heart, but outside of this the growth had been much slower. I had not time to measure them carefully, or estimate the number now standing on an acre; but two of the finest trees on the steep banks of the combe were 116 by 14 feet, with a bole 65 feet long; another was 116 by 16 feet, with a bole of 50 feet by 36 inches quarter-girth. The thickest trees, which I did not measure, are on the outside of the grove. Assuming the price of £1000 per acre to have been based on 4s. per foot for the butts, which for trees of this size and character would, sixty years ago, have been about the value, and the trees to have averaged 200 cubic feet, there would have been perhaps forty trees to the acre, averaging £25 each, and though the cubic contents do not come up to what we are told is produced in some of the picked areas of oak forest in France and Germany, I have never heard of an actual sale of any timber in England at so high a price.

At Hazlegrove, Somersetshire, the property of the Rev. A. St. John Mildmay, is a remarkably fine oak, reported to be the largest in the county. It is about 75 feet high by 29 feet 9 inches at 5 feet from the ground, and at ground level spreads out to no less than about 18 yards in circumference. Though it seems sound, yet it has a rent on the north-east side, as though struck by lightning, and many of the largest limbs have been broken by wind, and are mended with lead. A drawing of it, made in 1833 when it seems to have been in full vigour, is in Hazlegrove House.

In Melbury Park, Dorsetshire, the seat of the Earl of Ilchester, there is an extraordinary oak, known as Billy Wilkin's Oak (Plate 88), which swells into an immense burry trunk, 38 feet in girth at the ground, and 35 feet at 5 feet up. Above this it falls away a good deal, and is only about 50 feet high. Like all the trees I have seen of this type, of which perhaps it is the largest in England, it is of the pedunculate variety, and bears acorns abundantly.

At Longleat, Wilts, which has a most beautifully timbered park, and is one of the finest places in England, there is an extremely fine tall oak growing in the

¹ The Rev. Mr. Hancock, who is a connection of the Trevelyans of Nettlecombe, says that he has always heard that they were planted about 1600, when part of the existing house was built.

grove of limes which I shall describe later, in a position which makes it difficult to photograph. This tree measures about 100 feet high by 23 feet in girth, and has a fine clean bole of 40 feet. It contains, according to Mr. A. C. Forbes's estimate, about 950 feet of timber.

The finest oak I have seen in Devonshire is in the park of the Hon. Mark Rolle at Bicton, a place long celebrated for its arboretum and for its avenue of Araucarias, which I have elsewhere described. It measures about 78 feet high by 24 feet 8 inches girth at 3 feet, and has a spread of branches of 103 feet in diameter. There are some fine but not extraordinary oaks at Powderham Castle and at Poltimore in the same county.

Near Mottisfont Abbey, Hants, there is a very thick but short pollard oak on the banks of the Test, of which a photograph, by Mr. J. Bailey, Southampton, has been kindly sent me by Mrs. Meinertzhagen, who long resided at Mottisfont. It measures 32 feet in girth and spreads considerably, and, though evidently of very great age, is full of healthy foliage. It must have been frequently flooded, as it stands close to the river.

Near Bramley, Hants, by the road leading to "The Vine," is an oak, which Henry measured in 1905, 100 feet by 22 feet, and which seems quite sound. There are, so far as I know, no oaks now living in the New Forest which are remarkable for their size as compared with the trees I have mentioned.

Of the historical parks of England I know none which contains so many fine oaks as Bagot's Park, near Rugeley, Staffordshire. This must be one of the oldest parks in England, for though Lord Bagot cannot tell me the exact date of its enclosure, he states that it belonged to his family long before 1367, and that in the "Peregrinations of Dr. Boarde, *temp.* Henry VIII.," printed at the end of Hearne's *Benedictus Abba*, p. 795, "Baggotte's Park" is mentioned in the list of Staffordshire parks. It is generally said to contain 1500 acres within the pale, but varies from time to time, as land has been added in some places and taken out in others for planting, to be again restored when the woods are grown.

This practice seems to be well worthy of more general adoption, for no one who is acquainted with the condition of the trees in many of our oldest parks can have failed to notice, that they are as a rule going back; and as trees cannot be successfully raised to a great height if deer are not excluded—unless enclosures of considerable size are made about once in a generation, in which trees can be properly drawn up to a sufficient height, before they are thinned and the deer admitted—the time must come, and in some cases already has come, when nothing but wrecks are left, and the singly planted trees, though protected by iron or wooden guards at great cost, are a mere mockery of their predecessors.

The soil in Bagot's Park is poor and cold, being a moist gravelly loam upon a clay or marl bottom, and Lord Bagot says it is not worth 10s. per acre at the present time. It affords, however, an excellent proof of the fact that land which is not valuable from an agricultural point of view, may often be of great value for planting. The woods extend over many hundred acres and consist almost wholly of oak, mostly, I believe, of the pedunculate variety. Many of the trees are of great age, being mentioned by Dr. Plot in 1686 as full-grown timber.

I visited it in March 1904, and, though the weather was dull, Mr. Foster was able to secure some excellent photographs, of which I reproduce the following:—

Plate 89 represents the Beggar's Oak, which has been well figured by Strutt in his plate No. 2, and though eighty years have elapsed since that picture was taken, a comparison with my plate shows that very little change has taken place in the tree—thanks to the care with which it has been treated by successive owners, who have worthily kept up the spirit described by Strutt in his account of this tree. It now measures, as nearly as I could estimate, 62 feet high, with a bole of about 33 feet long, and a girth of 24 feet. The roots measure 25 paces round, and the branches cover an area of 114 paces round (according to Lord Bagot's measurement 7850 square feet). It is one of the finest and best-preserved oaks of its type that I know, for though the Major Oak in Sherwood Forest (Plate 95) is bigger, it is not nearly so sound; and the Bourton Oak (Plate 93), which is taller and in better condition, is not so large in girth or so spreading at the base.

Another very fine tree in this park is the Squitch Bank Oak, also figured by Strutt (Plate 34), who gives its measurements as follows:—height, 61 feet; girth, 21 feet 9 inches; contents, 1012 feet. When I saw it in 1905 its top was dead, and the butt seemed to be decaying at the base internally. I measured it as about 60 feet by 24 feet 10 inches, so that it has increased three feet in girth in eighty years. The Beggar's Oak, in the same time, has increased rather more, but in measuring the girth of such trees as this a few inches higher or lower will often make a great difference, and therefore these rates of increase cannot be considered exact.

Other great trees in this park mentioned by Strutt were the Rakeswood Oak, the Long Coppice Oak, and the twisted oak on the Squitch Bank, which, though I did not see them, still survive. In the Horsepool grove are a number of younger but very tall and straight trees, which have been grown close together, and which Lord Bagot's old woodman, W. Jackson (now dead), said he "could remember so thick that you could hardly swing an axe amongst them." Of these, one, which was called Lord Bagot's Walking-Stick, is the straightest and cleanest oak I ever saw in England, though recently struck by lightning; another was 95 feet by 8 feet 6 inches, with a clean stem 65 feet high. On the other side of the park, at the west end of the grove called the Cliffs, are a number of splendid trees of great size. Two of them, standing near each other, are figured in Plate 90. Of these, the one in the foreground measures about 112 feet by 16 feet 8 inches, with a bole 35 feet high and four great erect limbs. The other, about the same height and a foot less in girth, has a clean bole 45 feet high. One hundred pounds was offered and refused for it. In the same grove, farther east, is an oak with a bole about 40 feet by 15 feet 3 inches, twisted from right to left, and another called the King Oak, which, though now partly hollow, has been perhaps the finest timber oak in the park (Plate 91). It is now about 100 feet high, but has been taller, as the topmost branches are dead, with a straight clean bole 21 feet 3 inches in girth, and must have contained over 1000 feet of timber. It is stated¹ that in 1812 £200 was offered for the first length of this tree, estimated at 12s. per foot, and £93 for the

¹ *Gard. Chron.* xvi. 230 (1881).

remainder, including the bark, estimated at £14 per ton. Near it is a tree of great height, leaning at an angle of about one in four to one side, though quite firm in the ground; and it seemed to me that all the trees in this grove owed their great height and clean stems to their having been drawn up by beech trees, many of which are now dead or dying. Close to the Park Lodge are three very curious and picturesque old trees, one of which is called the Venison Oak, because King John is supposed to have dined under it; another, which we christened the Beer-barrel, is an immense burry shell 10 or 12 feet high and 28 feet round, with hardly any branches; a third we called Gouty Toes, because of a huge swollen root, like a gouty foot, on one side of it.

Dr. Plot, in his *Natural History of Staffordshire*, p. 213, after speaking of different species of trees growing together, among which were an oak and an ash near Chartley, hollies and oaks at Bagot's Park, and an oak and thorn at Drayton Basset, goes on to speak of trees "that grow so conjoynd that they seem (after the manner of some sort of animals) to prey upon one another," and says: "But the most signal example of this kind is the large fair birch, about the bigness of one's thigh, that grows on the bole of an oak in the lane leading south from Adbaston Church, which has sent down its roots in six branches perpendicularly through the whole length of its trunk and fastened them in the ground, which might be seen in a hole cut in the bottom of the oak; having eaten out the bowells of the old tree (as all the rest will doe) that first gave it life and then support. All which are occasioned, no doubt, by the seeds of those trees dropt by birds in the mould on the boles of the others that lyes commonly there, and is made of the annual rottings of their own leaves."

He goes on to speak of another great oak, "lying near the Lodge house in Ellen Hall Park, of so vast a bulk that my man upon a horse of 15 hands high, standing on one side of it, and I also on horseback on the other could see no part of each other"; and also of an oak that "was felled about twenty years since in Wrottesley Park which, as the worthy Sir Walter Wrottesley (a man far from vanity of imposition) seriously told me, was 15 yards in girth."—"How much less in bigness and number of tuns the oak might be that grew in the New Park at Dudley, and made the table now lying in the old hall at Dudley Castle, is not remembered, but certainly it must be a tree of prodigious height and magnitude out of which a table all of one plank could be cut, 25 yards 3 inches long and wanting but 2 inches of a yard in breadth for the whole length, from which they were forced (it being so much too long for the hall at Dudley) to cut off 7 yards 9 inches, which is the table in the hall at Corbins Hall hard by, the ancient seat of the Corbins."

In the park at Merevale Hall, Warwickshire, the seat of W. F. S. Dugdale, Esq., are a quantity of very fine and tall oaks, which rival those at Bagot's Park, and are, according to Sir H. Maxwell, of the sessile variety, though when I saw them they were not in leaf. They stand at a considerable elevation, on a dry and seemingly rather shallow red sandstone. Many of them are 100 feet and more in height, with clean trunks of 40 to 60 feet long.

The best that I could find measured as follows:—112 feet by 13 feet, with a

straight bole 65 feet long; 107 feet by 15 feet, with a clean bole of 70 feet, and probably containing about 600 feet of timber; 107 feet by 17 feet 3 inches, with a bole 48 feet long, and about the same cubic contents as the last; 114 feet by 15½ feet, bole about 60. This last is, I believe, the same tree which Mr. Dugdale had measured some years ago, when it was thought to be 133 feet high; but I do not think it can be nearly so much, the sloping ground on which it stands making a base line difficult to get. He tells me that these trees are believed to have been planted by the monks who lived at Merevale Abbey at the foot of the hill, which would make them at least 370 years old, and that most of them have now passed their best. The timber being very straight in the grain is largely used for cleaving spokes.

Chirk Castle in Denbighshire, the seat of R. Myddleton, Esq., and one of the most ancient inhabited castles in England, is in a park full of oaks, most of which I believe to be of the sessile variety. They are not of great age, having been planted, as Mr. Parker, agent for the property, told me, after the Commonwealth, but are remarkable on account of their uniformly straight boles 30 to 60 feet high. They grow on millstone-grit, where the rock comes very near the surface, on land where the pedunculate variety would not, I think, make nearly such fine trees. I only measured two, one just below the castle which was 100 feet by 11 feet 8 inches, with a straight clean bole of 60 feet; another, probably of greater age, about 90 feet by 18 feet 2 inches, was beginning to decay at the base. A curious growth is seen on an oak in this drive, a branch having grown out of one stem into another, somewhat in the same style as the beech in Plate 4 of this work.

The trees in the Great Park of Windsor have been described by many writers, and especially by the late Mr. William Menzies in a rare folio published by Longmans in 1864,¹ which gives photographs of some of the finest trees, these being, so far as I know, the first large photographic plates of trees published, and, considering the imperfect development of the art forty years ago, wonderfully good.

They show Queen Victoria's Favourite Oak, which was chosen by her late Majesty shortly after her accession, and which stands with the three other royal trees between High Standing Hill and New Lodge. This is a very well shaped tree of fair size, 70 feet high and 11 feet in girth when Menzies measured it in 1864. Now, as I am informed by Mr. Simmonds, it has increased only 9 inches in girth. Queen Anne's Oak, a very handsome tree in shape, but past its prime, though supposed to be only 400 years old, measured 60 feet in height by 15 feet 3 inches in girth. Queen Charlotte's Oak, a tree of no special beauty, was 65 feet high by 17 feet 3 inches in girth. The great Pollard Oak at Forest Gate, known as William the Conqueror's Oak, and figured in the Supplement to *Gardeners' Chronicle*, 31st October 1874, supposed by Menzies to be 800 years old, though about 37 feet in girth, and the largest in the forest, is now a wreck; but there are near the Prince Consort's chapel, and in the Cowpond grove, many beautiful tall and straight-grown oaks, one of which, growing near the culvert of the pond, measured by me in March 1904, was from 114 to 118 feet high and 10 feet

¹ *History of Windsor Great Park and Windsor Forest.*

10 inches in girth. For this tree Mr. Simmons told me, £100 was offered to make the keel of a ship forty or fifty years ago. It should live for many years, and may perhaps become the finest timber oak in Windsor Forest.

Mr. Menzies gives¹ an excellent explanation of the old custom of pollarding oaks and beeches, which has produced the picturesque veterans which are so common in most of our really old parks. For the support of the deer in winter it was customary to lop off the boughs of the oak and beech. The law required that no bough should be cut larger than a buck could turn over with its horns, and after they had been stripped by the deer these branches became the perquisite of the keepers, under the name of "fireboote," or "houseboote." Any timber fit for the navy could not be cut without the sign manual of the King, a rule yet extant; but in times of civil war, and in royal forests which were granted to favourites in the times of the Stuarts, the keepers often cut and sold as timber or firewood a great deal more than the deer needed; and notwithstanding that these matters were investigated by James I. with his national and personal thriftiness, and that the surveyors whom he employed were spoken of by the country people as "shroade and terrible men,"² these abuses increased to such a point that the growing scarcity of naval timber was a common complaint for centuries.

There is no doubt that browse or lop, being the natural winter food of deer in hard weather, is more suitable for them than beans and maize, which is now given in so many places probably to save trouble. I find in my own park that ash and elm are the favourites, and beech the next best lop for deer, and only give hay when the ground is frozen or covered with snow; but many parks are so overstocked with deer and with cattle in summer that in February and March the former must have some extra food, or a heavy death-rate follows.

Gloucestershire is not famous for fine oaks, though the Boddington Oak, near Tewkesbury, now gone, must have been an exceptionally large tree. The Newland Oak, near Coleford, is an immense pollard, with a short burry trunk no less than 43 feet in girth. An excellent photograph of it has been published as a postcard by Mr. J. W. Porter of Coleford. There are some fine ones in the Winchcombe Valley, near Sudeley Castle, one of which is 25½ feet in girth; but in the Vale of Gloucester elms are commoner than oaks, and I know none of special note, though Mr. J. R. Yorke tells me of a large tree still standing near Forthampton Court.

The largest I have seen are in Witcombe Park, the seat of W. H. Hicks-Beach, Esq., a small but picturesque park lying under the steep Birdlip Hill. Here on fertile clay soil, facing north and west, are a number of very fine trees, which, judging from the rings counted on one of the largest which has recently been felled, are not so old as they appear to be. This tree, which measured about 90 feet by 17½ feet, and contained 400 to 500 cubic feet, was only about 210 years old, and beginning to fail in the upper branches, which were dying off. The largest tree, in a very exposed position, has lost some of its biggest limbs, and measures 25 feet in girth at about 5 feet from the ground, and 50 feet round the roots at the base. A very tall, well-shaped, handsome tree, with its bole clean and straight

¹ *Op. cit.* 7.

² Arthur Standish, *The Common Good*.

for 30 to 40 feet, stands on high ground in the centre of the park; and at the bottom of the hill near the house is a pollard which seems sound, and is 24½ feet in girth at the smallest part of its trunk.

In a grove near Campden, close to Norton House, which has been lately restored by the Earl of Harrowby, I was shown a remarkably tall and clean oak over 100 feet high with a straight bole clean for 60 feet, but only 7 feet 5 inches in girth.

Near Bourton-on-the-Water, on the east side of the road to Stow, stands a pedunculate oak which, of its type, is almost equal in size to any I have seen, and which is specially remarkable on account of the perfect condition of all its branches, which, as Plate 93 shows, are growing to the very tips, and which spread over an area of 115 paces in circumference, equal to that of the Beggar's Oak. This tree grows in a grass field on the property of Mrs. Butler of Wick Hill.¹ It measures about 85 feet high by 22½ in girth, and has the appearance of having been pollarded at about 12 feet up very early in life. There are some fine tall oaks at Wick Hill, not far off, measuring 85 feet by 14 feet and 80 feet by 13 feet, and there are still some big ones in the cow pastures at Sherborne Park in the same district. But the best of these were felled fifty years ago by the father of the present Lord Sherborne, who has never ceased to lament their loss.

There are many superb oaks in Earl Spencer's park at Althorp, Northants, which were carefully measured by the former forester, Mr. Mitchell, now at Woburn. Lord Spencer's ancestors were evidently great lovers of trees, and followed a practice which is much to be admired. In Althorp Park are several inscribed stones, giving the date of planting and the name of the planter. The earliest of these is in the Heronry, and is dated 1568.

Of the others one reads as follows—

This Wood was planted by
Robert Lord Spencer
In the year of our Lord,
1602-1603

Another has the legend—

This Wood was planted
by Sir William Spencer, Knight of the Bath
in the year of our Lord
1624
Up and be doing, and God will prosper

When one sees how small are the trees planted about 300 years ago, when compared with the older trees, one realises the immense time it takes for such oaks to grow. The finest at Althorp is shown on Plate 94. It grows near a farmyard, and is No. 8 in Mitchell's list.² It measures about 90 feet in height, and carries a thick straight stem up to about 45 feet high, and girths 19 feet 6 inches at 5 feet. It must contain at least 1000 feet of timber, and is apparently sound, healthy, and growing, with no signs of decay in the top.³

There are some very fine oaks in Burleigh Park, Stamford, the seat of the

¹ In 1906 I saw this tree again, and found that a large fungus had attacked its trunk, and that some of the branches were showing signs of decay at the ends. Steps are being taken to preserve it as far as possible.

² A description of some of the finest trees at this place is given in *Trans. Scottish Arb. Soc.* xiii. 83.

³ Sir Hugh Beevor measured fifteen oaks standing on one acre in a grove planted at Althorp in 1561-1568, and found them from 100 to 115 feet high, with an average girth of 11 feet 8 inches, and the average cubic contents of the first length of 54 feet was 330 feet. In another plantation, made in 1589 on stiffer soil than the last, there were more trees per acre, but their size was less, the average being 90 feet by 9 feet 7 inches.

Marquess of Exeter. The best, known as the King Oak, is 100 feet high by 16 feet 6 inches in girth. At Ashridge the oaks are not so fine as the beeches, but the King Oak in that park is a splendid tree, measuring 98 feet by 21 feet 8 inches.

Sherwood Forest, in Nottinghamshire, contains an immense number of very ancient, picturesque, and curious oaks, many of them now mere wrecks, but preserved with care by Earl Manvers, who is the owner of a large area of the unenclosed part of what was formerly a royal forest. I have seen no other place where so many of the trees are covered with immense burrs, and where they assume such extraordinary shapes, as in that part of Sherwood Forest between Edwinstowe and the Buck gate entrance to Thoresby Park. The soil in this district is mostly a poor-looking sand on which the birch thrives remarkably. About seventy years ago the open forest which up to that time had been grazed by sheep, came into the possession of Lord Manvers. An immense quantity of seedling birch then sprang up, and large quantities of acorns were sown to fill up the vacant spaces caused by the decay of the old oaks, most of which are now stag-headed, and dead at the top.

The finest oak now standing in Sherwood Forest is the Queen or Major Oak (Plate 95). This tree, though hollow, and having its branches partly supported by iron stays, is still healthy and vigorous. It measures about 60 feet in height by 30 feet 5 inches in girth, and the spreading roots are about 18 paces round at the ground. The spread of the branches is 30 yards in diameter. It is about three-quarters of a mile from Edwinstowe, and is not far from another tree known as Simon Foster's Oak, which is about 44 feet high and 25 feet in girth.

At Welbeck, the seat of the Duke of Portland, in the same beautiful and well-wooded district, known as the Dukeries, on heavier soil than that at Thoresby, are a number of magnificent oaks which were described and figured in 1790 in a scarce pamphlet by Major Rooke. Of these I saw the Porter Oaks, so called because they stand opposite each other on each side of a gate in the park. When measured by Rooke about 1779 they were as follows:—No. 1. 98 feet high, 23 feet girth at 6 feet; contents, 840 feet. In October 1903, 25½ feet; the top having been dead for many years it is now much less in height. No. 2. 88 feet high, 20 feet girth at 6 feet; contents, 744 feet. Now it is 23 feet and rapidly decaying.

Another tree, called by Rooke the "Duke's Walking Stick," of which there is a small figure in Loudon, p. 1766, was in 1779, 111 feet 6 inches high, and 70 feet 6 inches to the first branches; at 6 feet it measured 12 feet in girth, and was estimated to contain 440 cubic feet. A very celebrated oak at Welbeck is the Greendale Oak, which has often been figured and described. In my copy of Strutt there is a good plate of this tree, without number or description, bound at the end of the volume. Tradition says that a bet was made by a former Duke of Portland, that he had an oak so large, that a coach and four could be driven through its trunk, and the hole having been cut, he won his bet. When measured by Rooke it was, above the arch of the hole, 35 feet 3 inches in girth, the hole being 10 feet 3 inches high and 6 feet wide. Even at that time Rooke's figure shows it to have been a mutilated wreck, but the tree is still alive.

Near the Greendale Oak there is a magnificent though dead specimen of burr

oak, about 50 feet high and 28 feet 9 inches in girth, and though all the veterans are long past their prime, there are still healthy growing oaks at Welbeck on the south side of the road to Norton, of which I measured one with a butt 32 feet high and 19 feet in girth, which Mr. Michie, the forester, considered would contain 500 feet in the butt alone. Such oaks have actually been cut and sold here in recent times; and I have a photograph, given me by Mr. G. Miles of Stamford, of a tree which he bought at auction for £40, and whose trunk measured 38 feet 6 inches long by 43¼ inches quarter-girth—equal to 511 feet 8 inches. It was so heavy that the weight on the wheels of the timber carriage broke through the road, and when brought to the station after much risk and trouble, the railway company refused to take it to Peterborough except on a special train by itself.

In Rockingham Park, Northants, the seat of the Rev. Wentworth Watson, there are a number of wonderful oaks, many of which are brown, and I had the opportunity, through the kindness of Mr. C. Richardson of Stamford, of seeing several of these felled in September 1903. He told me that, in the whole course of his long experience, he had never seen so many fine brown oaks together as these. The park lies high, on land which looks like oolitic limestone, the rock in some places coming near the surface; but where these oaks grow there is a good depth of loamy soil. Some of the trees which I saw lying were more or less hollow, and required no saw to bring them down. I was anxious to photograph one in the act of falling, and as the fellers were at work on one of the best, I asked them to let me know how long it would take; the roots only being then cut all round the tree. I expected that some hours would be required, but before the camera was fixed to take the tree as it stood, they suddenly called out, "stand clear," and down it came.

Plate 96 shows what the roots of these brown oaks are usually like, but if there is a foot or two of sound wood in the lower part, and the brown colour extends a good way up the trunk, they are still very valuable. I asked the fellers if they could tell a brown oak standing without boring it, and they said they could make a good guess at the colour, though they could not be sure. Probably long experience in a district where brown oak seems to be commoner than elsewhere, is the only guide, if there is one; but stories are told of men going in the night to bore such trees with an auger before trying to buy them, in the hopes of getting a bargain. From a statement sent me by Mr. Richardson, it appears that twenty-six of these trees were sold for £1100, five of them for £100 each, and contained about 8030 feet, all measured over bark, and nothing allowed for defects.

The best of this lot were eventually sold to Messrs. J. T. Williams of New York, and afterwards bought by the Pullman Company at a very high price. Mr. Richard Dean, of that Company, informs me that he considered the wood superior to any that they had previously used, and was good enough to send me some samples of the veneer made from them, which has been used in decorating their palace railway cars. The largest of these specimens measures 6 feet 1 inch by 2 feet 8 inches without a flaw, and is throughout of a uniform chestnut-brown colour, mottled with silvery patches, formed by the medullary rays, showing that it has been cut from a quartered plank.

The sandy and gravelly tracts in Essex have extensive woodlands, in which the oak is the principal timber tree. Sound oak trees with boles measuring from 16 to 20 feet in girth are scattered through the county. Oak trees of larger dimensions, many in a more or less decayed condition, have been measured and described by Mr. J. C. Shenstone.¹ Some of these I visited under his guidance in March 1907, and I think the following are worthy of notice:—At Thorrington are four trees from 27 to 31 feet in girth, decayed; at Danbury Park two trees of 31 feet in girth, decayed; at Hatfield Broad Oak the Doodle Oak, 42 feet in girth, decayed; at Havering-atte-Bower Bedford's Oak, 27 feet in girth, decayed; in Easton Park the finest tree is 80 feet by 23 feet, sound and vigorous, and there are many old pollards of great size. One of these, covered with burry growths, is 29 feet in girth; and another, on which the burr is very peculiar from its kidney-shaped lobes, is 33½ feet, of which the burr takes up 14 feet. At Marks Hall, near Coggleshall, the property of T. P. Price, Esq., there are very large sound oaks, as well as some relics of the ancient forest; the largest, which is perhaps the finest tree of its kind now standing in the county, is 90 feet by 24 feet 3 inches, and though some large branches are gone on one side it seems sound and vigorous. The only very large oak now left in Epping Forest is the Fairmead Oak, 30 feet in girth, and much decayed. At Thorndon Park, the ancient seat of Lord Petre, are many picturesque relics of the ancient forest; and at Wealside House, Brentwood, is an oak 27 feet in circumference of bole.

Mr. E. R. Pratt of Ryston Hall kindly sends me the following account of—

Kett's Oak at Ryston, Norfolk.—In the year 1547 this tree was the trysting-place of the West Norfolk rebels under the brothers Robert and William Kett. The former and the other "Governors" selected large oak trees under which their Courts sat to administer justice and regulate disorders. The Court in this case did not seem to look upon sheep-stealing as other than a necessary evil, since they left on the tree the following inscription:—

Mr. Prat, your shepe are very fat
and we thank you for that
we have left you the skinnes
to buy your ladye pinnes
and you must thank us for that.

Dimensions in 1840.		In 1906.	
On the ground level,	46 feet 6 inches.	49 feet	6 inches.
Three feet from the ground,	27 " 4 "	26 "	6 "
Five feet do.	24 " 3 "	23 "	11 "

From the photograph which accompanied this account it seems that the old tree is still fairly sound and vigorous. In an old map of the seventeenth century Kett's Oak is marked, showing that it was then known as a landmark.

Other remarkable oaks in Norfolk which I have seen are at Merton Hall, the

¹ *Essex Naturalist*, June 1904.

seat of Lord Walsingham, where the largest, now much decayed, is about 27 feet in girth; at Blickling, where an oak in the kitchen garden 95 feet high, said by Grigor to have been planted by the Earl of Buckinghamshire, has a straight clean trunk 32 feet high and 15½ in girth; and at Stratton Strawless, where there is a beautiful straight-stemmed oak close to the house clean to 40 feet high and over 10 in girth.

Cowthorpe Oak.—No oak in England has probably been the subject of so much writing as the Cowthorpe Oak, near Wetherby, which perhaps never was such a great tree as has been supposed, and is now a mere wreck. It has been figured several times, so that I need only refer those who wish to know more of it to a paper with illustrations by Mr. John Clayton, published in the *Transactions of the Botanical Society of Edinburgh*, 1903, p. 396. A comparison of the various measurements taken at different times shows great discrepancies. Mr. Clayton attempts to prove by a diagram that the decay of its roots have allowed it to settle into the ground, and thus explains the diminution in its girth, but the discrepancy between measurements taken by different people is considerable. The girth at 5 feet given by Marsham as 36½ feet in 1768, when no hollow or cavity is mentioned as existing in the tree, and the girth given by Mr. Clayton of 36 feet 10½ inches, at 5 feet 3 inches in 1893, are so nearly identical that I do not think Mr. Clayton proves his argument. Whether trees ever subside owing to the decay of their roots is to me a very doubtful point, and I have certainly seen oaks felled which, though of great age and completely hollow, were supported in their original position by a mere shell. I visited the Cowthorpe Oak in July 1906, and found that in its present condition no accurate measurement of it could be taken, a large part of one side having fallen in. I could see no evidence to support Mr. Clayton's idea that the base of the tree had sunk into the ground. The few living branches still bear acorns, from which some seedlings were raised in 1905 by Messrs. Kent and Brydon, nurserymen of Darlington.

The finest oaks in Yorkshire that I have seen or heard of are in the park at Studley Royal, which were described and figured by Loudon from drawings which I have seen in the Marquess of Ripon's library. Though I could not identify the drawings with trees now standing, Loudon gives the dimensions of the largest pedunculate tree as 80 feet by 24 feet 4 inches, and the largest sessile oak, which he says was then the largest in England, as 118 feet by 33½ feet. The best that were shown me were a pedunculate oak 80 feet by 23 feet, a good deal past its prime, and a sessile oak which I made 114 feet by 12 feet 2 inches, a vigorous and healthy tree.

One of the most remarkable oaks in England on account of its shape is the Umbrella Oak at Castlehill, North Devon (Plate 97). This tree had not altered materially during the recollection of the late Earl Fortescue, who lived to be over eighty, though it does not give the impression of very great age. It grows on a slope called Eggesford Bank, near the house, and has a clean bole about 8 feet by 6 feet 8 inches. The branches spread horizontally from one point, and form a close flat surface, of which the twigs are interlaced, and spread to a diameter of about 25 yards. Seedlings have been raised from its acorns, which do not produce this very curious habit, and attempts to reproduce it by grafts have not succeeded.

Another freak of nature is the Marriage Oak in Eridge Park, Kent, which Lord H. Nevill was good enough to show me. Here a yew and an oak have grown up together, though the two trunks, which measure 16 feet 3 inches in girth, have not combined, the yew having spread its branches widely over the top of the bole of the oak. A similar case is recorded by Mr. A. D. Webster¹ in the South Park at Holwood, Kent. Here the two trees have combined their stems into a normally shaped trunk, which girths 7 feet 10 inches at 5 feet, the yew being only 15 feet high, and spreading 36 feet, while the oak is 35 feet high with a spread of 54 feet.

Pollard oaks, when they are hollow at the top, sometimes support other trees of considerable size, which originate from seeds dropped by birds or brought by the wind. The best living instance of this that I know, is on an oak of no great size at Orwell Park, the seat of E. G. Pretyman, Esq., in Suffolk. This grows in a wood near the Decoy Pond, which is full of large self-sown hollies mixed with oaks, and looks as if it might be part of an original forest. Here a birch about 30 feet high, 20 inches in girth, is growing on the top of the oak, and has formed inside its hollow trunk what on one side seems to be a woody stem, whilst on the other side the roots are still in process of formation within the bole of the oak, which on that side is dead, but on the other has living branches.² Henry has seen a similar example on the road between Byfleet and Cobham, on Lady Buxton's property, where the birch, growing out of a stout oak bole, is 49 feet high and 8 inches in diameter.

Wistman's Wood.—After having said so much of big oaks, I must now mention one of the most remarkable oak woods in Britain, called Wistman's or Welshman's Wood, which is on Crockern Tor, Dartmoor, at an elevation of about 1400 feet. It contains a number, perhaps a thousand, of the most stunted and dwarf oaks in existence, growing among granite boulders in a very exposed and windy situation.

Wistman's Wood was described by Burt in his Notes to the second edition of Carrington's *Dartmoor*, p. 56, and also by Mr. W. Borrer.³ I am indebted to Mr. E. Squarey of Downton, Wilts, for information in a letter to him by Mr. P. F. S. Amory of Druid, Ashburton, which brings our knowledge up to date, with photographs showing the curious appearance of these trees. The *Journal of Forestry*, v. 421, in a description of them, says that no acorns are produced; but Mr. J. B. Rowe, editor of the *Perambulations of Dartmoor* (ed. 1896), in 1895 found two acorns after a long search, one of which, planted at Druid on 9th November 1902, is over 4 feet high.

In September 1868 Mr. Wentworth Buller obtained leave from the Prince of Wales to cut down one of these trees in order to find out its age. One section was sent to Kew; and another now in Mr. Amory's possession is 9 inches by 7 in diameter, and shows 163 years' growth, with distinctly marked medullary rays and several deep shakes. The bark is extremely thin, probably owing to the thick coat of moss and lichen which covered it. The slowness of growth in this tree is remarkable, no less than forty years to the inch.

¹ *Trans. Scot. Arb. Soc.* xii. 313 (1889).

² Compare Plot's account of a similar case quoted on p. 318 *supra*.

³ Loudon, *loc. cit.* 1757.

STRUTT'S OAKS

Strutt in *Sylva Britannica*, published in 1822, figured no less than twenty-one oak trees, and as I have seen a good many of these myself, it may be interesting to notice their present condition after a lapse of over eighty years.

Plate 1. The Swilcar lawn Oak in Needwood Forest was then supposed to be about 600 years old, and was 21 feet 4½ inches at 6 feet, having increased 2 feet 4 inches in 54 years. When I saw it in 1904 it was about 25 feet in girth, but nearly dead at the top.

Plate 2. The Beggar's Oak in Bagot's Park, fully described above. It measured in 1822, 20 feet; in 1904, 24 feet 1 inch.

Plate 3. The Great Oak at Fredville was in 1822, at 8 feet from the ground, more than 28 feet in girth, and contained above 1400 feet of timber. Now, I am informed by the Rev. S. Sargent, who sends me a photograph, showing that it is in good health, it measures at 3 feet, which seems to be about its smallest girth, 33 feet 6 inches.

Plate 4. The Panshanger Oak, near Earl Cowper's house in Herts, seemed to Strutt to have scarcely reached its prime, though his plate shows that the spire was already dead. It measured in 1822, 19 feet at a yard from the ground, and was supposed to contain 1000 feet of timber. When I saw it in 1905 the topmost limbs were dead or dying, and there was a large rift in the trunk on one side. The girth was 21 feet 4 inches at 5 feet.

Plate 9. The Salcey Forest Oak was a mere wreck in 1822. I know not if it still exists.

Plate 10. The Abbot's Oak at Woburn Abbey was never a very large tree, but if it is the same that I saw in 1905 it remains sound.

Plate 11. The Chandos Oak at Michendon House, Southgate, was also not a first-class oak, though a very handsome one. It was then only 60 feet by 15 feet 9 inches. Henry's measurements in 1904 were 80 feet in height and 18 feet in girth, with a spread of branches 143 feet in diameter.

Plate 12. The oak called Beauty at Fredville, not a first-class tree among great oaks and figured with a dead top, measured only 16 feet in girth.

Plate 17. The Shelton Oak near Shrewsbury I have not seen. It was a hollow tree of great age, 26 feet in girth, in 1822, and I am told that it is now a mere wreck.

Plate 18. The Bounds Park Oak, near Tonbridge Wells, was a tree in perfect health and vigour when figured by Strutt, and measured 69 feet by 17 feet 9 inches at 12 feet. It is still standing, and as I am informed by Mr. H. J. Wood, has not much changed in appearance.

Plate 19. The Moccas Park Oak was much decayed in 1822, when it measured 36 feet in girth; it still survives, but is fast going to ruin.

Plate 20. The Wotton Oak was never a first-class tree, judging from the plate, and I do not know what is its present condition.

Plate 25. The Cowthorpe Oak has been already discussed.

Plate 26. Queen Elizabeth's Oak at Huntingfield in Suffolk is, I believe, the same tree which I saw on Lord Huntingfield's property, near the Hill Farm, Strutt quotes from Davy's letters but gives no measurement. It was quite hollow in 1773, and is now divided into three great sections which lean outwards and measure in all 39 feet 8 inches in girth. It has a few green and healthy branches, and the sound parts of the shell are about a foot thick.

Plate 27. Sir Philip Sidney's Oak at Penshurst, Kent, was, in 1822, a very old tree measuring 22 feet in girth.

Plate 28. The King Oak in Savernake Forest was quite hollow when figured by Strutt, and measured 24 feet in girth.

Plate 33. The Twelve Apostles at Burley Lodge, New Forest.

Plate 34. The Squitch Bank Oak in Bagot's Park was in 1822, and still is, one of the finest in England, and is now considered by Lord Bagot the best oak in his park.

Plate 35. Two trees called Gog and Magog near Castle Ashby still survive, and, judging from photographs of them sent me by Mr. Scriven, have not changed much in appearance, though Gog has apparently lost its bark on one side. Though very picturesque, they are not well-shaped trees. The former is now 58 feet by 28 feet, at 3 feet, with contents 1668 feet; the latter is 49 feet by 28½ feet.

Plate 36. The Tall Oak at Fredville is to my eye the best shaped of Strutt's oaks, though not of extraordinary size. He says the stem went up straight and clean to about 78 feet, and the girth at 4 feet was 18 feet.

Among the trees figured in *Sylva Scotica*, a continuation of the work just cited, there is only one oak, namely, Wallace's Oak at Elderslee or Ellerslie, near Paisley. Many larger and finer oaks than this occur in Scotland. Judging from the figure it is not remarkable except from its historic interest, which seems rather mythical.

THE OAK IN SCOTLAND

The oak rarely attains in Scotland the size and vigour so commonly met with in England.¹ Mr. Hutchinson² has catalogued 151 Scottish oaks, remarkable for size; and of these only six exceeded 20 feet in girth at 5 feet above the ground; the largest recorded by him, at Lee, Lanarkshire, was 23 feet girth at 3 feet up, the total height being 68 feet. The tallest oak recorded by Hutchinson was one at Hopetoun, Linlithgowshire, 110 feet high, with a bole of 93 feet, girthing 8 feet 8 inches, but I saw no tree approaching this height at Hopetoun in 1904. In Dr. Christison's³ paper on the "Rate of Girth Increase in Trees," the average rate of increase is given for trees at the Edinburgh Botanic Garden; Craigiehall, Linlithgowshire; Pollok, Renfrewshire; and Methven Castle, Perthshire. The rate of course depends on the age of the trees, and is very variable even in the same locality. At

¹ Sir Herbert Maxwell thinks that this is not owing to soil or climate, but to the fact that Scotland was denuded of trees before the seventeenth century. Planting was carried on slowly and sporadically after the Union, and there are few planted oaks in Scotland over 200 years old.

² *Trans. Highl. and Agric. Soc. Scot.* xiii. 218 (1881).

³ *Trans. Bot. Soc. Edin.* xix. 461 (1892).

Methven, an oak planted in 1811 had attained, in 1893, 16 feet in girth, and during the last sixteen years had increased as much as 18 inches in girth.

The "Capon Tree,"¹ near Jedburgh, in 1893 was 22 feet 7 inches in girth at the narrowest part of the trunk. It divides at 6 feet into two stems, girthing 16 feet 2 inches and 10 feet 9 inches. The "Pease Tree" at Lee,¹ Lanark, measured, in 1890, 23 feet 7 inches in girth.

There is a fine oak at Methven Castle called the Pepperwell Oak, which Henry measured in 1904, 85 feet by 20 feet 4 inches. Colonel Smythe informed him that when his ancestor Peter Smythe was imprisoned in the Tower of London in 1722, his wife, though in sore straits for money, refused 100 marks for this tree.

In the shrubbery of Scone Palace, Perth, in ground which was formerly gardens belonging to a village, there is an oak, planted in 1805 (growing in black loam 4½ feet deep, resting on sand of unknown depth), which in 1904 was 102 feet high, 36 feet to the first branch, and 11 feet 4 inches in girth at 5 feet up. This shows unusually rapid growth. Near it is another oak, probably of the same age, 98 feet in height, 10 feet 8 inches in girth, with a bole of 25 feet.

The finest oak seen by Henry in Scotland is growing in front of the house at Blair Drummond, Perthshire, the seat of H. S. Home Drummond, Esq. It is 118 feet in height and 17 feet in girth, the first bough coming off at 24 feet up. This oak and a number of others near it probably date from some time after 1730, the year in which the house was built. At Drumlanrig, Dumfriesshire, there is an oak 16 feet in girth, with a bole of 22½ feet, which is estimated to contain 361 cubic feet of timber. At Dalswinton, Dumfriesshire, there are two remarkable oak stools, standing close together. The larger is 28½ feet in girth near the base; and gives off five great stems, 81 feet in height, which average 8 feet in girth.

(H. J. E.)

THE OAK IN IRELAND

The most famous oak wood in Ireland was that of Shillelagh in Wicklow, from which is derived the name formerly given to an oak stick, but now erroneously transferred to the blackthorn. From the wood of Shillelagh, according to tradition, were derived the timbers which roof Westminster Hall, and also those on the roof of the chapel of King's College, Cambridge. There is said² to be a record in St. Michan's Church, verified by "Hanmer's Chronicle" in the library of Trinity College, Dublin, which states: "The faire greene or commune, now called Ostomontoune Greene, was all wood, and hee that diggeth at this day to any depth shall find the grounde full of great rootes. From thence, anno 1098, King William Rufus, by license of Murchard, had that frame which made up the roofes of Westminster Hall, where no English spider webbeth or breedeth to this day." According to Hayes,³ the finest trees in Shillelagh were cut down in the time of Charles II. and exported to Holland for the use of the Stadt House, under which hundreds of thousands of piles were driven. In 1692 iron forges were introduced into Shillelagh; and the ruin of the wood

¹ *Trans. Nat. Hist. Soc. Glasg.* 4th Sept. 1894.

² *Woods and Forests*, Jan. 28, 1885, Suppl. p. iii.

³ *Practical Treatise on Planting*, 111 (1794).

speedily followed. Great trees, however, still remained till near the end of the eighteenth century. At that time Mr. Sisson, who had purchased large quantities of timber, was given an oak tree of his own choice as a present, and this tree was so large that though forked at the base, each stem was big enough for a mill shaft at more than 50 feet from the butt. Two pieces being appropriated to this use, he sawed the remainder into panels for coach-building, which were sold for £250. In the MSS. of Thomas, Marquess of Rockingham, it is recorded that in 1731 there were standing in the deer park of Shillelagh 2150 oak trees, then valued at £8317, the timber being rated at 1s. 6d. a foot, and the bark at 7s. a barrel. In 1780 there remained of the old reserves 38 trees, which contained 2588 feet of timber. In the adjoining woods of Coolattin, in Hayes' time, there was a considerable number of young healthy oaks, several being $7\frac{1}{2}$ feet in girth.

I visited Coolattin in 1906 and was shown many fine trees, though none were of great thickness, the best tree seen being 118 feet high with a clean bole to 40 feet and a girth of 13 feet. All the trees were *Quercus sessiliflora*.

The largest oak wood in Ireland is in Viscount de Vesci's park at Abbeyleix, Queen's County, where there are several hundred acres of trees of the pedunculate species, growing very close together, especially on the alluvial flats along the river Nore. The trees are of no great height, and have usually short boles with wide-spreading, stout branches, the largest tree measured being 21 feet in girth.

Hayes gives several instances of the remarkable growth of oak in Ireland. At Ballybeg in Wicklow, a tree growing in alluvial soil, eighty years old, was 12 feet in girth at 8 feet from the ground. At Muckross, Killarney, six trees sown in 1760 measured in 1794, from 3 feet to 4 feet 11 inches in girth at 5 feet from the ground. Ireland, renowned in ancient days for its oak timber, which was valued abroad, is now singularly wanting in even good specimens of solitary oak trees; and Loudon gave in 1838 no examples of fine oak trees growing in Ireland. The finest which have been seen by me are:—At Dartrey, Cootehill, the seat of the Earl of Dartrey, a beautiful symmetrical pedunculate oak, 100 feet high with a girth of 14 feet 4 inches; at Kilmacurragh, Wicklow, a sessile oak $14\frac{1}{2}$ feet in girth; at Glenstal, Limerick, a tree of the same species $16\frac{1}{2}$ feet in girth; and at Shane's Castle, Antrim, a pedunculate oak 19 feet in girth. There are also many fine trees with good boles at Done-raile Court, Co. Cork, the largest about 13 feet in girth. (A. H.)

REMARKABLE TREES ABROAD

As the oak is one of the most characteristic British trees we give only a few details of the remarkable oaks which we have seen on the Continent. A good account of the trees in the forests of Retz, Compiègne, and St. Amand was written by Prof. Fisher in the *Trans. Eng. Arb. Soc.* v. 205. I took part in the excursion which this paper records, and saw the splendid sessile oaks at Compiègne, of which the one called the Czarina's Oak is the finest. This is as well-grown, but not a finer tree than some of those which I have described and figured in England, though in cubic contents inferior to several of them. The French measure-

ments given on the trunk of the tree are—height 36 metres = 118 feet; girth at 1.30 metres, 5.20 metres = 17 feet; volume 32 cubic metres = 1130 feet; value £100. Mr. George Marshall, Past-President of the English Arboricultural Society, who is a timber valuer of great experience, estimated the butt of the tree to contain (46 feet by 42 inches quarter-girth) 550 cubic feet; plus 150 cubic feet for the top, making a total of 700 cubic feet; which, with the addition of an unknown quantity for the branches, always reckoned in France, plus 20 per cent for the difference between the total volume and the English quarter-girth measurement, will come near the French estimate. A photograph of an oak in the Forêt de Bellême was reproduced in this report. Its total height was $119\frac{1}{2}$ feet, and its girth at 4 feet 6 inches was 9 feet 9 inches. It is impossible to imagine a tree containing more useful timber and less waste than this tree, which has rather the appearance of a gigantic mop than of an oak as we know them. Prof. Fisher considers Bellême as the finest oak forest in France, and in the *Gardeners' Chronicle*, xxviii. 220 (1900), speaks of a sessile oak which he measured there 146 feet high, with a clean bole 113 feet by 9 feet 10 inches girth, and a volume of about 500 cubic feet.¹

Another renowned forest in France is that of Bercé near Chateau du Loir (Sarthe), visited by Henry in 1903 and in 1906, which covers 13,350 acres; and is made up of about 90 per cent of sessile oak and 10 per cent of beech. It is situated on a plateau; the soil being a deep loamy sand, poor in lime. There is not a single pedunculate oak in the forest itself, yet, curiously enough, all those in the hedgerows of the surrounding country are of this form. The sessile oak, owing to its ability to bear shade, is grown densely in the forest, and attains an astonishing height, though it is slow in growth, as far as regards diameter of stem, which averages at 200 years old only 20 inches. The best individual tree, the *Chêne Boppe*,² in 1905 measured 115 feet high, 75 feet to the first branch, and 14 feet in girth. Another tree, measured in 1906, was 125 feet total height, 92 feet to the first branch, and 8 feet in girth. In one section, containing a little less than twenty acres, there stood in 1903, aged 211 years, 1314 oaks and 268 beeches; the oaks averaging 28 inches in diameter. The total amount of the timber³ was estimated by an accurate survey in 1895 at 275,000 cubic feet, valued at £14,720, or about £740 an acre. The yield of the first and second series in this forest, 2700 acres in extent, over which felling is done in sections once every 216 years, works out at 66 cubic feet of timber per acre per annum, equivalent to a net annual revenue per acre of £2:3s. A photograph taken by Henry, shows the shape of these forest oaks, all beautiful, clean, cylindrical stems, and illustrates the way in which the

¹ Henry visited Bellême in 1906, and does not consider it to be quite as fine a forest as Bercé. The best tree seen, possibly the same as the one measured by Prof. Fisher, was 125 feet total height, 95 feet to the first branch, 10 feet 4 inches in girth, and about 425 cubic feet in volume. On referring to Prof. Fisher as to this measurement, he sends me two photographs given him by M. Granger, then Garde Général at Bellême, representing (1) the *Chêne de Brignonnais*, which is 37 metres = about 120 feet high; girth at 4 feet 6 inches, 3 metres = 9 feet 10 inches; height to the first branch, 23 metres; (2) the *Chêne Lorentz*, which is 40 metres in height = about 130 feet, girth $4\frac{1}{2}$ metres = about $14\frac{3}{4}$ feet, and 18 metres long to the point where it divides into two nearly equal stems. It therefore appears that we have in England a few oaks at least as tall, and many larger in bulk than any recorded in France.

² Near this tree Henry observed an oak bearing mistletoe on a branch at 60 feet up.

³ Huffel, *Economie Forestière*, i. pp. 370, 372 (1904). The capital or volume of wood in the forest is not diminished by its felling, but is steadily increasing slightly all the time, owing to careful management.

woodcutter, to save the seedlings beneath from damage, lops off the crown of the tree with an axe at a point below the first branch before felling the trunk.

The oaks in the German forest of Spessart have been so frequently mentioned by recent writers on Forestry that I need not say anything of them, but doubt whether they equal the oaks in some of the few remaining virgin forests of Slavonia. In 1900 I saw a splendid lot of clean straight logs 3 to 5 feet in diameter, which had been felled in these forests, and floated down the Save to Bosnabrod.

We are indebted to Dr. Simonyi Semadam Sandor, a member of the Hungarian Parliament, for an account of the oaks of Slavonia in the Forest of Brod Petevarad, which is published in a Hungarian journal called *Erdzesti Lapok*, at Buda Peth, June 1889, with photographs showing splendid clean-stemmed trees, 30 to 40 metres high, and 2 to 3 metres in diameter.

The European oak seems able to grow well in temperate parts of the southern hemisphere. In Chile it seems as much at home as in Europe, and not only grows much faster, but reproduces itself with such ease from seed on land capable of being irrigated that I saw no reason why it should not be cultivated for its timber.¹

In South Africa the original Dutch settlers planted oaks near Cape Town, and under one of these trees the Convention was signed by which the Colony was transferred to Great Britain in 1814. On 5th April 1905 my brother posted me a few acorns from this tree, the trunk of which is now hollow and bricked up. I sowed them in May to see whether they would at once revert to their proper season of growth; and out of twenty acorns, three germinated in June, and are now nice young trees, the others never coming up at all.

In North America I have seen no European oaks of any great size, though there is one in Prof. Sargent's grounds near Boston, which has puzzled several good botanists as to its origin.

INJURIES TO OAKS

The liability of the oak to be struck by lightning was noted by Shakespeare, who, in *King Lear*, Act III. Scene ii., wrote—

You sulphurous and thought-executing fires,
Vaunt-couriers to oak-cleaving thunderbolts.

Mr. Menzies says,² "Of all forest trees oaks are, in my experience, the most dangerous. If they have a large spreading head, they are shivered into shreds when struck. If they have long tapering stems, and thus can act almost as conductors, they are not so dangerous, and the lightning will run down the side, ploughing out a deep furrow. I have once seen a beech struck, an ash once, an elm once, a cedar of Lebanon once, but never any other trees, except the oak. And while the others stood comparatively singly in an open space, the oaks have been selected and struck in the midst of a thick wood."

¹ Sir W. Thiselton Dyer informs me that on the Blue Mountains of Jamaica Sir Daniel Morris found a characteristic English oak.

² *History of Windsor Great Park*, p. 8.

Several interesting particulars of the effect of lightning on oaks are given by Loudon, who also states that the oak, owing to its roots not being so liable to rot in the ground as those of most trees, is not often blown down. He describes the effect of a hurricane in October 1831, on the splendid oaks growing in Lord Petre's park at Thorndon Hall in Essex, which reminds me of a similar case in April 1890, when I saw, at Narford, in Norfolk, oaks of 2 to 3 feet in diameter broken off at 4 to 10 feet from the ground by the force of the wind, which tore up many plantations of spruce and other shallow-rooting trees by the roots.

Sir Charles Strickland tells me that a very tall young oak tree 54 feet to the first branch, and quite straight, growing at Housham in Yorkshire, nearly on a level with the river Derwent, was, in the severe winter of 1860-61, completely killed by a frost which was the severest in his recollection. Though he has no record of the temperature at Housham, yet he believes that at Appleby, in Lincolnshire, it was as low as $15\frac{1}{2}$ below zero,¹ and generally in the northern counties the thermometer went below zero. Many other oaks were killed in the woods and in the hedgerows between Malton and Pickering by the same frost.

The various insects which attack the oak are too numerous to be mentioned in detail, but are described at length by Loudon and by many other authors.

The galls, which are so common on the leaves, are produced by several species of Cynips, and the so-called oak-apples are the result of an injury by an insect of the same family.²

MISTLETOE ON THE OAK

Since the time of Pliny, who describes the worship of the oak, and especially of the mistletoe-bearing oak by the Druids, the occurrence of this parasite on the oak has always been looked on as a rarity. Loudon only mentions two trees known to him, of which one near Ledbury was cut down in 1831, and another at Eastnor Castle is still living; but we have now been able to collect many more authentic records. A paper on the subject by the late Dr. Bull of Hereford³ gives particulars of several, and states that it is considered a dangerous practice to interfere with a mistletoe-bearing oak. One at St. Diels, near Monmouth, was cut down by the bailiff about 1853, and the owner of the estate immediately dismissed him. A woodman who climbed the Eastnor tree to get some mistletoe, fell down and broke his leg, and other similar stories are quoted. The finest mistletoe oak I have seen was shown me by Sir George Cornwall, at Bredwardine, in 1902. When described by Dr. Bull, mistletoe was growing on it in no less than fifteen different places, and it measured 78 feet by 11 feet 6 inches in girth. Sir George has lately found another in his park, and has a third on his estate in Woodbury Wood.

This part of England seems to be, for some reason, the most prolific in England

¹ This is a little lower than any temperature recorded by the Meteorological Office, but the subject of meteorology as affecting trees will be discussed fully later.

² An article in the *Kew Bulletin of Miscellaneous Information*, Additional Series, v. 1906, on Oak Galls, by R. A. Rolfe, gives much information on the subject, but is too long to quote. Nearly one hundred different kinds have been described which occur on the roots, buds, leaves, stamens, ovaries, and fruit.

³ *Trans. Woolhope Nat. Field Club*, 1870, p. 68.

in mistletoe oaks; and it will be observed in the list which follows that there are none reported in the northern half of Great Britain.

The subject has been recently studied by M. H. Gadeau de Kerville,¹ who records in Normandy alone no less than 26 mistletoe-bearing oaks, living or recently felled, of which a list with exact particulars of their locality is given, pp. 298-301. An excellent illustration of one of the finest of these growing on the farm of Bois, at Isigny-le-Buat, Department of Manche, shows a large and well-shaped tree, about 60 feet by 16 feet, of the pedunculate variety, which is covered with tufts of mistletoe, some of them growing on the trunk, and of very large size. M. de Kerville estimates the age of this tree at 200 to 300 years, and says that it has begun to deteriorate, as the dead branches show. M. Eugène Ormont states that a tuft of mistletoe of about a foot in length, which he examined on an oak, was eleven years old and seemed slower in its growth and yellower in colour than mistletoe growing on the apple.

LIST OF REPORTED MISTLETOE-BEARING OAKS IN ENGLAND²

Locality.	Authority.	Date.	Particulars.
Bredwardine, Hereford,	Dr. Bull,	1870	
	H. J. E.	1902	
Moccas Park, do.,	Rev. Sir G. Cornwall,	1904	
Woodbury Wood, do.,	do.	do.	
Tedstone Delamere, do.,	Dr. Bull,	1870	
Haven in the forest of Deerfold, do.,	do.,	do.	
Badham's Court, near Chepstow, Monmouth,	do.,	do.	
Near the Hendre, Llangattock, do.,	do.	do.	This tree is not known to exist now, so far as I can learn, at the Hendre.
Eastnor Castle, Worcestershire,	do.,	do.	
	H. J. E.	1903	
Lindridge, Worcestershire,	<i>Leisure Hour</i> ,	1873	
Frampton-on-Severn, Gloucestershire,	H. Clifford, Esq.,	1904	Mentioned by Lees in 1857, and still living.
Knightwick Church, Worcester,	<i>Leisure Hour</i> ,	1873	
Plasnewydd, Anglesea, in Marquis of Anglesea's Park,	Lees,	1857	
Hackwood Park, Basingstoke, Hants,	<i>Leisure Hour</i> ,	1873	
Lee Court, Kent,	do.,	do.	
Burningfold Farm, Dunsfold, Surrey,	do.,	do.	
Bodlam's Court, Sunbury Park, do.,	do.,	do.	
Shottesham, Norfolk,	Francis, in Trimmer's <i>Flora of Norfolk</i> ,	1866	
Alderley, Norfolk,	Winter, in do.,	do.	
Not far from Plymouth, by side of S. Devon railway,	Britten,	1884	
Near Cheltenham,	<i>Leisure Hour</i> ,	1873	I can get no confirmation of this.
Seven miles from Godalming,	Menzies,	1860	

¹ *Les Vieux arbres de la Normandie*, pt. iv. (1905).

² Sir Herbert Maxwell in *Memories of the Months*, p. 285, mentions the existence of mistletoe-bearing oaks at Stoulton in Worcestershire, in Sherwood Forest, Windsor Forest, and Richmond Park.

BARK

The bark of the oak was until recently a valuable source of revenue in England, but, owing to the introduction of other materials for tanning, has now fallen so much in price that in some districts it hardly pays to take off, and large areas of coppice oak in the western counties have become almost worthless in consequence. Whether the leather made by these modern substitutes is as durable as that produced under the old system is doubtful, but the comparative slowness of the process of tanning by oak bark seems to be one of the chief reasons for the change.

Professor H. R. Procter of the Leather Industries Department of the Leeds University, whom I consulted on this question, tells me that though he agrees with me that no tree at present grown in England is worth growing for the sake of its bark alone, yet he thinks that it will be long before the demand for oak bark entirely disappears. He considers that though leather tanned with oak bark alone is perhaps the best for boots and shoes, the cost of the slow process is so much greater in proportion to quality, that the leather so tanned is practically an article of luxury.

In the *Land Agents' Record* for October 29, 1904, there is an article on the price of oak bark, which is stated to have fallen from £8 a ton in the writer's experience to 47s. 6d.; and when the cost of peeling, which averages about 25s. per ton, the cost of loading and delivering to the station, and the cost of railway carriage is added, little or nothing is left for bark grown at any distance from its market. Since then the price in some districts has risen a little, but in this case, as in others, it is clear that chemically prepared substitutes are killing an industry of much importance to landowners and labourers.

TIMBER

With regard to the difference in the timber of the two varieties of oak, we have, strange to say, little or no certain experience in England. Laslett says that though he agrees generally with the opinion then prevalent, that *Q. sessiliflora* was slightly inferior to *pedunculata*, he feels bound to admit that during a long experience in working them, he has not been able to discover any important difference between the two varieties. He says that very fine specimens of long clean oaks of the sessile form were found in the Forest of Dean, which, however, were liable both to cup and star shake, and that he is inclined to believe that these defects are less common in *Q. pedunculata*.

Though little attention is now paid to the difference of winter- and spring-felled oak timber, and it seems as if most users of wood will pay as much for the latter as for the former, yet, considering the low price of bark and the importance of durability, I should strongly advise the former being used for all first-class work.

Laslett,¹ who, as timber inspector to the Admiralty, had probably as much experience as any man of his day, and more than any one at the present time,

¹ By far the best account that I know of is in Laslett's *Timber and Timber Trees*, of which a new edition, revised by the late Prof. Marshall Ward, was published in 1894.

gives in chapter xi. many proofs in support of his opinion that winter-felled oak is better than spring-felled; though the practice he recommends was to bark the trees standing, and fell them in the succeeding winter, a custom which is still followed in some parts in England. He also states, on page 73, that having carefully examined and compared many pieces of both winter- and spring- or summer-felled logs, he found almost invariably that the winter-cut timber, after being a few years in store, was in better condition than that which had been cut in the spring. "The winter-felled logs were sounder, less rent by shakes, and the centres or early growths generally showed less of incipient decay than the spring-felled."

So much has been written about the timber of the oak that it seems unnecessary to go into very great detail with regard to this subject, especially as this timber, of which little is now required for the navy, is being ousted by iron and by cheaper imported timber from many of its former uses, and is of far less value than formerly; but though at the present time English oak is out of fashion, there is no doubt that such durable and beautiful wood must always have a considerable value to those who do not sacrifice durability to cheapness, and who have patience to wait until it has been properly seasoned, which requires from two to six years according to the thickness of the plank.

There are so many proofs of its everlasting character in the form of roofs and in the old timbered buildings which are common in Cheshire, and of which so many beautiful illustrations are given in *Country Life*, that I need not repeat them, but an extraordinary instance of its longevity when exposed to the weather was pointed out to me by the late Lord Arundell of Wardour in the ruins of Wardour Castle. This building, according to an account of it published in *The Antiquary*, November 23, 1873, was inhabited before the reign of Edward III., and was besieged and sacked by the Parliamentary army in the reign of Charles I., and blown up by its owner, Lord Arundell, in 1644, rather than allow it to remain in the hands of the enemy. An oak lintel, which must therefore have been exposed to the weather for 260 years, still remained *in situ* in 1903, and as far as I could see from below was not much decayed.

In a paper by W. Atkinson¹ it is said that during the last thirty years he had taken every opportunity of procuring specimens of wood from old buildings, and particularly what the carpenters called chestnut, but never in a single instance had he seen a piece of chestnut, the wood so called being always that of *Q. sessiliflora*, mistaken for chestnut from a deficiency of the flower or silver grain. He goes on to say: "The roof of Westminster Hall has been said to be chestnut; while it was under repair I procured specimens from different parts of the roof, the whole of them were oak, and chiefly the *Q. sessiliflora*. Most of the black oak from trees dug out of the ground I have found to be of the same kind. From finding the wood of the oldest buildings about London to be chiefly of the *Q. sessiliflora*, I should suppose that some centuries ago the chief part of the natural woods were of that kind; at present the greater part of the oak grown in the south of England is *Q. pedunculata*. Specimens of oaks that I have procured from different parts of

¹ *Trans. Hort. Soc. Second Series*, i. p. 336 (1835).

Yorkshire and the county of Durham have all been *Q. sessiliflora*, which is very scarce in the south. There are some trees of it at Kenwood, the Earl of Mansfield's, near Highgate, which I believe to be one of the oldest woods near London, and a greater part of the *Q. sessiliflora* appears to be trees from old stools." To this the Secretary, Mr. G. Bentham, adds a note, as follows:—"Mr. Atkinson's opinion on this subject is confirmed in a remarkable manner by the discovery that the oak in an extensive submarine forest near Hastings is *Q. sessiliflora*."

BROWN OAK

In a paper on British timber which I read before the Surveyors' Institution in February 1904,¹ I called attention to a form of oak timber, known as "brown oak," which does not appear to have been much noticed by any previous writer.² Though after very careful investigation I have failed to ascertain with certainty the causes which produce it, I am inclined to believe that it is not, as some have thought, caused by a fungus; though spores of some fungoid mycelium are often found running through it; but that the change of colour is produced, especially on certain soils and in certain localities, by age. And though I have evidence that in exceptional cases the heartwood of quite young oaks is brown,³ the majority of the trees which produce this beautiful and valuable wood are in an incipient stage of decay, and often hollow, leaving only a shell of more or less sound wood. The change of colour in some trees commences at the ground and extends upwards, or less commonly begins in the upper part and extends downwards. No one can be certain, without boring or felling the tree, whether the wood is brown or how far the colour may extend; but if the tree is allowed to stand too long after it has become brown it loses its "nature," to use a carpenter's expression, and is often so shaky and full of cracks that it is of little use. The sapwood always remains of the normal colour. But when a brown oak of good rich colour contains sound and solid timber it is superior to any wood I know for the interior decoration of houses, and for the making of sideboards and other heavy furniture.

Until about fifty years ago this wood was little valued in England, and I am told that on the Duke of Bedford's estate its use was prohibited in building contracts because it was supposed to be unsound. Even now it is hardly known or recognised as valuable except in certain parts of England, and is often sold far below its real value by inexperienced persons. But the Americans have created such a demand

¹ *Trans. Surveyors' Institution*, vol. xxxvi. pt. vii.

² Laslett, ed. 2, p. 96, only says of it, "and even when in a state of decay or in its worst stage of 'foxiness,' the cabinetmaker prizes it for its deep red colour, and works it up in a variety of ways."

³ Mr. Alexander Howard tells me that he has seen a group of young oaks felled in Essex, which were not more than 12 to 18 inches in diameter, all perfectly sound, in which the wood was of a rich brown all through the trunk up to and beyond the first main branch. He purchased near Chelmsford a very fine oak which had no less than five secondary trunks growing out of the butt, all of a very rich brown colour, and a number of younger trees growing near it in the same park also proved to be of the same colour. Thus it seems that though the conditions of the soil have some influence, yet the colour may in some cases be inherited. Mr. Howard has inquired for many years but never heard of a brown oak on the continent, and believes it to be only found in this country. Some woodmen in Essex have thought that the trees which carry their leaves longest in winter produced "red oak," which is the local term for brown oak, but I could get no definite proof of the truth of this idea.

for it, that most timber merchants are now quick to appreciate the difference between brown and common oak, and the best qualities of it are sometimes sold for as much as 10s. per cubic foot.

When the wood shows the blackish streaks running through it, which is known as tortoise-shell grain, it is most valued for cutting veneers. These are laid in thin sheets on other wood, partly to make it go farther, and also because this wood is so difficult to season properly, and so wasteful in conversion that it is not safe to use in the form of thick boards.

My friend, Dr. Weld of Boston, U.S.A., who is a great connoisseur and admirer of fine woods, and especially of brown oak, showed me at his house the most magnificent specimens of panelling and wainscoting, done under his own supervision by Messrs. Noyes and Whitcombe of Boston, with oak which he selected and purchased himself in England. In their works I saw a quantity of carved brown oak pews, and a very large brown oak organ front designed by Mr. C. Brigham, architect, of 12 Bosworth Street, Boston, for a memorial church at Fairhaven, Mass. Mr. Whitcombe was good enough to show me the manner in which the boards are seasoned after they are cut from the logs, which are imported in the rough as an unmanufactured product to escape the heavy duty. Dry white pine boards fresh from the hot-air kiln are laid on each side of the oak boards, and properly stripped in an open covered shed. When the moisture has been partially absorbed, they are all turned over and again sandwiched between fresh dry pine boards; thus saving a great deal of time, which is rarely given to season timber properly in America, and preparing the wood to stand the conditions of dryness, which are more trying to furniture in American than in English houses.

Mr. C. M'Kim, a distinguished American architect, writes me as follows respecting English oak:—"We regard it as the most beautiful oak in the world, costly because of its scarcity and the duties imposed upon it; requiring the best workmanship in putting it together; but preferred above all others for its finer quality, richer colour, and endurance. The most important and dignified panelled rooms in this country are furnished in English oak." I also was pleased to find that the great dining-room in the White House at Washington is completely panelled with English brown oak.

Mr. F. H. Bacon of the A. H. Davenport Company of Boston, one of the best firms for cabinet work in the United States, writes:—"Mr. Davenport has been using it in his business for at least thirty years, and we think it is a wood which will always be in demand, as a room furnished with English oak has a richness and depth of tone which is impossible to get with any other oak. The wood is becoming more expensive, but I think it will always be used by people who can afford it. It is difficult to work; the plain surfaces are generally veneered. It stands perfectly well without warping and twisting, and is not attacked by worms as walnut wood is."

The best example that I have seen of fine brown oak work in England is at Rockhurst, the residence of the late Sir Richard Farrant, in Sussex. This

was done by Marsh, Cribb, and Company of Leeds, with brown pollard oak, showing very varied figure, and superior in this respect even to that of Dr. Weld's house.

This wood requires no varnish, but when simply polished with wax and shellac only, in the manner adopted by Dr. Weld, is as rich as any mahogany. It is to some extent imitated by a practice called fuming, which is now very commonly used to give a darker colour to foreign oak, and thus make it resemble old oak, which has become so fashionable; but fumed oak can easily be distinguished from, and is far inferior to real brown oak, which also varies a good deal in colour when new.

POLLARD OAK

There is another form of oak wood usually called pollard, which is produced from the burrs or swellings which often appear on old oaks, especially in very dry and in wet ground. The real cause of these excrescences is not yet fully explained; but in some places, and especially in Sherwood Forest, they are very common, and when cut, show a twisted and contorted grain, sometimes full of little eyes which resemble those of the so-called "birds'-eye maple," a variety of the wood of American maple, of which we shall speak later.

Pollard oak is usually full of little cracks, and is best cut into thin slices or "plating" $\frac{1}{8}$ inch thick or less. When polished the little cracks are filled up, and when the wood is mottled with brown, yellow, and pink in various shades it is very beautiful. An oak of this type, which was only about 10 feet high and 9 feet in girth, grew on Chedworth Downs, Gloucestershire, and was given to me by the Earl of Eldon. Its wood, when cut into veneer, was throughout the whole thickness of the tree more like that of birds'-eye maple than oak, and has served to make the front of a very handsome bookcase.

OAK PANELLING

I cannot pass from this subject without alluding to the use of English oak for panelling walls, a practice which was almost universal in houses built in the sixteenth and seventeenth centuries, and of which many beautiful examples still exist. Modern architects, however, do not seem to have properly appreciated, that the beauty and fitness of oak for such work depends on the extent to which the "figure," "flower," "silver grain," or "flash" is shown—all these terms are used to express the bright glossy patches and lines which the medullary rays of oak show when cut "on the true quarter."

In our ancestors' time, when roads were bad or non-existent, and when sawmills were unknown, it was necessary to cut up large oak trees where they fell, either by digging a saw pit near or under them, or by cross-cutting them into suitable lengths, and then "rending," cleaving, or splitting them into slabs. This practice is now adopted principally for making oak palings and for wheel spokes, which are much stronger

when rent than when sawn; but it will be found on examination of the back of old panelling that it was usually rent, and as you can only cleave oak on the line of the medullary rays, the figure shown by rent oak is much better and more abundant than when sawn on the quarter, and though the practice is more wasteful and is only possible in the case of straight-grained trees, yet it should certainly be tried by those who admire finely figured oak.

Strange to say, the importance of selecting and matching the figured pieces, and of placing them in the most conspicuous positions, does not seem to be noticed, for I have seen in modern houses, and in old castles on whose restoration no expense has been spared, panelling in which new and plain pieces have been introduced amongst splendid old panels, and finely figured new and old panels put in dark corners where they were unseen. When one considers how small a proportion the cost of the wood bears to the workmanship, it is extraordinary that this should be allowed, or that American oak should be used, as I have seen sometimes done, in restoring ancient houses, when infinitely better and more beautiful wood was growing, and often rotting on its roots, within a very short distance.

Experienced cleavers are not to be found in every county, but in Kent, Surrey, Sussex, and Hants, and where rent oak palings are much used, as in the neighbourhood of London, such men may be found, who with a tool called a "break-axe" or "flammer," will convert straight-grained oak into slabs of suitable dimensions for panelling, which, when properly seasoned, show better figure than sawn timber. For this purpose logs of not less than three feet diameter should be selected, as straight as possible in the grain, and cut into the lengths of which the panels are required. The slabs come out rather irregular in size, and are, of course, much thicker on the outside. They should be carefully piled for about twelve months in a dry, airy place, when they can be reduced by a thin circular saw and by planing to the proper thickness, choosing whichever side shows the best figure for the face. Longer and narrower pieces, either rent or sawn, must be selected for the stiles and rails, and if put together by a competent joiner, I can say from experience that the effect will be much superior to work done by the best London firms with foreign timber, especially when brown oak can be found fit for rendering.

The diagram, Fig. 1, on the following page shows the best method of rending oak to show its fine figure.

For quartering by the saw different methods are adopted, the best being that shown on the following page, Figs. 2 and 3, taken, by permission of Messrs. Rider and Son, from a very useful little book.¹ By this method, which, though rather wasteful, produces the best results, only the central boards of each cut are on the true quarter, and the others are narrower, and more or less across the natural line of cleavage.

Of the different styles of oak panelling it is not my intention to speak, but it seems to me that elaborate carving is out of place in such wood as this, which wants no extraneous adornment. Many beautiful specimens of ancient panelling in various

¹ *English Timber and its Economical Conversion*, London, 1904.

styles may be seen in the galleries of the South Kensington Museum, among which that taken out of Sizergh Castle, Westmoreland, is, though rough in workmanship, a good example of ornamentation with native wood.

One of the most elaborate instances of room-decoration in woodwork of old times is seen in the dining-room at Gilling Castle, near York, formerly the property of the Fairfax family, now belonging to W. S. Hunter, Esq. It is a room about 30 by 20 feet, and is panelled with large panels of oak, in oblongs 2 feet 4 inches wide and 3 feet deep, surrounded by heavy carved mouldings. Each panel is inlaid with highly intricate and varied geometrical patterns in narrow lines of black and white wood, which I believe to be bog oak and holly, inlaid in narrow lines, and forming an elongated diamond in the middle of the panel. The four corners of each

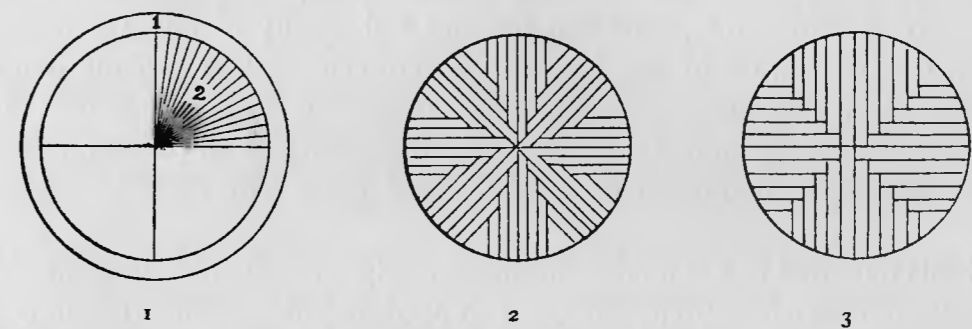


FIG. 1. (1) Sapwood; best taken off. (2) Feather-edged boards somewhat variable in width and thickness, but following the natural line of cleavage on the medullary rays of the wood.
FIGS. 2 and 3. Methods of quartering by the saw.

panel are also inlaid with flowers done in similar wood. This work runs from the ground up to about 10 feet high, above which an elaborate decoration in colour, containing many family trees and coats of arms, reaches to the ceiling. Some good judges think this is the most beautiful room in England, but without resorting to such minute and fanciful patterns, I may safely say that good plain oak panelling, in which the stiles and rails are duly proportioned, and the silver grain well matched in each panel, gives not only the handsomest and richest effect of any wall covering I know, but is also the most durable, improving in colour with age, and if done with one's own timber, affords an interest which no Italian frescoes or plaster work can give.

In the chapel, in the hall, and in the Earl's study at Powderham Castle, Devonshire, are very good examples of pews and panelling, both of the linen pattern and carved panels, but though the linen pattern was once a favourite one, and is still copied by some decorators, it seems to me a mistaken notion to imitate the folds of a textile material in wood, and especially in oak.

WAINSCOT OAK

What is usually known under this name was for many years imported from the Baltic seaports of Dantzic, Riga, and Libau, and was the produce of forests in the interior of the Russian Baltic Provinces, and of Russian Poland, from whence it was brought to the coast by water, until railways were made. According to Laslett, the Riga timber, though of moderate dimensions, had the medullary rays more numerous and better marked than the Dantzic oak, and came to market in the form of hewn billets of about 18 feet.

But as the supplies of this oak became less, and the demand greater, a fresh source of supply was found in Slavonia and South Hungary, which for many years has furnished about half the total import through the ports of Trieste and Fiume. Mr. A. Howard tells me that the size and quality of this was better than the Baltic oak, but owing to the Austrian Government having recently diminished their cuttings in consequence of the rapid diminution of mature timber, a large quantity of billets are now exported from Odessa, which are believed to come from the forests of Podolia and Volhynia, and other provinces of South-West Russia.

All this imported oak is milder and more easily worked than English oak, and as only selected logs free from knots are shipped, it can be converted into boards with less waste and risk than home-grown timber. We have no certain evidence as to the existence of a sufficient quantity in Russia to keep up the supply either from the Baltic or Odessa, and though the more scientific foresters of Austria are taking steps to restore their oak forests by natural regeneration, it is probable that the French, who consume an immense quantity of oak from this region, will take all they can get, and this, coupled with the approaching disappearance of American oak large enough for quartering, must, sooner or later, cause our own timber when long and clean to be much more valuable than it is at present.

A note in Holinshed's *Chronicles*,¹ vol. i. p. 357 (ed. 1807), seems to show that wainscot oak was already exported from the Baltic as long ago as Queen Elizabeth's reign, but whether "Danske" means that it came in Danish ships or from the port of Dantzic I cannot ascertain, though Colonel Brookfield, H.B.M. Consul at that port, has made inquiry on the subject.

Laslett is the only practical English writer I know of who was personally acquainted with the oak in its native forests in the east of Europe, having been employed by the Admiralty to survey the forests near Brussa, in Asia Minor, as well as in Bosnia, Herzegovina, Croatia, Styria, and Hungary. He states that in the

¹ According to Mr. J. C. Shenstone, Harrison of Redwinter in Essex, who lived in the reign of Henry VIII., was the author of this note. "Of all oke growing in England the parke oke is the softest, and far more spalt and Prickle than the hedge oke. And of all in Essex, that growing in Bardfield parke is the finest for joiner's craft; for often times have I seene of their workes made of that oke so fine and faire as most of the wanscot that is brought hither out of Danske, for our wanscot is not made in England. Yet diverse have assaied to deale with our okes to that end, but not with so good successe as they have hoped, because the ab or juice will not so soone be removed and cleane drawne out, which some attribute to want of time in the salt water."

forests south-east of Brussa he found oaks resembling the English *Q. Robur* on the upper ranges of the mountains, while in the valleys *Q. Cerris* or the mossy-cupped oak was found. In Austria, he says, that in the Kogarate mountains, and in the district between the rivers Verbas and Okvina they were chiefly of the sessile variety, mixed occasionally with *Q. Cerris*, and all of straight growth with long clean stems, generally of good quality, but at that time no attempt had been made to utilise them except for cleaving cask staves.

Of all the oaks of which trials were made in our Government dockyards during the period at which British oak became scarce, Laslett says that the white oak of North America compared very favourably with all the foreign oaks, but proved to be slightly inferior in strength to English oaks.

BOG OAK

This is obtained from trees which have been buried in peat bogs for centuries, and which has become blackened by the peat water. It is very commonly found in Ireland, and in some parts of England and Scotland. When large and sound enough it is used for furniture, picture frames, and for small ornamental work, but as a rule is so full of shakes, and cracks so much in drying after it is dug up, that it is of no use for cabinet-making except in the form of inlay, or marqueterie. Occasionally, however, fine sound logs are dug out, which if slowly seasoned in an airy cellar may be used for larger work. One of the best examples I have seen of black oak was a door exhibited by Mr. E. R. Pratt of Ryston at the Royal Agricultural Society's Show at Park Royal in 1905, made from oak found on his property in Norfolk. He tells me that the planks after being sawn are dressed two or three times with "fuel" or "dead" oil which replaces the evaporated water by the refuse of petroleum, a substance theoretically similar to that lost by age. The result is certainly very successful.

Many cases have been recorded and published of the great durability of the timber of the oak under ground and under water; but I have come across no relic of the past so interesting in this respect as the prehistoric boat which was dug up at Brigg, in Lincolnshire, in 1884, when digging a foundation for a gasometer. This has been well described by the Rev. D. Cary Elwes in a lecture, which was published in 1903,¹ and a photograph of it is published in a recent pamphlet by the Rev. A. N. Claye,² for which I am indebted to Miss Woolward. This wonderfully preserved dug-out was hollowed out of one huge oak log 48½ feet long, and approximately 6 feet in diameter, which showed no signs of branches, a log which must have contained nearly 1000 feet of timber, and which could not be matched now in England, or, so far as we know, in Europe or North America. The boat is 4 feet 3 inches wide by 2 feet 8 inches deep at the bows, and 4 feet 6 inches by 3 feet 4 inches at the stern, which was the root end of the tree. The sides are about 2 inches thick, the bottom 4 inches at the bows, and as much as 16 inches at the stern. The stern piece was

¹ *A Prehistoric Boat*. Stanton and Son, Northampton.

² *Brigg Church and Town*. Jackson, Brigg.

ingeniously fitted in, though not found *in situ*, and a large rift on one side had been still more cleverly repaired with wooden patches caulked with moss. No metal had been used in any part of it. The boat was found embedded in the blue and brown clay which underlies the peat, and is considered on geological evidence, which is given with great detail, to be from 2600 to 3000 years old. It was offered by Mr. Cary Elwes to the British Museum, but was declined as being too large; it is, however, now suitably housed at Brigg.

Many similar oaken boats of smaller dimensions have been discovered in various parts of England, and I saw one myself which had been just dug out of a peat bed close to Shapwick Station, in Somersetshire, in September 1906, which was 20 feet long by 2 feet 10 inches wide.

At Brigg an ancient causeway was discovered, which is described by Mr. Claye in the same pamphlet, and a photograph given. This roadway was found in a brickyard lying between the two branches of the river, under a deposit of blue alluvial clay, and above the forest bed which lies on the top of the glacial drift, and was probably made by the early Britons to secure a safe passage across the valley when it was little more than a swamp. Small trees and branches of yew were laid lengthwise, and across them rough planks of oak, which were fixed in their place by long wooden pins driven through holes at each end. From the photograph the wood appears to have been well preserved, but having been covered up again shortly after the excavation was made, I can give no further details of its condition. In the same place was discovered a sort of raft or flat-bottomed boat, 40 feet long and 6 feet wide, which was also covered up again. From the illustration given, this seems to have been made of five logs placed side by side, and held together by cross ties passing through holes in projections on the upper side of the logs.

In the foundations of Winchester Cathedral, oak piles had been used to form a solid foundation in the wet peaty soil on which part of the structure rested. When the Cathedral was under restoration in 1906, samples of these piles sent me by Mr. Jackson, the architect of the work, who said that they were put down in the time of William Rufus, were in places decayed. Some logs of beech laid horizontally under the same building, which Mr. Jackson attributes to Bishop de Lucy, about A.D. 1206, remained comparatively sound, and, though the wood has changed from its natural colour to a grey, is fit to use as boards for book-binding.

With regard to the foundations of the Campanile at Venice, it has been stated that they were laid on larch piles, which are still used in that city for the same purpose; but when I was at Venice in 1905 I inquired into this, and was given a section of an oak pile only about 6 inches in diameter, but perfectly sound and very hard, which was cut from one of the piles taken from the foundation of the Campanile after it fell.

(H. J. E.)

L A R I X

Larix, Adanson, *Fam. Pl.* ii. 480 (1763); Bentham et Hooker, *Gen. Pl.* iii. 442 (1880); Masters, *Journ. Linn. Soc. (Bot.)* xxx. 31 (1893).
Pinus, Linnæus, *Gen. Pl.* 293 (in part) (1737).
Abies, A. L. de Jussieu, *Gen.* 414 (in part) (1789).

TREES belonging to the order Coniferæ, with thick scaly bark, irregular and not whorled branches, and deciduous foliage. Branchlets of two kinds, long shoots bearing solitary leaves spirally arranged, and short shoots bearing numerous leaves in tufts at their extremities, these leaves being of unequal lengths and arising each in the axil of a bud-scale. Leaves linear, either flattened or keeled above, always strongly keeled beneath, with a single fibro-vascular bundle and two resin-canals close to the epidermis of the outer angles. Buds of three kinds: (1) terminal on the long branchlets and developing either into long or short shoots; (2) axillary on the long branchlets, scattered, solitary in the axils of the leaves, and developing occasionally into long shoots, or more commonly producing short shoots with apical tufts of leaves; and (3) apical buds on the short shoots, which usually on developing slightly prolong the short shoot and produce again a tuft of leaves, this process being repeated for several years; or occasionally suddenly elongate into long shoots with solitary leaves, or produce flowers. In this way a complicated and irregular system of branching results, very different from that produced by the regular whorled buds of pines, silver firs, and spruces.

Flowers monœcious, fertilised by the wind, arising solitary on the apices of short shoots of two to six years old. Male flowers always much more numerous than the females, directed downwards; globose, ovoid or oblong; sessile or stalked, surrounded at the base by scales, and composed of numerous stamens with short stalks spirally arranged on a central axis; anthers two-celled, dehiscing longitudinally; connective rounded. Female flowers always erect, subglobose, girt at the base by a bundle of leaves, and consisting of a series of orbicular, stalked, ovular scales, each in the axil of a much longer mucronate, oblong bract. The scales, each bearing two ovules, increase in size, as the flower develops into the fruit, while the bracts do not increase.

Fruit a cone, short-stalked and always erect, composed of concave imbricated woody scales, which are persistent and are either longer or shorter than the bracts; cones ripening at the end of the first season, the scales opening and letting out the seeds, which are distributed by the wind in autumn or in the following spring, the

empty cones remaining on the branches for several years. Seeds, two on each scale, with a translucent wing, which remains coalesced with the seed, covering it entirely on the upper side, and extending for some distance along its outer edge.

The genus is confined to the temperate and colder regions of the northern hemisphere, and comprises about fourteen described species. Four of these, which we have not seen either growing wild or in cultivation, will now be briefly alluded to.

Larix Cajanderi, Mayr, *Fremdländ. Wald- u. Parkbäume*, 297, fig. 88 (1906). Discovered by Dr. Cajander in eastern Siberia, where it occurs along the banks of the river Lena from the mouth of the Aldan at 68° N. lat. northwards to 72° N. lat., becoming here a stunted tree only 10 to 20 feet in height. It usually forms mixed woods with the Siberian spruce or *Betula odorata*, assuming in wet soil the same appearance as is presented by *L. americana* in the swamps of Wisconsin; or on unflooded land growing pure to a height of about 70 feet. Judging from the description it is closely allied to, if not a mere variety of, *L. dahurica*. The young branchlets are yellowish brown with scattered hairs, older branchlets becoming ashy grey. The leaves are very long, up to 2 inches in length; and are accompanied on the opening of the bud by a tuft of dense whitish pubescence, which is absent in *L. dahurica*. The cones are small, with about twenty scales, which gape widely when ripe, and are broad and concave on the upper margin.

Larix Principis Rupprechtii, Mayr, *op. cit.* 309, figs. 87, 94, 95 (1906). This species was discovered by Mayr on the Wu Tai mountain in the province of Shansi in northern China; and appears to resemble strongly the European larch, from which it differs in the cone-scales being finely denticulate and glabrous, with bracts short and only visible towards the base of the cone. This species has been introduced into Europe by Mayr, who brought a living plant to Grafrath, near Munich, which is growing there very vigorously.

Larix kamtschatika, Carrière, *Conif.* 279 (1855); *Abies kamtschatika*, Ruprecht, *Beit. Pflanzenkund. Russ. Reich.* ii. 57; *Pinus kamtschatika*, Endlicher, *Conif.* 135 (1847). This species, which occurs in Kamtschatka, is said to differ from *L. dahurica* in having larger cones. It is imperfectly known, and has not been introduced.

Larix chinensis, Beissner, *Mitteil. Deutsch. Dendrol. Gesell.* 1896, p. 68, and 1901, p. 76; and *Nuov. Giorn. Bot. Ital.* iv. 183, t. 5 (1897). A tree, dimensions of which are not stated. Branchlets yellow, glabrous. Leaves up to 1¼ inch long, triangular in section, stomatose on the under surface. Cones ovoid-cylindrical, 1½ to 2 inches long; scales numerous, orbicular, entire, coriaceous, furrowed and tomentose on the outer surface, standing horizontally in the opened cones; bracts lanceolate, truncate at the narrowed apex, with a short mucro, extending considerably beyond the upper margin of the scale, and appressed and not recurved in the unripe cone. Seeds about ¼ inch in length with a broad wing slightly exceeding the seeds in length.

This species, specimens of which I have recently seen in the Museum at Florence, was discovered at 10,000 feet altitude in the Peling mountains of Shensi in China by Père Giraldi in 1893. Beissner has raised seedlings from seeds sent in

1899, and some of these have been grafted on the common larch and are now growing in the Arnold Arboretum, Massachusetts.

This larch in botanical characters stands nearest to *L. occidentalis*. Occurring at a high elevation in Shensi at about lat. 38°, it should prove perfectly hardy in this country; but must not be expected to be of much importance as a forest tree.

The remaining species, ten in number, are tolerably well known, and are readily distinguishable by the characters of the cones and flowers. In the absence of cones, the following arrangement will give a good clue to the species:—

A. *Leaves deeply keeled on both surfaces.*

1. *Larix Lyallii*, Parlatores. Western N. America.

Young branchlets completely covered with a dense greyish tomentum, which persists in part in the second year.

2. *Larix Potanini*, Batalin. Western China.

Young branchlets bright yellow in colour, with a scattered pubescence.

B. *Leaves keeled only on the lower surface, the upper surface being flattened or rounded.*

* *Young branchlets pubescent.*

† *Leaves glaucous, bluish, with two conspicuous bands of stomata, each of five lines, on the lower surface.*

3. *Larix leptolepis*, Endlicher. Japan.

Branchlets of the second year reddish, with a glaucous tinge. Leaves numerous in the bundle, at least forty, long and slender, arranged in an erect cone-like pencil.

4. *Larix kurilensis*, Mayr. Kurile Islands.

Branchlets of the second year shining reddish brown, pubescent, not glaucous. Leaves few in the bundle, often only twenty to thirty, short and very broad, spreading so as to form an open cup around the bud.

†† *Leaves greenish, with two inconspicuous bands of stomata, each of two to three lines, on the lower surface.*

5. *Larix Griffithii*, Hooker. Himalayas.

Branchlets of the second year very stout, dull reddish brown, pubescent. Short shoots broad and fringed above by very large loose reflected pubescent membranous bud-scales.

6. *Larix occidentalis*, Nuttall. Western N. America.

Branchlets of the second year slender, light brown, shining, pubescent. Short shoots slender, with narrow inconspicuous fringe of bud-scales.

7. *Larix sibirica*, Ledebour. Russia, Siberia.

Branchlets of the second year slender, shining, greyish yellow, glabrous, the long hairs present in the furrows between the pulvini of the first year's shoot having fallen off. Leaves very long and slender, up to 2 inches in length.

** *Young branchlets glabrous.*

† *Branchlets yellowish grey in colour.*

8. *Larix europæa*, De Candolle. Europe.

Branchlets of the second year shining, glabrous, yellowish grey.

8A. *Larix sibirica*, Ledebour, *var.* Russia.

In certain specimens of this species the branchlets are indistinguishable from those of *Larix europæa*, and in the absence of cones only show a difference in the leaves, which are very long and slender in *L. sibirica*.

†† *Branchlets brown in colour.*

9. *Larix americana*, Michaux. North America.

Young branchlets often glaucous. Branchlets of the second year shining brown. Short shoots blackish. Leaves short, not exceeding $1\frac{1}{4}$ inch in length.

10. *Larix dahurica*, Turczaninow. Siberia.

Young branchlets never glaucous. Branchlets of the second year shining brown. Short shoots blackish. Leaves long, exceeding $1\frac{1}{4}$ inch.

These two species strongly resemble each other in technical characters, but are readily distinguished, as seen in cultivation in this country, by the appearance of the branchlets, which in *L. dahurica* are vigorous, long, and straight, whereas in *L. americana*, which makes slow growth, they are short, curved, and twisted.

10A. *Larix occidentalis*, Nuttall, *var.* In glabrous specimens of this species the chestnut-brown coloured short shoots will readily distinguish them from either of the two preceding species.

Mayr says that though the various species of larch seem very different at the first sight, yet that they all have the same biological character, and are all inhabitants of the coldest limits of the forest, whether produced by latitude or altitude, and that when introduced into warmer regions or zones, they lose their economic usefulness through premature fruitfulness or fungoid attacks. This opinion, though so often expressed in various forms by foresters of continental experience, is not strictly applicable to Great Britain, as the pages of this work will prove; and though the liability to spring frost is greater with the more northern and alpine species, yet in their native countries larches are also subject to frosts during almost every month in the year, and though the young shoots in spring and the unripened wood in autumn are often much injured by frost, yet no trees have a greater power of recovering from injuries produced by climatic influences, provided the soil is suitable; and Mayr truly says that the warmer the climate in which the larch is cultivated the better the soil it requires. He considers that the timber of all larches is practically of equal value, its quality depending on the slowness at which it is grown, rather than on the species or origin of the parent tree.

LARIX EUROPÆA, COMMON LARCH

Larix europæa, De Candolle¹ in Lamarck, *Fl. Franç.* 3rd ed. iii. 277 (1805); Loudon, *Arb. et Frut. Brit.* iv. 2350 (1838); Willkomm, *Forstliche Flora*, 140 (1887); Mathieu, *Flore Forestière*, 555 (1897); Kent, *Veitch's Man. Coniferae*, 391 (1900).

Larix decidua, Miller, *Dict.* ed. 8, No. 1 (1768); Kirchner, Loew, u. Schröter, *Lebengesch. Blütenpfl. Mitteleuropas*, 155 (1904).

Larix pyramidalis, Salisbury, *Trans. Linn. Soc.* viii. 314 (1807).

Larix vulgaris, Fischer, *ex Spach, Hist. Vég.* xi. 432 (1842).

Larix Larix, Karsten, *Pharm. Med. Bot.* 326 f. 157 (1882).

Pinus Larix, Linnæus, *Sp. Pl.* 1001 (1753).

Pinus læta, Salisbury, *Prod.* 399 (1796).

Abies Larix, Poiret in Lamarck, *Dict.* vi. 511 (1804).

A tree attaining 100 to 150 feet in height² and 10 to 15 feet in girth. Bark of young stems and branches smooth and grey; on older stems (twenty years and upwards) fissuring and scaling off in thin irregular plates, exposing the reddish cortex below; at the base of old trunks in the Alps becoming extraordinarily thick, a foot or more. Young branchlets slender, glabrous, greyish yellow, with linear pulvini separated by narrow grooves; in the second and third year shining yellow with more elevated pulvini, at the apices of which are the scars of the fallen solitary leaves; base of the shoot girt by a sheath of the bud-scales of the previous season, within which is visible a ring of pubescence. Short shoots dark brown, with rings of pubescence marking each year's growth. Terminal buds small, globose, resinous, with glabrous scales, the lowermost of which are subulately pointed. Lateral buds hemispherical, glabrous, broadly conical, surrounded at the base by a dense ring of hairs.

Leaves light green, soft in texture; those solitary on the long shoots shorter, broader, and more acuminate than those in the tufts, the latter differing in length, the longest about $1\frac{1}{2}$ inch long, and rounded at the apex; upper surface flat or rounded, with one line of stomata on each side; lower surface deeply keeled, with two to three lines of stomata on each side.

Male flowers sessile, ovoid, $\frac{1}{8}$ to $\frac{2}{8}$ inch long. Pistillate flowers, reddish or occasionally whitish, ovoid, about $\frac{1}{2}$ inch long; bracts, with their mucronate apices pointing upwards and outwards and not reflected or recurved, about $\frac{1}{4}$ inch long, oblong, widest at the base, deeply notched above between two pointed projections; mucro about $\frac{1}{2}$ inch long.

Cones ovoid, with the tips of the bracts slightly exerted, $1\frac{1}{4}$ to $1\frac{1}{2}$ inch long,³ the terminal scales small and not gaping but closing the rounded or flattened apex of the

¹ We adopt the name *Larix europæa*, although it is not the oldest one, because it has been in general use for over a century. According to a note at Kew of Alph. de Candolle the *Flore Française*, 3rd ed., was published in reality in 1805, and not in 1815, as it is printed in the volume at Kew.

² Kerner, *Nat. Hist. Plants*, Eng. trans., i. 722 (1898), gives the greatest certified height of the larch as 53.7 metres, equal to 176 feet; and this refers to a tree growing in Silesia, mentioned by Mathieu, *loc. cit.* 556.

³ In the Museum at Florence there are specimens from Courmeyeur, in the Piedmontese Alps, with cones two inches in length, the largest which I have seen, and remarkable for the dense velvety pubescence of their scales.

cone. Scales in four to five spiral rows, nine to ten scales in each row, about $\frac{1}{2}$ inch broad and long, convex from side to side but flattened longitudinally, with the apex usually retuse, often emarginate or rounded; margin thin, entire, not bevelled, and neither inflexed nor recurved; outer surface light brown pubescent, the pubescence most marked towards the base. Bracts oblong, widest at the base, truncate or rounded at the apex, with a short mucro extending about half-way up the scale. Seeds in shallow depressions on the scale, with wings narrowly divergent and extending almost quite to its upper and outer margin; body of the seed $\frac{1}{8}$ inch long, wing short and broad, widest near the base; seed with wing less than $\frac{1}{2}$ inch long; wing $\frac{1}{5}$ inch broad.

VARIETIES

The flowers of the common larch are occasionally white in colour.¹ This occurs both in the wild state and in cultivated trees, as at Arley Castle.

Various kinds of weeping larch have been found wild or have originated in cultivation: and some have been propagated by grafting. *Var. pendula*, Lawson, is noted by Loudon, who states that there were large trees of this kind at Dunkeld, which had been raised from Tyrolese seed. In this form there is an erect leader, and the branches are spreading or even ascending, the branchlets being very slender, elongated, and quite pendulous. In another form of weeping larch the habit is quite different, as it has no tendency to form an erect leader, the trunk remaining short and often divided near the top into several secondary stems that are bent downwards, as are the branches and branchlets. A remarkable example² of the latter form, with extremely long slender pendulous branchlets, was growing in 1888 in Mr. Maurice Young's nursery at Milford. *Var. pendulina*,³ Regel, *Gartenflora*, 1871, p. 101, does not seem to be essentially different in habit from this. Loudon⁴ mentions a remarkable pendulous larch at Henham Hall, Suffolk, which was planted in 1800, and was supported on pillars, the main branches forming a covered alley 80 feet long and 16 feet wide in 1841. I am informed by Mr. Simpson, gardener at Henham Hall, that this tree is now in good health, the tall shrubs which surrounded it having been cleared away on one side some three years ago, since when it has made surprising growth. At three feet from the ground it measures 8 feet 2 inches in girth, and at about eight feet forms an angle, and extends laterally for a great distance, being supported on pillars and cross pieces which form a pergola 140 feet long, 8 feet high, and 10 to 14 feet wide, which is almost completely covered by its branches, and will shortly require extension. In a note at Kew, dated 1882, Sir J. Hooker mentions a weeping European larch at Waterer's nursery, Bagshot, which was 50 feet high and had the habit of *Larix Griffithii*.

¹ Referred to in *London Catalogue of Trees*, 43 (1730).

² Well figured in *Gard. Chron.* iii. 430, 531, Supplementary Illustration (1888). *Var. pendula*, Lawson, is figured in *Gard. Chron.* ii. 684, fig. 132 (1887).

³ Cf. Beissner, *Nadelholskunde*, 325, fig. 89 (1891).

⁴ *Gard. Mag.* 1841, p. 353. Another weeping larch is figured in the same journal, 1839, p. 574.

DISTRIBUTION

The most recent account of the distribution of the European larch is by Cieslar,¹ the distinguished Austrian forester, who points out that the tree in the wild state occupies four distinct and separate regions, namely, the Alps, the Silesia-Moravia boundary, Russian Poland, and the Tatra mountains in the Carpathians. Cieslar strongly disputes the commonly accepted view that the larch is everywhere an alpine tree, occurring at high elevations; and holds that the Silesian and Alpine larches are two distinct climatic varieties, differing in habit and mode of growth, in period of vegetation and in the altitude at which they naturally grow. He has not apparently studied the Polish tree, of which I have seen no specimens, nor the Carpathian larch.

In the Alps, the larch is widely distributed, occurring in French territory in Savoy, Provence, and Dauphiné; and in the Maritime Alps it reaches about 44° 30' N. lat., its most southerly and at the same time its most westerly limit. In Switzerland the larch, while generally found, does not occur in the Jura and in the cantons of Glarus, Schwyz, Upper and Lower Unterwald; it reaches its most northerly point in Switzerland on the Gäbris in Appenzell. Extending eastwards it occurs in Vorarlberg, in the Alps of Bavaria and Salzburg, in the Tyrol and in Carinthia. According to Cieslar it is wild in the provinces of Upper and Lower Austria only south of the Danube, but is found near Vienna as a planted tree. It is absent from lower Styria and nearly the whole of the Karst; and in Carniola does not occur wild south of the Sannthaler Alps; from Idria the southern limit of distribution runs westward into Italy through the Isonzo valley. In Italy the larch is confined strictly to the Alps and is not wild in the Apennines, where it has been occasionally planted with unfavourable results, as the tree, after growing rapidly for twenty years, slackens in growth and becomes decrepit at 40 to 45 years old.² Elwes saw it planted in the Sila mountains of Calabria, where it was producing seed at 10 to 15 years old.

In the Alps the larch is certainly an alpine tree, often reaching the timber line in company with *Pinus Cembra* and *Pinus montana*; while lower down, but above the zone of the beech, it is usually met with either pure or in company with the spruce and silver fir. It occurs, mixed with the beech, at low elevations, according to Cieslar in certain valleys of the Tyrol. M. Coaz,³ Inspector-General of Forests of Switzerland, is of opinion that the forests of pure larch which now exist in the Alps are not natural, but have been produced artificially by cutting the ancient mixed woods. The larch has taken possession of the felled areas and has succeeded well as regards growth; but the pure forests are liable to insect attack and possibly also to disease; so that he thinks that it is necessary to restore artificially the ancient and natural condition of the forest. The highest elevation recorded for the larch is 8200 feet in the Dauphiné. The upper limit in the Central

¹ *Waldbanliche Studien über die Lärche*, 4 (1904).

² Borzi, *Flora Forestale Italiana*, 25 (1879).

³ See *Garden and Forest*, 1895, p. 238, for a résumé of M. Coaz's monograph on "Insect Ravages in the Forests of Larch on the High Alps."

Alps varies from 6500 to 8000 feet, and in the Engadine is 7622 feet; on Mont Blanc 7218 feet; at Zermatt 7874 feet; in Northern Switzerland, Salzburg, and the Bavarian Alps, 6400 feet; in the Venetian Alps 6700 feet. The lower limit to which the larch descends in the Alps is 1400 feet at Martigny, 2300 feet at Castasegna, 2000 feet at Chur, 3000 feet in the Bavarian Alps, 2000 to 2300 feet in the South Tyrol, 1300 feet in Lower Carinthia, and 1600 feet in Lower Austria.

The Larch occupies on the boundary between Silesia and Moravia a small area, about 30 German square miles, lying between the rivers Mohra and Oppa, and occupying a zone on the mountains between 1170 and 2840 feet elevation; but only occurring in a very scattered condition above 2600 feet. It grows here in mixture with spruce, silver fir, and beech; and appears to be indifferent to soil, as it is met with on primitive schists, grauwacke, and basalt: it occurs also on all aspects. It is absent from the adjacent high mountain of Altvater, which rises to 4900 feet, and is clothed with spruce and mountain ash. According to Cieslar, the Alpine larch has been unadvisedly introduced into Silesia, and it will be difficult in the future to obtain pure seed of the Silesian variety. Cieslar considers this form to be entirely distinct from the larch of the Alps, as it has a cylindrical stem, with slender branches and twigs which are directed upwards, and form a very narrow slender crown. The Alpine larch has stouter branches and twigs, which are directed horizontally, and form a much more spreading crown of foliage, the stem being much more tapering. Introduced into cultivation at low elevations, the Silesian larch is later to come into leaf, and sheds its leaves earlier in autumn, grows much faster, is less liable to damage from snow, and can, on account of its narrow pyramidal form, be planted much more densely. The Alpine larch will not bear crowding, according to Cieslar, and is an inferior tree for planting in every respect.

In Russian Poland, the larch is mainly met with on the hilly land of Lysa Gora, where it forms large forests on sandy soil between Konskie and Szydłowice, near Samsonow. It also extends over the right bank of the Weichsel into Galicia. According to Vrzozowski, the larch at one time was spread over the governments of Piotrkow and Warsaw, as churches and manor houses built 300 to 500 years ago of larch wood are still standing. The distribution of the larch in ancient times must also have extended considerably to the eastward, as a church built of larch in 1419 is reported to exist at Slucz in the government of Minsk in West Russia. Count Dzieduszycki's forester at Poturzyca, near Sokal, in Galicia, reports that larch occurs there between 600 and 800 feet elevation.

The larch occurs also, but not extensively, in the Tatra mountains, between Hungary and Galicia, where it grows on southwest slopes up to 5200 feet, reaching a somewhat higher altitude than the spruce and not ascending as high as the Cembra pine. Cieslar finds no reliable evidence for the larch being wild in the Carpathians east of the Tatra mountains; and does not credit its occurrence in Transylvania.

Prof. Hufferl¹ of Nancy states that the larch occurs, but is very rare, in Roumania, where he saw it in the mountains which separate the valleys of the Ialomitza and Prahova at 6300 to 6600 feet elevation. Here it was growing either in mixture

¹ *Forêts de la Roumanie*, 6.

with the spruce or higher than it. In Moldavia he reports it on the Ceahlău, where it rises on a southern slope to 5550 feet. The larch in Moldavia and Roumania has been considered to be *Larix sibirica*; but Hufferl doubts this.

Herr F. Mack, forest administrator at Azuga in Roumania, states¹ that larch is common at Bucecii above the beech region, at from 1300 to 1600 metres, mixed with spruce. It attains 60 to 65 centimetres, or about 2 feet in diameter, and is often clear of branches to a considerable height. The wood is hard, red, and durable, and was used in the construction of the Royal Palace of Sinaia.

INTRODUCTION

There is little doubt that the larch was introduced into England about the beginning of the seventeenth century, as Parkinson, who published his *Paradisus* in 1629, speaks of the tree as rare. Evelyn,² writing in 1664, mentions "a tree of good stature not long since to be seen about Chelmsford in Essex," and urged its cultivation as a useful timber tree. The earliest trees in Scotland are supposed to be those at Dunkeld, the history of which is given below; but we have no reliable evidence as to the exact date and locality where it was first planted. Loudon's account is very full and should be consulted. The very useful little book by C. Y. Michie on the larch, published in 1885 by Blackwood, must not be overlooked, as it gives a very good résumé by a practical forester whose experience in Scotland was considerable.

A. H.

PROPAGATION

Ever since it was realised by landowners that the larch was the tree which before all others could be looked on as profitable to plant, its propagation has been one of the most important branches of the nurseryman's business, especially in Scotland, where by far the larger part of the trees grown in England are raised; and until the disease spread all over the country, and it became evident that precautions must be taken, which in the palmy days of larch-growing were not considered necessary, the majority of raisers were not very careful as to the source from which their supplies of seed were obtained. It was generally supposed that Scottish seed was best, though in years when it could not be obtained in sufficient quantity foreign seed was used.

So far as I have been able to ascertain from very numerous inquiries, the reason for this idea was, that foreign seed usually germinated more quickly, and that the seedlings were therefore more liable to be killed by severe spring frost just as they were germinating. But as all the old larches in England and Scotland must necessarily have been raised from foreign seed, it seems obvious that though Scottish seedlings may have been most profitable to the nurseryman, yet that unless the seed was gathered from carefully selected trees, they were liable in after-life to show weakness of constitution, and succumb, as they often did, to the attacks of *Peziza Willkommii*.

¹ *Zeit. für Forst. und Jagdwesen*, Oct. 1904, p. 644.

² *Silva*, Hunter's ed., 1776, p. 297.

Another reason has been assigned, with some probability, to the apparently greater liability to disease of larch now than formerly, namely, that the cones are often gathered too early, and exposed to too much heat in the kilns in order to extract them. The cone of the larch does not open of its own accord usually until spring; often in this climate so late that the seedlings make little growth the first year, and the seed cannot be extracted without heat, or by breaking up the cones in a mill, which bruises and destroys many seeds; and in the climate of Scotland they do not often ripen so early or thoroughly as in the drier, colder, and sunnier climate of its native Alps: therefore it seemed to me desirable to make experiments with larch seed from abroad, in order to find out whether there was any real difference in the vigour of foreign and home-grown seedlings; and though my experience in this way now extends over fifteen years, I cannot say that I have solved the question.

On many occasions I have sown seed from Scotland, the French Alps, and the Tyrol, and have found that on my poor calcareous soil, which, though it grows larch very well, is not at all suitable for raising it, a large proportion of these seedlings from all sources either perished in infancy, or grew so slowly in the first two years that they were far inferior to seedlings raised in Scotland on a better soil and climate, and probably on manured land. But many of these weaklings have afterwards grown into robust young trees, and the difference in their liability to suffer from spring frost, which is their greatest enemy, is not sufficiently marked to enable me to form a sound opinion as to which are best.

What I have learnt, however, is that, though seedlings cannot be raised as cheaply or as rapidly at Colesborne as in a Scotch nursery, they are more satisfactory in other ways, because it is better to eliminate the weaklings before they are planted out than to have to replant them afterwards; and I believe that the greater the risk of disease the more careful one must be, not only in the selection of seed, but also in their nursery management. Another point in favour of home raising is that the seedlings are not exposed in their younger stages to the extreme drying of the roots which arises from the careless way in which they are often lifted and packed by nurserymen, and from the long delays in transit on the railway; and, finally, the transplantation in a private nursery is more carefully done, and the roots are better developed and more able to endure the severe check of final transplantation to a soil which is less favourable to their growth than that of the nursery.

Mr. J. P. Robertson, forester to the Duke of Devonshire at Chatsworth, writes me as follows with regard to the comparative hardiness of larch raised from native and foreign seed in 1903:—

“We have two nurseries, one at an elevation of 900 feet, the other at about 600. In both a large quantity of larch from home seed have been put in this spring, while in each a break of the Tyrolese, 10,000 in number of similar size, has been placed. These last were from two different nurserymen. In both nurseries the home variety has suffered severely from the strong white frosts that we had in Easter week, while the Tyrolese in each case is practically untouched.”

But on inquiry in 1905 whether this apparent superiority was still the case, he wrote:—

“I did not require to wait long to see the results reversed, as severe frosts in June of that same year, I think on 21st, 22nd, and 23rd, when we had 9°, 10°, and 8° of frost respectively, nearly put the Tyrolese bed out of existence, while those that had been cut earlier in the season (the home variety) did not suffer to anything like the same extent. I am now so thoroughly convinced in my own mind of the superiority of larch from home or British seed, that I have entirely discarded the Tyrolese.”

Though the seed is ripened in ordinary seasons in all parts of the country, and a few self-sown trees may be found on most estates where rabbits are kept down, yet our conditions of soil and climate are so unlike those of the natural larch forests of the Alps, that it is useless to attempt natural reproduction with any economic advantage. The only cases in which I have seen any number of self-sown seedlings in the southern half of England are where a clean felling has been made of the larch, and the ground more or less broken up by hauling out the logs immediately afterwards. Of the seedlings which germinate, so large a proportion are destroyed by frost, drought, or vermin in the first season, that the number remaining is not worth consideration, and their growth is so slow for five or six years that planted trees of half the age will usually be stronger. On sandy land, however, or at high elevations, and especially in Scotland, it may sometimes be worth while to encourage self-sown trees, but I cannot say that I have ever seen even a small area which is either sufficiently or regularly stocked by self-sown larch.¹ In the Alps, on the other hand, where the soil is covered with snow for three months or more, natural regeneration is both easy and regular, and I have, both in the French and Italian Alps, seen the ground covered with larch seedlings, which, taken up as late as May, when just uncovered by the snow, I have brought to England when a few inches high, with success. Indeed, it is wonderful how long seedlings will live if taken up when vegetation is just commencing, and sent by post in small tin boxes, tightly packed with a little damp moss or soil, and such trees are my most agreeable souvenirs of many visits to distant countries.

The manner in which the seed is collected in the French Alps is described to me as follows by M. Surel, Inspector of Forests at Briançon, a district which is celebrated for its larch forests:—“In February, before the season when the cones are ripe, we choose trees of which the cones are still closed, and spread large cloths round their trunks at about 10 feet from their base. When the cones open, the seed falls on the cloths. It is then dried in the sun, or preferably, in order to avoid excessive drying, under an open shed. The collection takes place at a minimum altitude of 5500 feet, where the snow is still frozen, and the drying of the seed by the sun, which in this district is remarkably strong, the thermometer rising in the sun in February to 30° to 32° Centigrade, is therefore carried on under very favourable conditions. Drying by the stove would give deplorable results. If I were obliged to work in a climate where the climatic conditions made our practice impossible, I should use closed rooms, slightly heated, but of which the air was freed from moisture by chloride of calcium.”

¹ Prof. Fisher tells me that on old roads, and other places where the soil has been exposed, on the shores of Lake Vyrnwy in Wales, and also on old pit banks in Dean Forest, he has seen numerous self-sown larches spring up.

I was informed by M. Mougin, Conservator of Forests at Chambéry, that in the Modane district the cones are collected at the end of November by men who climb the trees, with a long hooked pole, and gather the cones by hand into a bag which they carry. The cones are received twice a week at the drying-place, where they are spread out in an airy shed, and turned over every day to dry them and prevent them from heating. When the fine weather returns, they are spread out on a cemented floor, exposed to the sun, which opens them, after which the seed is collected and cleaned, and put in boxes, which are shaken frequently to prevent the attacks of insects. Sometimes seed can be collected on the snow under the trees in January by shaking the trees. But in no case is a stove used to extract them, as seems to be the usual practice in Scotland.¹

From Prof. A. Fron,² of the Forestry School of Les Barres, I have received valuable information on the germination of larch seed, which I summarise as follows: He considers that the process usually adopted of grinding the cones in a mill is very inferior to either of those which I have described as in vogue in the Alps, because the seeds of good quality which come from the central portion of the cone are mixed with those from its upper and lower ends, which are usually empty or imperfect. In 1905 he made experiments on the germination of larch seed obtained at Modane, which had been extracted by the heat of the sun, and obtained the following result:—

Purity	98 per cent.
Germinative power	61.3 „
Cultural value	60.1 „

whilst the average of the seeds obtained from seedsmen only gave the following result:—

Purity	80 to 85 per cent.
Germinative power	45 „ 50 „
Cultural value	40 „

I may say that the seeds I have gathered from my own trees late in March, and extracted by exposing them to the sun under glass in a garden frame, have germinated quicker and grown better than any which I have purchased.

An ideal way of raising larch would be as follows: To gather cones in the month of March or April from the best and healthiest mature trees in one's own district, or, failing this, from trees known to be healthy on a similar soil; or to purchase seed of known origin direct from a reliable firm abroad, among whom I can highly recommend Messrs. Vilmorin of Paris and Messrs. Jenewein of Innsbruck.

The seed-bed should be in an elevated position, where spring frosts are not likely to be severe, and sheltered as much as possible from the morning sun by trees

¹ Prof. Fisher tells me that in Germany larch seed is extracted from the cones by a toothed axis rotating in a drum, also lined with shorter teeth, and driven by water or steam power.

² For further particulars concerning the purity and germinative power of larch seed from different sources, cf. Fron, *Analyse et Contrôle des Semences Forestières*, 92 (1906).

or by clipped hedges or high walls. The soil, light and friable, and, if naturally poor, enriched by manuring with leaf mould and road scrapings, and as free from weed seeds as possible, should be laid up into beds 4 feet wide, with perfect drainage, in the previous autumn, so as to have a fine mould on the surface.

About the middle of April, but earlier or later according to the climate, the seed should be steeped in warm water for a day or two and dusted with red lead when damp, in order to keep mice and birds from attacking it.¹

On a dry day the seed should be sown broadcast as evenly as possible, and thick enough to have about one plant to the square inch, or less if the seedlings are to remain two years before transplanting. If the soil becomes dry the beds must be watered and shaded as the seed begins to germinate, which should be in fourteen to twenty days after sowing. At this time great care must be taken to prevent the seedlings from damping off, and it is better to keep the bed rather dry than wet. If weeds appear they must be carefully pulled up when quite small. If the soil and season are favourable the seedlings will in the first season be 4 to 6 inches high. If they should be too thick to stand a second season in the seed-bed, the strongest should be lifted and pricked off in lines about the end of March in the second year, and if there is much risk of a severe frost it is wise to transplant them all, as this check will retard their too early growth.

After transplanting they should remain two years in the nursery lines, except in the case of strong one-year seedlings, which may be fit to plant out one year after transplanting, but this must depend on the soil and the nature of the ground where they are to be planted out. Except for planting in woods or in places overgrown with coarse grass or fern, seedlings of one year old plus two years transplanted, or two years old plus one year transplanted, are, in my experience, large enough; and any which, from overcrowding or other causes, are not then strong enough may be rejected and have another year or two in the nursery. There will always be a considerable proportion of young trees which are inferior to the rest in size and vigour, and these are better separated when transplanting; whilst all those whose leaders are frosted or immature should be rejected, no more than forty to fifty per cent of the whole being usually fit to plant out at three years old.

The raising of such trees may cost from 20s. to 30s. per thousand in a private nursery, and though they can often be bought cheaper are, in my opinion, worth the extra cost.

Mr. Robertson writes on the same subject as follows:—

“Here we are now, I am glad to say, as little troubled with larch disease as most people, and the reason is simply that we endeavour to keep the plants strong and healthy *at all stages of their growth*, so as to be better able to resist attack. It must not be forgotten in these days of continental forestry that larch is a light-demanding tree, and ought not to be grown on the same principle of density as

¹ It is a regular practice in some nurseries where large quantities of larch are raised from seed to soak it for a day or more in water, and then spread it out on a floor where it is daily turned over and sprinkled with water until it seems ready to germinate. By adopting this practice the germination is quicker and more regular.

advocated for shade-bearing species; but it is equally dangerous to over-thin, and thus bring about starvation, and consequently weakness, by cold winds."

CULTIVATION

Whether the system of notching or pitting is adopted must depend on the local conditions and the size of the trees to be planted. If not more than 18 inches to 2 feet in height, notching, when carefully done, is sometimes as successful as pitting, but in very dry summers a large proportion of the trees will die whichever way the planting is done. In my own experience allowance must be made, in calculating the cost of planting, for a loss of about 20 per cent on an average, though this is often much exceeded when the trees are planted after Christmas, or when their roots have become dry, or when careless workmen have been employed without very close and constant supervision. This is allowing nothing for damage done by hares and rabbits, which, unless thoroughly killed down before planting and kept out by a really effectual wire fence, will soon destroy a great many of the young trees.

Having once planted the trees, the success of the plantation will depend more on soil and climate than on the skill of the planter. For though larch will, owing to their extraordinary vigour, grow almost anywhere up to fifteen to twenty years old, they will not attain a large size unless the soil is moderately fertile and well drained and the situation open and airy. If large trees are desired, I should always advise a mixture of beech or birch being planted with them or three to four years later; but where the crop can be profitably realised as small poles, or where the soil and climate are really favourable for larch, they may be planted at four feet apart without mixture. The distance apart and the mixture of other trees can only be decided by local experience, the object in view being to keep the trees thick enough to suppress the grass without depriving them of enough light and air to keep their lateral branches alive until they are fifteen to twenty years old. All thinnings should be based on these considerations, and the poorer the soil the more distance is required between the trees to keep them growing. On my own soil I have repeatedly noticed that if grass already exists when the trees are planted, it is impossible to keep the larch thick enough to smother the grass, without crowding each other to the point of starvation and disease, and in such land a mixture of beech, at the rate of one beech to two or three larch, is essential. The result of this mixture is that the larch, instead of beginning to decay at forty to sixty years old, as it often does when on soil deficient in natural fertility, at which period it may be worth 5s. to 15s. per tree, will live and increase in girth till at least 100 years, when they may be worth from £1 to £3 or £4 each. After they have been cut the beech may remain, or if not thick enough to stand with advantage, the land will be left in a very much better condition for replanting than after a crop of pure larch.¹

¹ Prof. H. M. Ward gave in *Nature*, xxxvii. 207 (1887), the following account of an experiment conducted by Prof. Hartig:—"There is a plantation of larches at Freising, near Munich, with young beeches growing under the shade of the larches. The latter are seventy years old, and are excellent trees in every way. About twenty years

With regard to the probable profit arising from a crop of larch planted pure, and realised at 30 to 50 years as compared with a crop mixed with hardwood and realised at 80 to 100 years, I have, with the assistance of Sir Hugh Beevor and Dr. Schlich, made several calculations, but it depends so much on local conditions, on the price realised for thinnings, and on other circumstances which cannot be foreseen, that it seems impossible to estimate it with any certainty.

I have, however, arrived at the conclusion that the short rotation is, as a general rule, the more profitable, especially where a sporting rent varying from 2s. 6d. to 5s. per acre can be realised from pure larch plantations after the age of 15 to 20 years, when rabbits can be admitted freely without risk of serious damage, or where, as in many parts of Scotland, larch plantations are thrown open to sheep grazing.

What is undoubtedly the best system of forestry is not always the most profitable to the landowner, and every one must decide from his own experience which system will suit his own circumstances best.

When mixed with Spruce or Scots or Corsican pine, as is often done, the larch on suitable soil will usually far exceed the other conifers in value at the same age; and I see no advantage, but rather a loss in such a mixture.

In woods which have been treated as coppice-with-standards the larch is a more profitable tree than beech or oak, and may be introduced to the number of thirty to forty per acre immediately after each cutting of the coppice. If left till sixty to eighty years old there would thus be eventually about 100 trees per acre, which will pay much better in these times than the underwood; for if only ten trees, worth say 30s. each, be taken at each rotation, the value will amount to £15 per acre, and there are not many districts in England where underwood is now worth half as much. In Earl Bathurst's extensive woodlands near Cirencester this system has been adopted for many years with great success; but if rabbits exist it is necessary to protect each tree by a wire cage until it is old enough to be safe from their attacks, which it is in this district after twenty to thirty years of age.

The produce per acre of larch in plantations on really good land has in many instances been surprising, and so profitable to the owner that some writers have greatly exaggerated the average returns that may be expected. Prof. Charles E. Curtis,¹ assuming that 300 trees per acre may be grown to maturity, which I greatly doubt, states as a reasonable possibility of production for the larch, no less than 10,000 to 12,000 feet per acre, and says that it will be found possible to bring 1000 to 1200 poles per acre to a useful and profitable size in thirty to forty years. I have

ago these larches were deteriorating seriously, and were subsequently underplanted with beech, as foresters say, *i.e.* beech plants were introduced under the shade of the larches. The recovery of the latter is remarkable, and dates from the period when the underplanting was made. The explanation is based on the observation that the fallen beech-leaves keep the soil covered, and protect it from being warmed too early in the spring by the heat of the sun's rays. This delays the spring growth of the larches; their cambium is not awakened into renewed activity until three weeks or a month later than was previously the case, and hence they are not severely tried by the spring frosts, and the cambium is vigorously and continuously active from the first. But this is not all. The timber is much improved; the annual rings contain a smaller proportion of soft, light spring wood, and more of the desirable summer and autumn wood consisting of closely-packed, thick-walled elements. The explanation of this is that the spring growth is delayed until the weather and soil are warmer, and the young leaves in full activity; whence the cambium is better nourished from the first, and forms better tracheides throughout its whole active period."

¹ *Journ. Roy. Agr. Soc.* lxiv. 36 (1903).

never seen or heard of such an instance, and on writing to Prof. Curtis he could not tell me of anything at all near it.

The best estimate I have is from Sir Hugh Beevor of a plantation at Petworth belonging to Lord Leconfield. It is growing on a steep hill facing east, on sandy loam overlying sandstone, and at thirty-two years after planting contained about 300 trees or more per acre, averaging 15 feet each, which makes about 4500 feet per acre. At Mailscoth Lodge, in High Meadow Wood, Forest of Dean, he saw a small plantation, thirty-four years planted, in which the trees on an area of half an acre numbered 214, averaging 9 feet per tree, equal to about 3800 feet per acre.

The best example on my own property is a plantation at Hilcot, now about fifty-four years old, in which there are 2500 trees on an area of about twenty acres. The trees average about 25 feet on the better parts of the land, and 10 to 15 feet on the worst, or about 18 feet over the whole area, equal to about 2200 feet per acre. There are some beech, wych elm, and other hard woods amongst them, which might make up a total of 3000 cubic feet per acre, and though the larch might stand ten to twenty years longer they are not now making a profitable increment.

Mr. J. E. Hellyar Stooke of Hereford sends me the following particulars of a sale in 1907, of larch sixty to seventy-five years old, growing on a hill 400 to 500 feet high, the soil being stiff clay overlying limestone facing east to south. There was no disease except on some of the smaller branches; the trees were all sound, and would probably have continued to grow for many years.

Lot.	Acreage.			Number of trees per acre.	Number of poles per acre.	Estimated contents per tree.	Estimated contents per pole.	Total estimated contents per acre.	Prices realised for larch on estimated contents.			
									Per cubic foot.	Per acre.		
	a.	r.	p.			cubic feet.	cubic feet.	cubic feet.	pence.	£	s.	d.
1	2	0	5	138.0	32.5	26.00	5.6	3769.6	8.89	139	18	0
2	2	2	18	134.7	54.3	26.27	6.26	3881.0	8.85	143	3	1
3	1	3	20	155.7	24.0	26.00	6.25	4197.8	9.01	157	14	8
6 2 3												
Average of the above.				142.8	36.9	26.09	6.03	3949.4		146	18	7

These trees were sold standing, by auction, at such a distance from a railway station that the hauliers could only make one journey daily.

At what age it pays best to fell a crop of larch is a question which depends entirely on the growth of the trees and the local value: in some cases thirty to forty years may be the most profitable age, in most fifty to sixty; and where the trees are planted with a good mixture of beech, and continue to grow well after this period, it may pay to let them stand to 100 years old, beyond which they will seldom if ever continue to make a profitable increase.

I should say that £100 per acre was a very fair average valuation of a clean

larch crop at forty to sixty years old, and though it is often exceeded, yet in many more instances I believe that at present prices the return will be less, even when disease has not seriously deteriorated the value of the trees by the scars and cankers which disfigure the trunks.

DISEASES OF THE LARCH

Though it is not within the scope of this work to describe the diseases of trees, yet an exception must be made in the case of the larch, because it is a subject of such vast economic importance that it may truly be said, that the losses of all other trees, from all kinds of diseases, whether induced by climatic causes, by insects, or by fungi, do not collectively approach the loss caused to English landowners by larch disease. In using this term without qualification I mean the disease caused by the fungus usually known as *Peziza Willkommii*, but which is now named by mycologists *Dasyascypha calycina*, and which is perhaps best described in English by the name "Canker," or "Blister." This began to attract attention in this country about 1859, when the Rev. M. T. Berkeley¹ made known its existence in England, and Charles M'Intosh in 1860 wrote a small book on larch disease, though what he described more especially was heart-rot, a very different thing from canker.

Hartig and de Bary were the first to describe the fungus. Prof. Marshall Ward in his *Timber and some of its Diseases*, published in 1889, described it more fully; and since then Mr. Carruthers, Dr. Somerville, and other scientific writers have written largely on the subject. In the *Gardeners' Chronicle*, 1896, are many interesting articles respecting the larch disease by J. S. W., Sir Charles Strickland, A. C. Forbes, and C. Y. Michie; and an excellent paper on it with coloured illustrations, by Mr. Geo. Masee, appeared in the *Journal of the Board of Agriculture* for September 1902.

The most practical observations on the larch disease I know of, are in Mr. A. C. Forbes's excellent work on *English Estate Forestry*, pp. 289-307 (1904). These should be studied carefully by every one who is in any degree interested in the subject. After giving a summary of the more important opinions and facts noticed in connection with this disease, he says—and I entirely agree with him—that the disease is as much the result as the cause of the bad health and unthrifty condition of many plantations throughout the country; and that the temporary debility which is induced by the conditions under which planting is conducted is largely responsible for a great deal of disease. He goes on to say that the practically permanent nature of the blister, when once established, renders the result of this temporary debility a much more serious matter than it otherwise would be. If the return to normal health and growth were accompanied by the disappearance of the disease, little harm would be done, but the existence of a blister, once established, is perpetuated indefinitely, and in most cases only ceases with that of its host, so that the occurrence of a blister on the stem of a young tree is much more serious than it would be on a branch or older stem. Cases commonly occur of the disappearance of

¹ *Gard. Chron.* 1859, p. 1015.

the blisters when the trees recover health and vigour; and he mentions a plantation over twenty years old, more or less mixed with beech, on greensand, where a number of old blisters are gradually becoming occluded. That they were genuine blisters is evident from the remains of the *Peziza* cups still present, and the only possible theory respecting their disappearance must be found in the improved health of their host. I have frequently observed similar cases, both on my own land, where in some of the worst diseased plantations, individual trees, which on account of their greater vigour have taken a lead from the first, remain almost untouched and growing vigorously, when most of the surrounding trees are killed or severely injured; and also in Hertfordshire, where tall slender larch trees growing amongst beech showed at various points, from near the ground up to 50 or 60 feet, signs of repeated attacks, which had neither killed them nor apparently checked their growth materially. Forbes says that one may pick up dead twigs or branches under the largest, finest, and most isolated larches that can be found, and the fructifications of *Peziza* are invariably present on them. This fact he thinks is sufficient to prove that the mere existence of the fungus does not necessarily lead to diseased trees, using the term diseased in its practical sense.

The year 1879 will long be remembered by all gardeners, farmers, and land-owners in the southern half of England as the most disastrous in its effects on plants, farm crops, and trees generally. There was practically no summer, and the rainfall was so continuous, that in late districts much of the corn never ripened at all, and being followed by two severe winters, the disease spread to a degree which ruined hundreds of acres of young larch on my own estate, and caused a loss which must have amounted to millions of pounds throughout the whole country. Though after bad seasons and in smaller areas there had been disease before, it was generally assumed by planters that larch might be successfully grown on almost any kind of land without mixture, and without any special precautions, and there is little doubt in my mind that a large percentage of the worst cases originated in that season, and may be directly traced to the exceptionally bad climatic conditions which prevailed.

Mr. A. M'Dougal, forester to the Earl of Feversham at Helmsley in Yorkshire, who has charge of something like 10,000 acres of woodland, and, having been brought up on the Duke of Atholl's estate, has had unusual experience of the larch, tells me that in Yorkshire the disease first began to be prevalent about 1862 when two plantations died clean off. Since then it has been very prevalent on thin red loam overlying limestone rock; and this applies as much to localities which have previously been under oak wood, or cultivation, as to those where larch has been replanted after larch. He considers that severe spring frosts, together with low-lying situations and heavy soil, are the conditions which bring on the disease most severely.

Sir W. Thiselton Dyer, who has been good enough to read this article, does not quite agree with me with regard to the disease, which he considers due to physical causes alone, and not influenced by heredity. He says that the fungus is a wound parasite, whose spores can only develop in lesions where the bark is injured either

by frost, weight of snow, insect punctures, or otherwise, and that it is usually worst in sheltered hollows, where damp air lies and spring frosts are severely felt, and that on high situations facing north and east the disease rarely causes much injury.

All this I admit in full, but I am also convinced that, as the spores of the fungus are now so generally present everywhere, it is impossible to eradicate it, the only way by which it can be combated is by planting only on soils and in situations which experience has shown enable the tree to grow vigorously, and on poor and dry soils mixing it with hardwoods, the fall of whose leaves enriches the soil and keeps it cool and free from grass.

Heart-Rot in Larch.—Though sometimes confused with *Peziza* by careless observers, this is a totally different disease. C. M'Intosh¹ describes it very fully, and Hartig refers to it under the name of root-rot. Forbes believes, as I do, that it is the direct result of unsuitable soil, either too wet or too dry. It is most common on very poor limestone, sand, and chalk, but also occurs on clay and gravelly soils. In my experience it is especially noticeable where larch follows larch on soils containing insufficient nourishment, and can only be avoided by not planting larch where it is found to be prevalent. It usually attacks trees of about twenty years old, when they have got over their first period of vigorous growth and have practically exhausted the available sources of nutrition. According to Mr. Simmonds, late Deputy Surveyor of Windsor Forest, larch grown on what is called iron pan in that district gets red rot at the heart and is then said to be "pumped."

Larch Bug.—What is commonly known as larch aphis or larch bug is an insect called *Chermes laricis*. The life-history of this insect is at present somewhat obscure, some continental observers believing that it passes through an intermediate stage of existence on the spruce, as no males have yet been found on the larch, in which case it is evident that the insect cannot spread or become numerous unless spruce exists in the neighbourhood. But this is contested by Dreyfus, and I have observed that in England at any rate it multiplies exceedingly where no spruce are near. The females pass the winter under the bark, and are wingless, oval, of a purplish-black colour, and have a long bristle-like sucker through which they feed on the sap of the leaves. In spring they lay eggs which produce young, which grow rapidly, and are covered later by a whitish woolly down, and when numerous give the trees a whitish appearance. They increase rapidly by successive broods, and seriously weaken the constitution of the trees when young, rendering them especially liable to succumb to the attacks of *Peziza*, which often accompany and succeed them. Whenever I have seen bad attacks of the bug I have noticed that the *Peziza* is more than usually destructive, and it seems as though the climatic conditions which favour the one also favour the other. In the autumn the bark of the trees in a badly attacked plantation appeared quite black; and though this plantation was in a high situation, exposed to the east, and was heavily thinned the year afterwards, the greater part of the trees, which were thirteen years planted from Tyrolese seed, and had been growing vigorously at first, were so sickly on the thinner and drier parts of the land

¹ *The Larch Disease* (1860).

that many will not survive. In the nursery I have observed that some trees were practically immune, though growing side by side with others whose branches touched them and were covered with the Chermes; but having marked these trees and watched them after they were planted out, I have not as yet been able to assure myself that this immunity is permanent. Though I have not found this insect attack Japanese, American, and Siberian larches at Colesborne as severely as the common species, yet I have seen it upon them all, both there and elsewhere. Blandford¹ says that washing the trees in April with a soft soap and paraffin mixture in hot water may prove effective, and suggests other forms of wash; yet it is evident that such remedies cannot be economically employed in plantations, and I know of no means of preventing the ravages of this insect; though thin planting, mixing with hardwoods, and the avoidance of thin dry soils and damp shady situations are undoubtedly the best means of avoiding severe injury from this pest, as well as Peziza.

*Leaf-Miner of the Larch.*²—The only other insect that I know of which causes serious injury to larch in this country is a small tineid moth, *Coleophora laricella*. This is extremely prevalent almost every year in some of my own plantations having a south-west aspect, and has been supposed by some authors to be directly connected with the attacks of Peziza, which usually accompany or succeed it. According to Stainton the larva is hatched in the autumn, and at first feeds as a miner inside the leaves, and at the approach of winter retires to the stem of the tree, where it passes the winter without feeding. In the spring as soon as the leaves appear it begins to work, and frequently becomes so numerous that most of the buds have several leaves injured. In May it is fully fed, and attaches the case which it has formed for itself from the leaves of the tree to a twig, and appears as a perfect insect in July. The tree is undoubtedly very much weakened by severe and repeated attacks, which render it more liable to die from Peziza, but as far as I know there is no practicable remedy for it in plantations.

A new enemy to the larch which has recently appeared in the north of England was described in the *Journal of the Board of Agriculture* in 1906, p. 375, and more fully in a paper by Mr. J. Smith Hill.³ This is the larva of a sawfly, *Nematus Erichsonii*, Hartig, which was first noticed about 1904 by Mr. Cyril F. Watson, of Cocker-mouth, and which has done considerable damage in the Lake district of Cumberland by defoliating the larch. Mr. Gillanders has recently found the larva near Rothbury, and Mr. Forbes in Chopwell woods, but I have not heard of its appearance in the south of England.

I am informed by Mr. R. D. Marshall, of Castlerigg Manor, that he has known periodical visitations of the same insect for several years, and that, owing to the late period of the season at which the larva appears, the trees have not suffered as seriously as they would if attacked earlier. He states that the plantation alluded to by Mr. Smith Hill first suffered from this cause as much as forty years ago, and has survived the attack in three consecutive years recently. It was noticed that during these

¹ *Journ. Roy. Hort. Soc.* 1892, p. 170.

² Cf. *Gard. Chron.* xxxvi. 181, figs. 70, 71 (1904).

³ *Quarterly Journal of Forestry*, i. p. 67 (1907).

seasons the plantation was full of small birds, which were apparently feeding on the larvæ.

REMARKABLE TREES

To enumerate all the larches which are remarkable for their size and age in Great Britain would be impossible, as in almost all places of sufficient age or importance this was one of the first exotic conifers to be planted, but it will suffice to say that many still exist in a sound condition which are 150 years or more old and exceed 100 feet in height. The tallest trees I have ever heard of were felled about the year 1890 in a deep valley near Croft Castle, Herefordshire, the seat of Capt. H. Kevill Davies, which I visited in 1904 under the guidance of Mr. Openshaw, who assured me that some trees there were 135 feet long at the point at which the tops were cut off, with a diameter of 6 inches. This was confirmed by the woodman on the estate, H. Prince, who estimated the tops to have been 10 to 15 feet long, making the trees nearly if not quite 150 feet high.¹ The soil is Old Red Sandstone and the situation very sheltered. I have a record of a tree measuring 134 feet by 10 feet 8 inches which grew in Yorkshire on Lord Masham's estate, and at Penrhyn Castle, North Wales, Henry measured a tree 118 feet by 7 feet 10 inches, and I saw another at the same place growing in a low, very wet, almost swampy situation very near the sea among hardwoods which was about 90 feet by 12 feet, and judging from the rings of felled trees lying near it was about 130 years old. This is remarkable from the fact of the conditions of growth being so extremely unlike those which are usually considered natural to and suitable for the larch, and I can only explain them by the fact that the natural drainage was better than it seemed. Certainly I would not expect larch now planted in such situations to escape disease.

At Ombersley Court, Worcestershire, the seat of Lord Sandys, a tree is growing on the lawn in deep red loam, which exceeds in girth any larch that I know of in England. It is no less than 15 feet 7 inches at five feet from the ground, though it falls away rapidly higher up, and is only about 80 feet high, and has very large and wide-spreading branches.

At Stoneleigh Abbey, Warwickshire, the seat of Lord Leigh, there are some very large and picturesque larches, near the park-keeper's house, which look as old as any in England. One of them, measuring 14 feet 8 inches in girth, has a mass of rugged branches, some of which touch the ground, where they seem to have taken root. Another is about 80 feet by 14 feet. In the grounds of Warwick Castle there is a group of seven ancient larches, as well as one in the castle yard whose top curves into a drooping form.

In Gloucestershire there are many fine trees of this species on the Cotswold hills, among which may be mentioned two near the Woodhouse in Earl Bathurst's woods (Plate 98). These are growing on dry and rather shallow soil, overlying Oolite rock, and are over 100 feet high by 11 feet and 12 feet in girth respectively.

¹ Mr. T. E. Groom of Hereford writes to me that he measured several of these trees himself, and has a clear recollection that two of them were over 140 feet long as topped for sale, where they would be 5 or 6 inches in diameter. The quarter-girth under bark half-way up was, however, only about 14 inches, which gives their cubic content as about 190 feet.

They seem to have been drawn up by surrounding trees, though now open on one side; and the fine trees beside them are Lawson Cypress, about fifty years old. At Sherborne House, the seat of Lord Sherborne, is a fine group of six old larches on the lawn, planted in a circle of very small diameter, which seed freely, and from which I have raised good plants. They are remarkable for their symmetry and equality rather than for their great size (Plate 99). At Mickleton Manor I measured in 1903 a very curious larch, 10½ feet in girth, but of no great height, whose branches spread to a distance of over twenty yards from the trunk. Plate 100 shows the tallest larches which I have measured myself in England, growing on a very dry, stony bank, composed of Oolite gravel, at Lyde, near Colesborne. These have no doubt been drawn up by the surrounding beeches to their great height, which exceeds 120 feet, the tallest, whose top is now dying, was, when measured in 1903, about 125 feet; but their girth is only 7 to 8 feet. They are remarkable from the fact that a part at least of their roots is under water, and must derive some part of their nourishment from the decaying beech leaves which accumulate there, as the trees higher up the bank are not nearly so large.

The tallest larch mentioned by Loudon in England was at Strathfieldsaye, where one was recorded as being 130 feet high by 3 feet 6 inches in diameter; but none over 80 feet were reported at the Conifer Conference in 1891. At Eridge Park, Kent, are some very fine larch trees growing on sandy soil, in what seems a damp situation below sandstone rocks, which average well over 100 feet in height, and one which I measured was 115 feet by only 5 feet 3 inches, a very unusual proportion of height to girth. Mr. R. Anderson has heard of a tree which was felled near Moorhampton which contained 356 cubic feet as measured over bark on the railway, and trees of over 200 cubic feet were not uncommon near this place. At Savernake House, Wilts, he has measured a tree 12 feet in girth, and tells me that the growth on this estate is sometimes so rapid that eight or nine rings may be found together with an average width of half an inch.

In the north-western counties there are, or have been, many very fine larches. Sir Maurice Bromley Wilson tells me of two on the shores of Windermere, which he thinks are the largest in the Lake district; but the best I have seen myself are at Greystoke Castle, the seat of the Howards of Greystoke, where Lady Mabel Howard showed me a tree in a plantation near the castle called John-by-Park, which is believed to have been planted by Charles, eleventh Duke of Norfolk, about 130 years ago, and which measured 11 feet 10 inches at 5 feet from the ground, and contains about 230 cubic feet. There are also two trees, taller but not so thick as the one at Greystoke, in the sunken garden at Lowther Castle in the same district.

In Wales the larch has been planted as extensively as in England on most of the large estates, and as a rule grows as well as, or better than, in England up to 800 or 1000 feet above the sea. Among the most remarkable trees are two at Chirk Castle, Denbighshire, the seat of R. Myddelton, Esq., one of which measures 74 feet by 13 feet 5 inches, and has very wide-spreading branches. The other forks low down and is 12½ feet in girth. At Maesllwch Castle, Radnorshire, the seat of

W. de Winton, Esq., there is a very fine group of twelve old larches 90 to 100 feet high, the largest of which measured 11 feet 10 inches, 11 feet 1 inch, and 10 feet 6 inches in girth when I saw them in 1906. At Dynevor Castle, in a low-lying damp spot, there is a very fine larch about 100 feet high and 9 feet 10 inches in girth, which may contain as much as 300 feet of timber. At Hafod, in Cardiganshire, the seat of T. J. Waddingham, Esq., there were planted in the year 1800 400,000 larch trees on a surface of 44 acres, for which the then proprietor, J. Jones, Esq., obtained a gold medal from the Society for the Encouragement of Arts.¹ Of these, I am informed by M. D. Barkley, Esq., many still remain, and a section of one which he sent me shows that they have grown to magnificent trees. As a rule, however, the large plantations in Wales are not allowed to stand to any great age, being more valuable when large enough to make pit timber.

In Scotland the number of larches remarkable for their size is so great that it is not easy to make a selection, almost every large estate, especially in the Highlands, having splendid trees of great age. So far as I can learn, the trees on Drummond Hill, near Taymouth Castle, the Perthshire seat of the Marquis of Breadalbane, are actually the largest in Great Britain. I visited this place in April 1904 and carefully measured the best trees myself. They are growing on the slope of a hill facing south in good open loamy soil, overlying rock, from which, in some places, springs of water rise; and seem to owe their immense size in part to the fact of their having been mixed with beech and oak, which were planted at or about the same time, and which they have far surpassed in height. The finest tree is figured in Plate 101, and is about 115 feet in height by 17 in girth. It carries its bulk very well up to at least fifty feet, where some large branches go off, and contains, according to Mr. Peter Mackay, the forester, over 500 feet of timber. I estimated the first length alone at 450 feet, the next at 100 feet, and the top and branches at about 50 feet more, so that this tree must contain nearer 600 than 500 cubic feet. In November 1893 a tree near it on the same hill was blown down, and the butt, which was sold, weighed ten tons on the railway, or about 500 cubic feet, besides which three tons more were cut up on the estate. Near it is a tree (Plate 102) remarkable for being divided at about 20 feet up into four large upright stems, a rare occurrence in this species. It is nearly the same height and girth as the first, and may contain as much timber. A third, as measured by the forester, has a bole of only 6 feet long, girthing at 1 foot from the ground no less than 24 feet, and at 5 feet 17 feet 9 inches; it divides into two huge trunks over 100 feet high. These trees are believed to be from 160 to 180 years old, and were probably planted as early as those at Dunkeld.

The next largest and probably the best known larches in Scotland are the so-called Mother Larches, which stand close to the ruins of the Cathedral at Dunkeld (Plate 103), and which were planted, according to the inscription on a stone slab in the wall close by, in 1738 by James, third Duke of Atholl, who, according to Hunter, obtained them from Mr. Menzies of Culdares, who brought a few small plants from the Tyrol in his portmanteau; but in an account of the larch plantations on the estates of Atholl and Dunkeld, published in the *Transactions of the Highland Society*

¹ Michie, *The Larch*, 63 (1885).

(vol. v.), which is largely quoted by Loudon, it is said that Mr. Menzies of Migenny was the introducer, and Walker¹ gives 1727 as the date of their introduction. When measured in 1831, Loudon says that the largest was 100 feet by 10 feet 6 inches at 5 feet from the ground. In 1888, according to the tablet mentioned above, it was 102 feet high, and girthed at 3 feet 17 feet 2 inches, at 5 feet 15 feet 1 inch, at 17 feet 12 feet 10½ inches, at 51 feet 8 feet 8 inches, and at 68 feet 6 feet 1 inch, the estimated contents being 532 cubic feet. When measured by Mr. Keir, forester to the Duke, in 1899 it was 15 feet 6 inches in girth; and I made it in 1904 15 feet 8 inches and 100 feet high; so it is still growing and vigorous, though the smaller tree beside it has lost most of its top and many of its branches.² There are many other fine larches on this estate, of which the largest perhaps, on the Kennel Bank at Dunkeld, is 120 to 125 feet high by 11 feet 10 inches in girth, with sound top and clean bole to 50 to 60 feet, containing about 350 feet of timber. Three trees of the same age as the Mother Larches are growing near the Castle at Blair Atholl, but are not nearly as large or well shaped.

At Gordon Castle there are some fine larches, one of which, growing in a plantation called Cotton Hill, exposed to the full blast of the North Sea, is figured on account of its remarkable trunk (Plate 104). An immense limb comes off close to the ground, where the trunk girths 20 feet 6 inches, and at about 5 feet, where the tape is seen in the plate, it is 11 feet in diameter. The branches spread to at least 15 yards on each side and measured 198 feet in circumference, and the tree in April 1904 was covered with fine cones, which were beginning to shed their seed, and from which I have raised some plants.

At Monzie Castle, near Crieff, are some splendid larches of the same age and origin as those at Dunkeld, of which the largest, according to Hunter, was 100 feet by 16 feet 3 inches, and contained about 380 feet of timber when he wrote in 1883. I have not seen these trees myself, but Henry measured the largest in 1904 as 109 feet by 17 feet 4 inches, and describes them as very beautiful trees with immense pendent branches in full health and vigour. Hunter says that John, fourth Duke of Atholl, called "the Planting Duke," because he is said to have planted over 10,000 acres of larch, considered them to be the only rivals to the Mother Larches at Dunkeld, and sent his gardener every year to report on their progress. They are figured by Michie on p. 205.

At Inveraray there are some very fine larches on the level ground near the Castle. The best that I measured was about 110 feet by 11 feet, but there may be taller ones;³ none approached the silver firs in the same locality in height or girth. They serve to show, however, that the larch will succeed well in a climate as unlike that of its native mountains as it is possible to find in Scotland, provided the soil is good and there is shelter from the west wind.

¹ *Economic History of the Hebrides and Highlands*, ii. 214 (1812).

² I was told by Mr. Keir in 1906 that the largest tree had lately been struck by lightning and was now quite dead.

³ In *Old and Remarkable Trees of Scotland*, p. 64, it is stated that a larch at Ben-an, in the parish of Inveraray, was 130 feet high and 10 feet in girth at 3 feet, and others are reported at Glenarbuck, in the county of Dumbarton, and at Auchintorlie, in the same county, 143 feet and 140 feet high, but these latter measurements are not reliable, and have never been confirmed. Mr. Renwick has recently measured the Auchintorlie tree, and finds it only 95 feet high.

In the *Scottish Arb. Soc. Trans.*, viii. 233, J. Hutton states that at Keppoch, in Inverness-shire, there were in 1878, 124 larch trees, said to have been brought home as two-year seedlings by Ranald Macdonald of Keppoch in 1753. They grew on an area of about eight acres, and had an average height of about 90 feet, and were then estimated to contain altogether 18,848 cubic feet of timber. The two largest, close to the banks of the Roy, were 108 feet by 12 feet 2 inches, contents 355 feet, and 86 feet by 14 feet 7 inches, contents 358 feet; and he mentions that upwards of forty similar trees were blown down in 1860, so that the timber on this area would have exceeded 3000 feet per acre. This property now belongs to the Mackintosh of Mackintosh, whose forester, Mr. A. Rose, tells me that at the present time there are only seventy-seven trees left, of which twenty-five are small ones which have suffered from various causes; the remaining fifty-two are fine trees with an average content of 120 feet, making, together with the smaller ones, only 7192 cubic feet in all. The largest now standing, which is about twenty-five yards from the banks of the Spean, is 74 feet by 18 feet 6 inches at 3 feet from the ground, and contains 395 cubic feet. The tallest is 108 feet by 11 feet 2 inches. The two largest in 1878 have both been since cut on account of decay, but the rings counted on the stump were 123 and 131 only, which does not agree with their reputed history.

There are very tall and large larches at Brahan Castle and elsewhere in East Ross, one of which was reported by Mr. Pitcaithley¹ as being 115 feet by 11 feet. Mr. Munro-Ferguson tells me that a very large larch was recently felled on his property at Novar; and his factor, Mr. Meiklejohn, sends me the following measurements:—at 5 feet from the ground 12 feet 8 inches, at 25 feet 10 feet, at 40 feet 9 feet 4 inches. The cubic contents of the trunk were 400 feet, and the branches probably contained 50 more.

The highest elevation which I found recorded for the larch in Scotland is in the Ballochbuie forest, where three larches of great size were reported, in 1860, to be in a sound condition at 117 years old and 1110 feet above the sea.

Michie² gives a long account of some fine larches growing in the Paradise at Monymusk, in Aberdeenshire, with details of their measurements; the largest in 1881 was 100 feet by 10 feet 5 inches at 20 feet from the ground, and was supposed to contain 416 cubic feet.

A remarkable instance of the manner in which the roots of the larch may continue to grow after the tree has been cut is described and figured in *Gardeners' Chronicle*³ from a specimen submitted by the late Mr. Webster, head gardener at Gordon Castle. The figure shows the felled stump, rotten in the centre, and with the new wood surging over the edges of the wound, and also two roots of the foster tree, inosculating by means of various branches with those of the stump.

The larch has been extensively planted in Ireland, and has given, when grown on ordinary soils, excellent results, as it has usually remained free from disease. As an instance of good growth, Mr. Mitchell, land-agent at Doneraile and an experienced forester, told Henry that many trees cut in 1891 in a plantation on the Kilworth

¹ *Trans. Scot. Arb. Soc.* xi. 505.

² *The Larch* (1885).

³ *Op. cit.* 31st Aug. 1872, p. 1161.

property in Co. Cork must have been 135 feet in height, as he measured them lying on the ground 120 feet to the small end, where they had been cut off at 6 inches diameter. There are still trees as large growing on the same property. Attempts have been made to plant pure larch on peat-bogs; but even when the bogs have been well-drained and good soil has been added to the pits at the time of planting, the trees have not grown. In such cases a preliminary plantation of Scots pine, or in localities with a mild climate the maritime pine, will prepare the bog for larch, which after a few years can be planted in amongst the pines. The conditions for success in bog-planting are delicate, depending apparently on moderate drainage, as when the bogs are quite dry the trees are starved for want of water, and when they are too wet, trees will hardly grow at all. Mr. Richards, forester at Penrhyn, who has had great experience, is confident that good larch can be grown on peat-bogs; and isolated trees doing well on peat have been seen by Henry in various parts of Ireland. Experiments with larch and various mixtures of trees that will grow easily on bogs should be attempted. The American larch has never been tried, and possibly might succeed better than the common species, as it is a swamp-loving tree.

The most remarkable old larches in Ireland are at Doneraile Court in Cork, the seat of Lord Castletown. The history of these trees, which were seen by Henry in February 1907, is obscure, but there is a tradition that they were sent in the eighteenth century to Doneraile by the Duke of Atholl. Five trees out of six originally planted now remain, all of peculiar habit, with numerous more or less weeping branches, the lowermost of which spread over the ground to a great distance, and in one tree are layering. This tree is about 70 feet high, and is 12 feet 7 inches in girth at 5 feet from the ground, the base of the tree below 4 feet being much swollen and covered with very thick bark, like that of old trees in the Alps. On one side the branches spread to 70 feet distance, and on the other side, where there was less room on account of other trees, to 30 feet. Another tree, 10 feet 10 inches in girth, has a spread of 91 feet in diameter. None of them attain more than a moderate height, which is difficult to explain, as ordinary larch grows very tall in the neighbourhood. From the seed of the old trees, sown in 1890, plants were raised, which were put out in 1893 on a hillside, seven acres in extent, and with good soil. This small plantation is now remarkably healthy, though the trees are very dense on the ground, and, at seventeen years old from seed, they average 37 feet in height and 20 inches in girth.

At Carton Park, the seat of the Duke of Leinster, there is a curious tree with the trunk inclined and pendulous branches, which was in 1903 60 feet high and 9 feet in girth. It is considered to be one of the original importations from Scotland in the 18th century. A fine tree in the same place with a straight stem measured 98 feet by 10½ feet. At Abbeyleix House, the seat of Viscount de Vesci, a tree is growing on the lawn similar to those at Doneraile in having weeping branches, some of which are layering. At Dartrey Castle, Co. Monaghan, the seat of the Earl of Dartrey, there are three very old trees, also with more or less pendent branches, which were in 1903 13 feet 10 inches, 13 feet 8 inches, and 11 feet 7 inches in girth respectively. At Emo Park, Queen's

County, the seat of the Earl of Portarlington, there are about twenty fine trees in the pleasure ground, one of which measured in 1907 105 feet by 7 feet 9 inches, another being 92 by 10 feet.

LARCH IN THE ALPS

In its native home the larch loves a dry cold winter climate, where the snow lies from December to April or May, and at the higher elevations does not begin to vegetate before the end of the latter month. It is not very particular as to the geological character of the soil provided that the rock is sufficiently disintegrated for the roots to penetrate and there is a fair amount of soil in which the seeds can germinate, and as a rule natural reproduction is fairly regular and abundant. It is not often allowed to attain its full age, which may be 150 to 300 years or more, on account of the value of its timber for building and other purposes.

As to the size it attains in its native home I have few exact particulars. The largest that I have measured myself was near Modane, in the forest de Villarodin, at 4500 feet elevation, growing on schist with a north aspect. This tree, said to be the largest in the district, was about 90 feet high by 16 feet in girth, but tapered rapidly, and would not contain more than about 200 feet of timber.

By far the finest specimen of the larch in the Alps is figured in Plate 105, made from a negative which was very kindly lent me by M. Coaz, Chief Forest Inspector of the Swiss Forest Department, and which is described in *Les Arbres de la Suisse*¹ as follows:—

“The larch of Blitzlingen grows opposite the little village of this name in the district of Conches in the upper Valais at an elevation of 1350 metres. At the foot of a slope facing north-west, on a narrow terrace this tree grows in a deep and fresh loam, rich in humus, and overlying gneiss rock. There it has become one of the largest in Switzerland, and measures at its base 8 metres 70 cent., and at 1½ metre is still 7½ metres in girth. Its branches extend 10 metres from the trunk. Its top is dead, and thus it is only 29 metres high. Strongly attacked by decay, its trunk does not allow its age to be exactly determined, but no one can accuse us of exaggeration if we estimate it at about five centuries.”

According to Dr. L. Klein, who gives an excellent account of the larch,² it sometimes attains in the Alps an age of 600 to 700 years. Some stumps which he saw in the so-called Park of Saas-Fee, in the canton of Valais, showed that number of rings, but these trees did not exceed from 1 to 1½ metre in diameter. Dr. Klein counted on a sawn stump near the Findelen glacier 417 annual rings in a diameter of 85 centimetres. He gives several excellent illustrations of Alpine larches taken near the Riffel Alp, one of which shows a tree forking close to the ground into four stems, and another a so-called Candelabra larch with branches rising parallel to the main stem.

¹ Schmid u. Francke, *Baum Album der Schweiz* (1900).

² Karsten u. Schenck, *Vegetationsbilder*, ii. tt. 25-28 (1905).

LARCH IN OTHER COUNTRIES

In Norway, so far as I have seen, the larch does not grow well on the coast, though there are fine trees 70 to 80 feet high at a farm called Kjostad near Trondheim, and in the interior and farther south. Schübeler tells us that it has been successfully grown as a forest tree, especially at Brandvold, in the Glommen valley, where trees planted in 1803 had attained in 1878, according to Forstmeister Mejdele, from 70 to 95 feet high, the largest having a diameter of 14 inches at 58 feet from the ground. A very large tree said to be 150 years old existed in 1866 near Gothenburg in Sweden.

The larch is one of the few European trees which appears to grow really well in New England. The following instances of its success are recorded in *Garden and Forest*:—vol. ii. p. 9, an acre of larch planted in 1877 by Mr. T. H. Lawrence of Falmouth, Mass., on gravelly soil, in an exposed situation, a mile from the coast, was awarded a prize in 1888, when the trees formed a regular and complete cover on the ground, and many of them were over 25 feet high; vol. iv. p. 538, records the success of a plantation made by Mr. J. Russell at East Greenwich, Rhode Island, with 100 small seedlings costing one dollar, which were planted in 1879, and in 1891 were 20 to 27 feet high. Here the larch has been planted alternately with the native *Pinus Strobus*, to which they form an excellent nurse. In 1896 Sargent (vol. ix. p. 491) speaks of it as a tree likely to produce valuable timber in the northern states; but in Virginia, on the lower Chesapeake river, the climate is too wet and hot for it, and the trees did not thrive (vol. i. p. 500).

European larch has been tried in various places in the Himalaya, but not with much success, those at Manáli, in Kulu, being apparently the most successful; in 1881 young trees four years old were 6 feet high.

TIMBER

The value of larch timber for all purposes where durability and strength are required has been so well known for so many years past and is so fully dealt with by Loudon, Michie, "Acorn," and many other writers that I need not say very much about it. There is no home-grown timber so generally used on estates for building and fencing, and though its price has fallen considerably of late years on account of the increasing competition of foreign timber, it is likely to remain in demand, and is easier to market at all ages than almost any timber except ash.

The only country from which larch timber is at present imported or from which any possible supplies can come in future is the north of Russia, and this at present is not used to any great extent; but shipbuilders, collieries, and railway companies are not buying home-grown larch so freely as they used to do except in districts where it can be procured close at hand.

For long telephone poles, for bridge-building and other purposes where lengths of 50 feet and upwards are required, heavy larch poles exceeding 50 cubic feet fetch prices of from 1s. 2d. to 1s. 4d. a foot standing, and cannot always be procured when

wanted. But the greater strength and durability of the red heartwood in trees of great age does not command the increased price which it ought to be worth, and it is often best to keep this for private use and sell the smaller and younger trees, whose timber cannot be expected to last as long. For trees of 30 to 50 cubic feet 1s. per foot and upwards, if not too far from a railway, is about the present price. For trees of 15 to 30 cubic feet 9d. to 1s. should be realised, and for small thinnings the price fluctuates according to the local demand for fencing, hop-poles, and pit-timber.

On account of the durability of larch wood under water, it is specially adapted for piles, wharves, and groins; but owing to its propensity to warp and twist and the difficulty of sawing, planing, and jointing it in comparison with most other coniferous woods, it is seldom used for inside work. It makes very handsome panelling, however, if the red heartwood is carefully selected and seasoned, and is preferred to all other woods in its native Alps for building log-houses, which in some cases are known to have remained sound for 400 years.

The Duke of Atholl informs me that the larch used in the construction of the stables at Dunkeld in 1809 appears to be still quite sound; and I saw at Blair Castle a handsome table 5 feet in diameter made from a transverse section, laid as veneer, of a larch grown on the property, which shows eighty-seven annual rings. In the museum at Innsbruck I saw a very handsome antique chest made from very dark-coloured larch wood, which had been dug out of the ground, akin to bog oak in character; and the wood is used in conjunction with that of *Pinus Cembra* for making artistic furniture by Messrs. Colli Brothers of Innsbruck.

For ship- and boat-building it was at one time much more used than at present, and knees cut from its roots are at least as strong and durable, if not more so, than oak knees.

The bark, though used to some extent for tanning, is now seldom worth stripping except in the case of large trees felled in the spring, when, if taken off in large slabs, it makes a very durable covering for summer-houses, sheds, and other rustic buildings.

Venice turpentine is a resinous product of the larch formerly much valued in medicine and surgery, and for making varnish, of the production of which Loudon gives ample details; but like so many similar products, it has gone out of use in this country at least, but is still sold in Venice, where I procured a sample of it. Manna of Briançon is a saccharine exudation from the leaves of the tree in the form of small white opaque grains which formerly had some repute in medicine.

(H. J. E.)

LARIX SIBIRICA, RUSSIAN LARCH

Larix sibirica, Ledebour, *Fl. Alt.* iv. 204 (1833); Willkomm, *Forstliche Flora*, 153 (1887); Kent, *Veitch's Man. Coniferae*, 402 (1900); Mayr, *Fremdländ. Wald- u. Parkbäume*, 311 (1906).

Larix intermedia, Lawson, *Agric. Man.* 389 (1836); Turczaninow, *Bull. Soc. Nat. Mosc.* xi. 101 (1838).

Larix archangelica, Lawson, *loc. cit.*

Larix europæa, De Candolle, var. *sibirica*, Loudon, *Arb. et Frut. Brit.* iv. 235² (1838).

Larix rossica, Sabine, ex Loudon, *Encycl. Trees*, 1054 (1842); Trautvetter, *Act. Hort. Petrop.* ix. 211 (1884).

Larix altaica, Nelson (Senilis), *Pinaceæ*, 84 (1866).

Larix decidua, Miller, vars. *sibirica* and *rossica*; Regel, *Gartenflora*, xx. 101, t. 684, ff. 1, 2, and 4 (1871).

Pinus intermedia, Fischer, *Scht. Anz. Entdeck. Phys. Chem. Nat. et Techn.* viii. 3. Heft. (1831). (Not Wangenheim.)

Pinus Ledebourii, Endlicher, *Syn. Conif.* 131 (1847).

Abies Ledebourii, Ruprecht,¹ *Beit. Pflanz. Russ. Reich.* ii. 56 (1845).

A tree attaining in Siberia over 100 feet in height and 9 to 12 feet in girth. Bark resembling that of the European larch. Young branchlets slender; in specimens from the Ural mountains and Tobolsk, pubescent with long hairs in the furrows between the pulvini; in specimens from the Altai, glabrous; girth at the base by a sheath of the previous season's bud-scales, within which a ring of pubescence is visible. Branchlets of the second year glabrous, greyish-yellow, shining. Terminal buds broadly conical, resinous, with ciliate scales. Lateral buds hemispherical, dark brown, resinous. Apical buds of the short shoots broadly conical, girth at the base by a dense ring of pubescence. Leaves soft in texture, very long and slender, up to 2 inches in length, narrower than in *L. europæa*, sharp-pointed, agreeing with that species in the arrangement of the stomata, but more deeply keeled on the lower surface. Staminate flowers as in the European larch. Pistillate flowers according to Willkomm, ovoid, pale green. Cones, when unopened, cylindrical, with the terminal scales not gaping and the bracts quite concealed; variable in size, up to 1½ inch long, composed of five spiral rows of scales, five to six scales in each row. Scales convex from side to side and also from the base to the apex, quadrangular, about as long as broad (½ inch); upper margin rounded or truncate, thin, entire, not bevelled, inflected; outer surface finely striate, covered with a reddish-brown pubescence, which is most marked towards the base of the scale. Bract ovate or oblong with a cuspidate point, extending about one-third the height of the scale. Seeds lying on the scale in shallow depressions, with their wings widely divergent and not extending to its upper and outer margin. Seed ⅙ inch long; with its wing ½ to ⅝ inch long; wing about ⅙ inch in width, broadest about the middle.

This species is amply distinct from *L. europæa*, differing in the long and slender leaves, which appear about ten days earlier in the spring; and in the

¹ This name is quoted wrongly as *Larix Ledebourii*, Ruprecht, in *Index Kewensis*, ii. 31, and in Sargent, *Silva N. Amer.* xii. 4.

cones, which have fewer and differently shaped scales and short concealed bracts. In the Siberian larch the scales are convex both laterally and longitudinally, whereas in the European larch they are flattened longitudinally. The seeds, moreover, of the former have longer and differently shaped wings, and do not cover the scales of the cone up to their margin as is the case in the latter.

VARIETIES

In wild specimens both pubescent and glabrous branchlets occur. Cones from a tree, cultivated in the Botanic Garden at St. Petersburg, differ in being narrowly cylindrical, with oblong scales only half the width of wild specimens; and the bracts are also much narrower. The seeds, however, lie on the scales as in wild specimens; and the scales have the convex form and inflected upper margin of typical *L. sibirica*.

A supposed variety, *rossica*, occurring in northern Russia, was distinguished by Regel as having small cones; but as Beissner informs me in a letter, it was subsequently abandoned by Regel, and is now not noticed by Willkomm or by any Russian botanist. Sir C. Wolseley, Bart., vice-consul at Archangel, has kindly sent me excellent fruiting specimens from Archangel, which differ in no respect from the Ural larch.

DISTRIBUTION

The Siberian larch has an extremely wide distribution, occurring in north-eastern Russia and throughout a great part of Siberia.

In European Russia it occurs wild in the governments of Archangel, Vologda, Viatka, Perm, and Orenburg. According to Korshinsky,¹ it grows rather sparingly in the plains of northern Russia, as isolated trees in the pine forests; whereas on the mountains of the Ural chain and its branches it forms extremely large forests, sometimes pure, and sometimes mixed with pine and spruce. Its exact distribution is differently stated by various Russian authorities. Herder² adds to the preceding provinces Ufa, Olonetz, eastern Finland, and the northern parts of Kostroma and of Nijni-Novgorod. Ruprecht³ states that it commences to grow in the northern part of the government of Olonetz beyond the city of Kargopol, from whence extensive woods of it stretch to the Ness river in the Kanin peninsula. In this peninsula it attains its most northerly point in Europe, on the Arctic circle. Further east its distribution sinks to the southward, and its most northerly point on the Ural range is about 58° latitude.

Its distribution in Siberia is not yet clearly known, as it has been confused with *Larix dahurica*. It would appear to be the species common in middle and southern Siberia west of Lake Baikal, while *Larix dahurica* apparently occupies eastern Siberia and Manchuria, a close ally of it, *Larix Cajanderi*, occurring in the extreme north in the lower part of the valley of the Lena, north of lat. 63°. *Larix sibirica* is reported from Olga Bay in Manchuria, but this requires confirmation; and it has

¹ *Tent. Fl. Rossia Orientalis*, 493 (1898).

² *Act. Hort. Petrop.* xii. 101 (1892).

³ *Loc. cit.*

been supposed to occur in Mongolia and north China; but Mayr has recently described the North China larch as a new species—*Larix Principis Rupprechtii*. In Siberia its most northerly limit is lat. 69° on the Yenesei and Kolyma, its southern limit extending from the Ural at lat. 54° to the Altai in lat. 52°.

The Siberian larch was reported by Kanitz¹ to occur as a shrub in upper and middle Moldavia at about 6000 feet elevation. He identified it on the authority of Parlatore in a letter. I have seen no specimens from this locality, and consider the identification very doubtful.² (A. H.)

An excellent account is given by Mayr³ of a plantation of this tree which was made in 1750-1760 for the Czarina Elizabeth at Raivola on the Russian-Finnish frontier north of St. Petersburg. The seed was procured from Ufa, and the trees have on the better land grown remarkably straight and clean without branches for 20 metres up, and attain 40 metres in height with a diameter of 70 centimetres. The wood of these trees, which was shown at the Paris exhibition of 1900, was of remarkably good quality, and Prof. Mayr recommends this tree strongly for cultivation. But as summer does not commence in Finland until June, and the trees had already turned yellow on September 18th, it is probable that the species is not unlikely to succeed in Great Britain except perhaps in elevated districts in the north and east of Scotland.

On my journey to Siberia in 1897 I saw larches in the Ural mountains near Zlataoust, but only after passing the watershed into Asia, and these were of no great size. In the Altai they first appeared at about 3000 feet, and at 4000 feet they became more numerous and larger, some of them 3 feet to 4 feet in diameter and about 100 feet high, but nearly all were dead at the top, and not yet in full leaf on 7th June. They grow scattered in open forest on the drier hillsides as well as on marshy flats, and where the soil is damper are often mixed with *Picea obovata*.

Farther to the south in the upper valleys of the Katuna and Tchuya the larch became the prevalent tree, and extends to a higher elevation than any other, following the banks of the mountain streams on the Mongolian frontier up to about 7500 feet. At this elevation I saw a grove of young larches from 8 to 15 feet high, and cut one of the smallest to count the rings, of which there were twenty-five in a diameter of only 1½ inch. Some of the old trees were remarkably stunted, only 10 to 12 feet high and 5 feet to 6 feet in girth. In this region the climate is extremely severe, frost and snow occurring even in July. The bark of the tree is used all over the region where it grows for covering the winter huts of the nomad Tartars, which are in shape and construction very like the lodges of the Indians in Montana.

CULTIVATION

It was introduced by the Duke of Atholl in 1806 from Archangel, as stated in the fourth volume of the *Transactions of the Horticultural Society*, p. 416, and

¹ *Plant. Romania*, 139 (1881). Cf. also Janka, *Flora Siebenbergens*, xvi. 366 (1866).

² See distribution of the European larch.

³ *Loc. cit.* and *Naturw. Stud. Nordw. Russl. Allg. Forst. u. J.-w.* 1900.

was described as follows:—"The bark quite cinereous, not of a yellowish-brown colour, and not distinctly scarred as in the common larch, but, on the contrary, the vestiges of the scars are scarcely visible; the leaves come out so soon that they are liable to be injured by spring frosts, and what is remarkable, the female flowers are not produced till some time after those of the European larch appear; they are like those of *Pinus (Larix) microcarpa*. Mr. Sabine has a plant of this sort in his garden at North Mimms, which he received under the name of *Larix sibirica* from Messrs. Loddiges, who obtained the seed originally from Professor Pallas, whose *Pinus Larix* it probably is. He contrasts the cinereous bark of his plant with the pale brown colour of the common larch; it may probably prove to be a distinct species." So far as I can learn no trees of this introduction are now living at Dunkeld.

Large quantities of seed were procured by Messrs. Little and Ballantyne of Carlisle, and raised in their nurseries about eight years ago, but the trees from them have generally been a complete failure owing to the very early bursting of their leaf-buds.

I received in 1902, from the Tula Government, through Professor Fischer de Waldheim, some seed of the Siberian larch, and a few of the seedlings look rather more promising than those from North Russia; but we are not aware that any fair-sized tree of this species now exists in England.

In December 1902 I received seed of this tree from Herr E. Rodd, which was gathered in the Ouimon valley in the Altai mountains early in September, but he tells me that it is not naturally shed there until spring. This seed germinated, but the plants raised from it are small and unhealthy, and vegetate very early in the spring, so that they seem likely to grow as badly in this climate as the larch from the Ural.

In England, as a forest tree this species seems likely to be worthless, for it opens its leaves so early, and suffers so much from spring frost, that with few exceptions the young trees I have grown are unhealthy, and many have already died, though planted in a very cold and exposed situation.

In the north of Norway I saw it growing at the Government nurseries in Saltdalen in 1903 from Russian seed sown in 1882. Trees only 15 feet high were already bearing cones, but were much healthier and more vigorous than the common larch; and in the Botanic Garden at Christiania I noticed that though growing at the rate of a foot annually, the leaves were attacked by a Chermes like *C. laricis*.

TIMBER

The tree is common in the north of Russia, where it forms a large part of the forests on the east side of the White Sea; and in the valley of the Petchora, seems to attain very large dimensions. Seebohm¹ says that Alexievka at the mouth of this river is the shipping port of the Petchora Timber Company, where ships are loaded with larch for Cronstadt. "The larch is felled in the forests 500 or 600 miles up the

¹ *Siberia in Europe*, 174 (1886).

river, and roughly squared into logs varying from 2 to 3 feet in diameter. It is floated down in enormous rafts, the logs being bound together with willows and hazel boughs. These rafts are manned by a large crew, many of whom bring their wives with them to cook for the party, sleeping huts are erected on the raft, and it becomes to all intents and purposes a little floating village, which is frequently three months in making the voyage down the river."

This larch is now shipped to London in some quantity for various purposes, and has been considerably used for piles in the Dover harbour works, and elsewhere. Mr. D. J. Morgan of Morgan Gellibrand and Company informs me that it is one of the most durable timbers that can be used, but so hard that when it is being sawn water is poured on the saw to keep it from heating, and this is probably the reason why it is not much used in England. He informs me that all the lighters at Onega were built of larch timbers, which lasted a very long time, and that when an old house at Archangel, which had been built on a foundation of larch logs, was pulled down, they were found to be quite sound after lying on the ground for possibly a hundred years. The experiments which have been made with it in the quays at the Surrey Commercial Docks, where the wood was continually wet and dry, have proved the lasting power of this wood, which, from what I have seen of it, is much closer in the grain than English-grown larch. But Mr. G. Cartwright, engineer of the Grimsby Docks, tells me that though he has no actual personal experience of its use, it is considered inferior to the best English larch, as indeed its lower price would imply, and inferior in strength and durability under water to English oak, greenheart, jarrah, or even to Danzig red fir, and that for constructional purposes he would consider its value less than half that of large oak.

Messrs. Crundall and Company of Dover inform me that Messrs. Pearson and Sons have used a large quantity of larch deals for their block moulds, and for other purposes where much wear and rough usage is entailed, and the wood has given entire satisfaction. I purchased from Messrs. Howard Bros. and Company of London a long clean log of this tree, from north Russia, in order to compare it with that of home-grown larch, and find the wood is very slowly grown, there being fifteen rings in an inch of radius. The heartwood is less red and apparently much less resinous than that of the European larch. My carpenter reports that when free from knots it works as well as some red deal, and he considers it very well suited for the roofs of plant houses. Its present value is from £11 to £13 per standard.

(H. J. E.)

LARIX DAHURICA

- Larix dahurica*, Turczaninow, *Bull. Soc. Nat. Mosc.* xi. 101 (1838); Trautvetter, *Pl. Imag. Fl. Russ.* 48, t. 32 (1844); Regel, *Gartenflora*, xx. 105, t. 684 (1871); Kent, *Veitch's Man. Coniferae*, 390 (1900).
Larix pendula, Salisbury,¹ *Trans. Linn. Soc.* viii. 314 (1807); Lawson, *Agric. Man.* 387 (1836); Forbes, *Pinet. Woburnense*, 137, t. 46 (1839).
Larix europæa, De Candolle, var. *dahurica*, Loudon, *Arb. et Frut. Brit.* iv. 2352 (1838).
Larix americana, Michaux, var. *pendula*, Loudon, *op. cit.* 2400.
Pinus pendula, Aiton, *Hort. Kew.* iii. 369 (1789); Lambert, *Pinus*, i. 56, t. 36 (1803).
Pinus dahurica, Fischer, ex Turczaninow, *loc. cit.*
Abies pendula, Poiret, *Lamarck's Dict.* vi. 514 (1804).
Abies Gmelini, Ruprecht, *Beit. Pflanz. Russ. Reich.* ii. 56 (1845).

A tree attaining in Saghalien 140 feet to 150 feet in height, but in Siberia usually much smaller. Bark scaling in broad, thin, irregularly quadrangular plates. Young branchlets slender, glabrous, becoming pinkish at the end of the season, shining brown in the second year; older branchlets yellowish grey. Shoots girt at the base by a sheath of the previous season's bud-scales, with no ring of pubescence visible. Short shoots slender, dark brown or blackish, glabrous. Terminal buds globose, glabrous, resinous, with the basal scales subulately pointed. Lateral buds hemispherical, resinous, dark brown, glabrous. Apical buds broadly conical and surrounded by a ring of brown pubescence. Leaves light green, similar to those of *L. europæa* in size and arrangement of the stomata, with the tips usually blunter than in that species.

Staminate flowers sessile, smaller than those of the European larch. Pistillate flowers ovoid, red, with the bracts and scales more closely appressed than in the common larch, making the flower narrower and shorter; bracts slightly recurved, $\frac{1}{8}$ inch long, oblong, with a shallow notch at the upper margin between two pointed projections; mucro short, less than $\frac{1}{12}$ inch long.

Cones variable in size, dependent upon the number of the scales, $\frac{3}{4}$ to $1\frac{1}{4}$ inch long, cylindrical, slightly narrowed at the apex, where the scales gape open in the ripe cone, composed of three to four spiral rows of scales, six to eight in each row, bracts concealed. Scales longer than broad, about $\frac{1}{2}$ inch long; upper margin rounded, truncate, or slightly emarginate, bevelled, slightly denticulate, not recurved; outer surface glabrous,² channelled, shining light brown when ripe. Bracts not exerted, about $\frac{1}{8}$ inch long, much shorter than the scales. Seeds lying upon the scale in slight depressions, their wings narrowly divergent and not extending quite to its upper margin. Seed about $\frac{1}{8}$ inch long; together with its wing scarcely $\frac{1}{2}$ inch long; wing broadest just above the seed.

The Dahurian larch is a native of eastern Siberia, Manchuria, Corea, and

¹ Though this is the oldest correct name under the genus, I have not adopted it, as it has been erroneously applied to the American larch, and its use now would cause considerable confusion.

² Cultivated specimens, as those from Boynton and Murthly Castle, occasionally have slightly pubescent scales; but the cones and seeds in all other respects are typical of *L. dahurica*.

Saghalien. According to Herder¹ it occurs in the northern Ural range at lat. 68°, and at Nijni Kolymsk in north-eastern Siberia at the same latitude; but it is probable that in the former locality he may be referring to *Larix sibirica*, and in the latter case to the form now distinguished by Mayr as *Larix Cajanderi*. It is uncertain whether the larch which occurs in Kamtchatka is *L. dahurica* or a distinct species.²

Larix dahurica is very plentiful on the Stanovoi mountains, and along the southern half of the coast of the sea of Ochotsk. Middendorff found it on the Aldan mountains up to 4000 feet elevation. According to Komarov³ it forms woods in moist situations in the mountain valleys throughout the Amur, Ussuri, S. Ussuri, and Kirin provinces of Manchuria and in northern Corea. Korshinsky⁴ states that it is frequent in the whole Amur region, forming forests in the mountains of the upper Amur and Bureja, but that it does not occur in the plain between the Zeja and Bureja.

It occurs in Saghalien, in the northern half of which it grows mixed with common birch and attains a great size, a fallen tree in the forest having been measured by Hawes⁵ as 145 feet in length. Elsewhere it forms part of the coniferous forest of the island, being mixed with *Abies sachalinensis*, *Picea ajanensis*, and *Picea Glehnii*. It also occurs on the island of Shintar.

Elwes saw at Wellesley, Mass., a young larch raised in the Arnold Arboretum from seed received at Petersburg as *L. dahurica*, which had a peculiar growth of the branches, which, according to Prof. Sargent, is seen in all the trees of the same origin. At the commencement of each season's growth the new wood made a distinct angle, turning upwards a little, so that in four years' growth it became erect. Prof. Sargent states that he saw many larches in eastern Siberia which he considered to be *L. dahurica*, and that they all had the same habit. The young trees at Boston have not yet borne cones, but the main stems were making annual growths about 2 feet long, and the tree seemed more at home in that climate than in England.

HISTORY

Pinus pendula was first described by Aiton in 1789; and Solander's⁶ MS., on which the description was founded, states that the tree is a native of Newfoundland, with leaves longer and cones shorter than the European larch. A sheet of specimens preserved in the British Museum bears in Salisbury's handwriting "*Pinus pendula*"; three specimens are unmistakable *L. dahurica*; the fourth, a small branch, is *L. americana*.

Lambert's figure of *P. pendula*, published in 1803, is certainly *L. dahurica*, the drawing being made from specimens obtained from a tree in Collinson's garden at Mill Hill which was planted in 1739, the supposed first introduction of the species. Lambert also figures and describes, as a distinct species, *P. microcarpa*, identical

¹ *Act. Hort. Petrop.* xii. 98 (1892).

⁴ *Act. Hort. Petrop.* xii. 424 (1892).

² *Larix kantschatica*, Carr.

³ *Flora Manchuria*, i. 190 (1901).

⁵ *Uttermost East*, 105 (1903).

⁶ According to Loudon, *op. cit.* 2401, Solander's description was taken from the tree at Mill Hill, which, according to Lambert's figure, must have been *L. dahurica*.

with *L. americana*. He states that cones of both species were sent annually from America to Loddiges, *P. pendula* under the name of black larch, and *P. microcarpa* as red larch; and that both kinds were growing in Loddiges's nursery.

Lawson's *Manual*, published in 1836, gives a careful description of both species, and repeats the information that they are natives of North America.

So far as we know *Larix dahurica* does not grow in N. America; and no traveller or botanist except Pursh ever claimed to have seen in the eastern part of the continent any species but *L. americana*. Pursh¹ asserts that *L. pendula* and *L. microcarpa* are distinct species, and were seen by him, the former growing in low cedar swamps from Canada to Jersey, the latter occurring about Hudson's Bay and on the high mountains of New York and Pennsylvania. As *L. americana* varies in the size of the cone, it seems certain that Pursh only saw forms of *L. americana*. It is very difficult to understand how seeds of *L. dahurica* from eastern Siberia could have been introduced so early.

Until about 1840 the American origin of *L. pendula* was unquestioned; and a tree planted in that year at Bayfordbury, and recorded in the planting book as *L. pendula*, is still living, and is undoubtedly *L. dahurica*. *Larix dahurica* was noticed first in Lawson's *Manual* as a stunted bushy tree, growing poorly, as it was propagated from cuttings or layers; and is stated to have been introduced in 1827.

(A. H.)

REMARKABLE TREES

The finest specimen we know is figured in Plate 106, and is growing on the edge of a grassy drive at Woburn Abbey, where I first noticed its peculiar bark on the occasion of the visit of the Scottish Arboricultural Society to that place in July 1903. None of the members present could name the tree, and on comparing the foliage with the specimens at Kew I came to the conclusion that it must be a tree which is mentioned in the *Pinetum Woburnense* as *Larix pendula*. I went to Woburn again on purpose to see it in flower, on 31st March 1905, when the difference in the flowers from those of a pendulous form of the common larch growing close by was evident. But the less rugged bark, which resembles that of a cedar, is the best distinction, and is clearly shown in our illustration. It measured 86 feet high by 6 feet 7 inches in girth in 1905. I have raised a seedling from this tree.

A very similar tree is growing by the side of the entrance drive at Beauport, which from its bark and habit we believe to be of the same origin.

At Bayfordbury the tree planted in 1840 as *Larix pendula* is now 56 feet high and 5 feet in girth, with a conical stem, and bark scaling in large thin plates. European larches planted near it at the same time are 70 feet high and 5 to 6½ in girth. A tree at Denbies, near Dorking, the seat of Lord Ashcombe, was in 1903 40 feet high and 2 feet in girth. It is said to have been sent to Denbies as *Larix Griffithii* by Sir Joseph Hooker, but some mistake had evidently been made in the plant that was forwarded from Kew some forty years ago.

¹ *Fl. Amer. Sept.* ii. 645 (1814).

In the Cambridge Botanic Garden there are two trees of this species, one 56 feet high by 5 feet in girth, in 1906. The bark scales off in smaller plates than the common larch, and shows more red-coloured cortex below. The second tree, labelled *L. pendula*, is grafted at 6 feet up on the common larch, and has its stem bent over at a right angle a few feet higher up.

At Ribston Park, Yorkshire, there is a well-grown tree of *L. dahurica* which cannot be more than about forty years old, as Major Dent remembers its being planted, though its origin is unknown. It has somewhat pendulous branches and smooth bark without ridges, and measures 71 feet by 5 feet 2 inches. It had both new and old cones on it in 1906.

There are some larches at Boynton, near Bridlington, Yorkshire, which Sir Charles Strickland has always known as red larches, and supposed to have been of American origin, but which I believe, on account of their smoother bark, to be *L. dahurica*. The best of them is 75 feet by 7 feet 8 inches; another, with a very spreading top, was 9 feet 4 inches in girth; and both had cones from which seedlings have been raised. Sir Charles Strickland has written of these in the *Gardeners' Chronicle*, 1896, pp. 399 and 494. He says that the trees which have been grown at Boynton for eighty or ninety years under the name of red and black larch are the two trees described in Loudon as varieties of *Larix americana*; and that the red larch is more like the European larch, and in loose, rather wet, sandy soil grows at Boynton as fast and to as large a size, but he does not consider the wood quite as good as that of the common larch; it is more liable to twist and warp, though probably as durable. On drier soils the red larch is much less healthy and vigorous than the common one.

At Murthly Castle there is a row of fifteen trees which were planted about 1881 by Mr. D. F. Mackenzie, who informs me that they were probably from the nursery of Messrs. B. Reid of Aberdeen, but their origin cannot now be traced with certainty. Their habit varies very much, the first one, coming from the Castle, having very pendulous branches and a weeping top, which none of the others possess. The cones also vary somewhat in size and colour, but with one exception—which I believe to be a common larch planted subsequently to replace a dead tree of the original lot—are characteristic of *L. dahurica*. The trees average 40 to 45 feet high and 3 to 4 feet in girth, and have the bark distinctly smoother and less corrugated than the bark of common larch growing under similar conditions. They are fairly healthy in appearance, with no evidence of having suffered from Peziza, but are bearing cones so freely that I do not expect they will become large trees. Mr. Mackenzie attributes this to their growing on dry, gravelly soil.

(H. J. E.)

LARIX KURILENSIS

Larix kurilensis, Mayr, *Abiet. Jap. Reiches*, 66, t. 5, f. 15 (1890), and *Fremdländ. Wald- u. Parkbäume*, 300 (1906).

Larix dahurica, Turczaninow, var. *japonica*, Maximowicz, in Regel, *Rev. Sp. Gen. Larix*, p. 59, and *Gartenflora*, xx. 105, t. 685 (1871); Miyabe, *Mem. Boston Soc. Nat. Hist.* iv. 261 (1890).

A tree, attaining in the Kurile Islands a height of 70 feet and a girth of 7 to 8 feet. Bark, according to Mayr, scarcely distinguishable from that of the Japanese larch. Young branchlets covered with a moderately dense, wavy, irregular pubescence. Branchlets of the second year shining reddish brown, pubescent. Base of the shoot girt by a ring of the previous season's bud-scales, the uppermost of which are loose and reflected, no ring of pubescence being visible; short shoots dark red, or almost black, shining. Terminal buds dark red, ovoid, with comparatively few scales, which are acuminate, non-resinous, ciliate with brown silky hairs. Lateral buds ovoid, dark red, with ciliate scales. Apical buds of the short shoots hemispherical, dark red, with no ring of pubescence at the base.

Leaves glaucous, short, broad, and curved, about an inch long, rounded at the apex, few in a bundle, usually twenty to thirty, spreading so as to form a wide open cup around the bud; upper surface flattened, green without stomata; lower surface deeply keeled, with two bands of stomata, each of five lines.

Flowers not seen. Cones small, cylindrical, about $\frac{3}{4}$ inch long, composed of few scales, less than twenty, with the bracts conspicuous at the base of the cone, but concealed elsewhere by the upper scales. Scales oval, longer than broad, about $\frac{1}{3}$ inch long; upper margin thin, emarginate, slightly bevelled, not reflected; outer surface minutely pubescent towards the base. Bract panduriform, about half the length of the scale, terminated by a very short mucro. Seeds lying on the scale in two depressions which are separated by a membranous ridge, with the wings slightly divergent and extending up to the margin of the scale. Seed about $\frac{1}{8}$ inch long; seed with wing about $\frac{1}{3}$ inch long; wing broadest just above the seed.

(A. H.)

This tree was first distinguished as a species by Dr. Mayr, the distinguished dendrologist and traveller, who found it in the Kurile Islands, especially on Iturupp,¹ where it forms forests of some extent. Sargent gives an excellent illustration, plate xxvi. in the *Forest Flora of Japan*, from a photograph taken by Dr. Mayr, and I am able to show its aspect in the same island from two photographs kindly given me by the Imperial Japanese Forest Department (Plate 107). The upper shows a forest of larch on Iturupp; the lower a scattered group near the shore on the same island.

The tree was commonly planted in the neighbourhood of Sapporo, and it was introduced into Europe in 1888 by Dr. Mayr, and seems to grow almost as well as the Japanese larch, at least when young. There is a tree 15 feet high at Grafrath,

¹ We adopt this spelling on Dr. Mayr's authority, as the correct Aino name for the island. Eterofu is the Japanese form of the word, and Eterop a corrupt combination of both forms of spelling.

the experimental forestry station near Munich, where the thermometer goes down to 15° Fahr. below zero, and seedlings only four years old are already 5½ feet high. They resembled *Larix americana* more than *L. leptolepis* in the blackish colour of their young shoots. Dr. Mayr says that it is the first larch to become green in Europe, though in my nursery seedlings of the Altai and north Russian larches are both earlier. He says that its dark shoots have gained it the name of black larch from visitors to his nursery, and that in the park of The Duke of Inn- and Knyphausen at Lütetsburg in east Friesland it grows faster than any other species of larch, being 6 metres high at the age of seven years.¹

So far as our very short experience of this tree in England enables us to judge, it is likely to thrive well, at any rate in its youth. Several young trees which are in my nursery grow fast, and ripen their growths earlier than common larch. Some seed received from Japan in June 1906 germinated very quickly, and made healthy little plants the same season. It should be tried especially in the wetter parts of Great Britain.

(H. J. E.)

LARIX LEPTOLEPIS

Larix leptolepis, Endlicher,² *Syn. Conif.* 130 (1847); Gordon, *Pinetum*, 128 (1858); Mayr, *Abiet. Jap. Reiches*, 63, t. 5, f. 14 (1890), and *Fremdländ. Wald- u. Parkbäume*, 302 (1906); Kent, *Veitch's Man. Coniferae*, 397 (1900).

Larix japonica, Carrière, *Conif.* 272 (1855).

Larix Kaempferi, Sargent, *Silva N. Amer.* xii. 2, adnot. 2 (1898).

Pinus Larix, Thunberg, *Fl. Jap.* 275 (1784) (not Linnæus).

Pinus Kaempferi, Lambert, *Pinus*, ii. preface, p. v (1824).

Abies Kaempferi, Lindley, *Penny Cycl.* i. 34 (1833).

Abies leptolepis, Siebold et Zuccarini, *Fl. Jap.* ii. 12, t. 105 (1842).

Pinus leptolepis, Endlicher, *Syn. Conif.* 130 (1847).

A tree attaining in Japan a height of 100 feet and a girth of 12 feet. Bark of native trees, according to Mayr, similar to that of the European larch, the freshly exfoliating scales being more brownish than red; but in cultivated trees in England the bark begins to scale very early, peeling off usually in large long strips and giving a red appearance to the trunk. Young branchlets glaucous, usually covered with a dense, erect, brown pubescence, but occasionally almost glabrous, only a few brown hairs being present. Branchlets of the second year reddish with a glaucous tinge, retaining some pubescence or quite glabrous. Base of the shoots girt by a sheath of the previous season's bud-scales, the uppermost of which are loose and reflected, with no ring of pubescence visible. Short shoots stouter than in the common larch,

¹ In *Mitt. Deutsche Dendr. Ges.* 1906, p. 27, the age of this tree is stated erroneously as twenty-five to thirty years. Its height in 1906 is given as 9 metres.

² *Pinus leptolepis* was the name preferred by Endlicher; but he quotes *Larix leptolepis*, Hort., as a synonym; and as this is the first publication of *Larix leptolepis*, Endlicher is responsible for the name, and it is credited to him; and being the first published name under the correct genus is adopted by us. Moreover, it is the name by which this species is universally known; and the adoption of Sargent's name, *Larix Kaempferi*, would cause great confusion, as this has been used for *Pseudolarix Kaempferi*, the golden larch of China. The Japanese larch, though known to Kaempfer and Thunberg in the eighteenth century and mentioned by Lambert, was first described by Lindley in 1833.

reddish, glabrous. Terminal buds sharply conical, resinous, glabrous, the lowermost scales subulately pointed. Lateral buds ovoid, glabrous, resinous, directed slightly forwards. Apical buds of the short shoots conical, with loose scales, surrounded at the base by a ring of pubescence.

Leaves glaucous, about 1¼ inch long, rounded at the apex; upper surface flattened, with two bands of stomata, variable in the number of lines, often two to four in each band on leaves of the long shoots, usually one to two irregular lines on leaves of the short shoots; lower surface deeply keeled, with two conspicuous bands of stomata, each of five lines.

Staminate flowers ovoid, sessile, smaller than in *L. europæa*. Pistillate flowers ovoid, pinkish; bracts all recurved, about ⅓ inch long, oblong, broadest at the base, truncate, and scarcely emarginate at the apex, brownish with pink margins, mucro about ⅓ inch long. Cones shortly ovoid, broad in proportion to their length, 1 to 1¼ inch long, readily distinguished by the thin reflected upper margins of the scales, of which there are four to five spiral rows of eight to nine in each row. Scales almost orbicular, about ⅔ inch long and wide; upper margin very thin, reflected, truncate or slightly emarginate; outer surface furrowed, slightly pubescent. Seeds in very shallow depressions on the scale, their wings slightly divergent and extending to its upper margin; seed about ⅓ inch long, with wing ⅔ inch long.

A stunted form, growing on the higher parts of Fuji-yama, was collected by John Gould Veitch, and was considered to be a new species by A. Murray;¹ and is recognised as a variety by Sargent. According to Mayr, it scarcely deserves to be ranked as a variety, as it only differs in being a low tree, with smaller cones than usual, which are only ⅔ inch in diameter and globular in shape. (A. H.)

INTRODUCTION

It was introduced by J. G. Veitch in 1861 from seeds which he procured during his visit to Japan. Nothing is said by Kent as to the number of plants raised and sent out at that time, but probably the number was small, as we know of few trees as old as forty-five years. Larger importations were made later, and the tree grew so well generally that it is now being planted almost everywhere, and some of the older trees have produced good seed for ten years or more.

DISTRIBUTION

In Japan this larch grows naturally on the slopes of volcanic mountains in a sandy soil at 4000 to 6000 feet elevation, in a climate very much warmer and moister in summer, drier in winter, and less liable to late frosts than England.

¹ *Larix japonica*, A. Murray, *Pines and Firs of Japan*, 94 (1863).

Larix leptolepis, var. *minor*, A. Murray, *Proc. Roy. Hort. Soc.* ii. 633, f. 155 (1862).

Larix leptolepis, var. *Murrayana*, Maximowicz, *Ind. Sem. Hort. Petrop.* 1866, p. 3.

Larix japonica, var. *microcarpa*, Carrière, *Conif.* 354 (1867).

Larix Kaempferi, var. *minor*, Sargent, *Silva N. Amer.* xii. 2, adnot. 2 (1898).

Abies leptolepis, Lindley, *Gard. Chron.* 1861, p. 23.

Where I first saw it, on a sandy plain above the Lake Chuzenji on the slopes of the volcano of Nantai-san, the trees were of no great size, averaging perhaps 60 to 70 feet in height, with a girth rarely exceeding 6 feet in mature trees, and more often 3 to 4 feet. They were very similar in habit to the larch in the Alps, and had not an excessive development of branches. Higher up above Yumoto in rich forest soil, thinly scattered among deciduous trees of many species, they were larger, sometimes attaining 80 feet high and 10 to 12 feet in girth; but I saw none anywhere which rivalled our larch in height, and am inclined to think it is not nearly such a long-lived tree, though, as I saw none felled, I was unable to count the rings. Prof. Sargent, who saw the tree in the same place as I did, came to a very similar conclusion. Mayr states that he found it wild on the volcanoes of central Hondo, Fuji, Ontake, Asama, Shiranesan, Norikura, and others, always growing near the timber line, with *Abies*, *Tsuga*, and *Picea hondoensis*.

The tree is valued for its timber, which is used for ship- and boat-building, and has lately come into great demand for railway sleepers and telegraph poles. In consequence of this it has been largely planted at elevations of 4000 to 5000 feet in the central and northern provinces, and many plantations that I saw of ten to fifteen years old were very similar to larch plantations in England in growth and habit. I also saw it planted experimentally in Hokkaido, along the lines of railway, where it seemed to grow as well in this rich black soil as in its native mountains.

CULTIVATION

In 1890 I sowed seeds from three different localities—Dunkeld, Hildenley, and Tortworth—and raised plants from each of them, which grew better than seedlings raised at the same time from Japanese seed; but this may have been partly due to the fact that the latter were dressed with paraffin by my forester to protect them from birds and mice in the seed-bed. At six years old these plants are now from four to eight feet high, and though some of them have been more or less checked by severe spring frosts, they are generally growing well.

As a proof of the hardiness of the tree I may mention that the late Sir R. Menzies showed me three young trees which he had planted, at an elevation of about 1250 feet, in the garden of the inn near the top of the pass between Glen Lyon and Loch Rannoch; and in some of his plantations on the north shore of Loch Rannoch they were growing very vigorously in mixture with Douglas fir.

No conifer of recent introduction has attracted so much attention among foresters as the Japanese larch, which, during the last ten years, has been sown very largely by nurserymen (Messrs. Dickson of Chester are said to have sold no less than 750,000 in the year 1905), and is looked upon by many foresters as likely to replace the common larch, because it is, so far as we yet know, less liable to the attacks of *Peziza Willkommii*. But this pest has already in more than one place been certainly identified on the Japanese larch, and I have little doubt that as time goes on we shall hear more of this. Henry visited in 1904 six plantations of Japanese larch of ages from five to sixteen years, and in none could detect any sign of canker. There

were plantations of European larch in every case adjoining those of the Japanese tree, and the former were all badly affected by disease. Henry concluded that the Japanese larch was practically immune from disease, though on his return to Kew he received specimens from estates in Perthshire and Dumfriesshire which were undoubtedly suffering from *Peziza*.¹ As, with the exception of Prof. Sargent and Dr. Mayr, no one had studied this tree in its native climate, I paid particular attention to it during my visit to Japan in 1904, and, as I have stated² elsewhere, came away with the impression that it is not likely to supersede the European larch as a forest tree, and am very doubtful whether it can be expected to become a profitable one, to plant under ordinary conditions. Though when young its growth is extremely rapid and vigorous, it has a great tendency to form spreading branches, and even in the much more favourable soil and climate of Japan, rarely, if ever, attains anything like the dimensions which the European larch does in Great Britain.

Mayr's opinion on the suitability of the tree for economic plantations in Europe is the same as my own, and he considers that though it may grow faster than the European larch for the first twenty years, yet that it will eventually be surpassed if planted under precisely similar conditions. He also agrees with me that though in selected positions and under careful cultivation it may not seem so liable as the European larch to the attacks of *Peziza*, yet that it is not immune, and the figures which he gives of its growth in Germany show that it has the same tendency to produce spreading branches there as in Great Britain. In a note on this tree by K. Kumé, chief of the Forestry Bureau in Japan, in *Trans. Scot. Arb. Soc.* xx. 28, January 1907, a yield table at various ages is given, which shows that on soils of medium quality in Japan the mean basal diameter at 100 years old is about a foot, the mean height 92 feet, and the stem volume per acre 6330 cubic feet. I will only note that what is meant by land of medium quality in Japan is very superior to what it is in this country. In Germany Mayr says that the seed falls in autumn from the cones, which are busily sought for by squirrels, and that self-sown seed has germinated freely at Grafrath under trees twenty-two years old.

REMARKABLE TREES

There are many specimens now of about 40 feet high in various parts of the country, but of those that I have seen the one figured, which is growing at Tortworth (Plate 108), is perhaps the finest. It measured in 1904, 45 feet by 4 feet 7 inches, and was covered with cones. It is growing on red sandy soil, and Lord Ducie thinks it is one of the earliest introductions. At Hollycombe, Sussex, the seat of J. C. Hawkshaw, Esq., Mr. G. Marshall measured a tree 45 feet by 2 feet 4 inches in 1904. At Hildenley, Yorkshire, there is a fine tree about 40 feet high, which produces good seed. A clump of fine trees is reported³ to be growing at Bothalhaugh, near Morpeth. There is also a fine specimen at Brook House, Haywards Heath, the residence of Mrs. Stephenson Clarke.

¹ See note by Mr. Massee in *Journ. Board Agriculture*, 501 (1904).

² *Trans. Scot. Arb. Soc.* xix. 77 (1906).

³ *Gard. Chron.* xxxix. 282 (1906).

At Dunkeld there is a tree planted close to a common larch, from which seedlings were raised at my suggestion by the late D. Keir, which appear to be hybrids between the two species.¹ His son, who succeeded him as forester to the Duke of Atholl, and who has watched the growth of these seedlings, considers them to be intermediate between the two species; but it is yet too soon to be certain.

At Abercairney, Perthshire, the seat of Col. Drummond Moray, there is a tree, raised from seed brought from Japan in 1883, which, measured by Henry in 1904, was 38 feet by 3 feet 5 inches. At Blair Drummond, in the same county, he measured ten trees planted in 1888, one of which was 44 feet high, and the average girth 2 feet 5 inches. They were all healthy though growing among common larch which was diseased.*

At Cullen House, Banffshire, Mr. Campbell tells me that there is a tree 45 feet by 3½ feet. At Kirkennan, near Dalbeattie, Kircudbrightshire, two larches sown in 1885 were in 1904 41 feet by 2 feet and 35 feet by 1 foot 11 inches. We are indebted for this information to the owner Mr. W. Maxwell.

In Germany at Schloss Lütetsburg, it seems to have grown faster than with us, for it is stated² that trees thirty-five to forty years old are 17 to 20 metres high, with a girth at 1 metre of 1.80 to 2.70 metres. (H. J. E.)

LARIX GRIFFITHII, SIKKIM LARCH

Larix Griffithii, J. D. Hooker, *Ill. Himal. Pl.* t. 21 (excl. ff. 1-4) (1855), *Flora Br. India*, v. 655 (1888), and *Gard. Chron.* xxv. 718, f. 157 (1886); Masters, *Gard. Chron.* xxvi. 464, f. 95 (1886); Kent, *Veitch's Man. Coniferae*, 395 (1900); Gamble, *Indian Timbers*, 720 (1902).

Larix Griffithiana, Carrière, *Conif.* 278 (1855).

Abies Griffithiana, Lindley and Gordon, *Journ. Hort. Soc.* v. 214 (1850).

Pinus Griffithii, Parlatores, DC. *Prod.* xvi. 2, p. 411 (1864).

A tree, attaining in the Himalayas about 60 feet in height, with thick brown bark, and wide-spreading, long and pendulous branches.

Young branchlets, reddish, covered with a dense wavy, more or less appressed pubescence, and girt at the base by a sheath of the previous season's bud-scales, the uppermost of which are very broad, loose, membranous, and reflected. Branchlets of the second year very stout, dull reddish brown, pubescent. Short shoots broad and stout, fringed above by very large, loose, reflected, pubescent, membranous bud-scales. Terminal buds broadly conical, non-resinous, with pubescent scales. Lateral buds ovoid, pointing outwards and forwards, non-resinous, pubescent. Apical buds of the short shoots conical, with loose pubescent scales.

Leaves light green in colour, about 1¼ inch long, ending in a short rounded point; upper surface rounded or flat, with one or two broken lines of stomata near the apex; lower surface deeply keeled with two bands of stomata, each of three

¹ Cf. *Trans. Roy. Scot. Arbor. Soc.* xviii. 62 (1905).

² *Mitt. Deutsche Dend. Ges.* 1906, p. 29.

(occasionally five) lines. In cultivated specimens, the leaves are fringed on each side with a very thin and narrow membranous translucent border.

Staminate flowers, ⅜ inch long, cylindrical, raised on short stout stalks, about 1/16 inch long. Pistillate flowers ovoid; bracts reflected at their bases, with the mucros pointing downwards, oblong, truncate or slightly concave at the apex, the green midrib being prolonged into a mucro about 1/8 inch long.

Cones 3 to 4 inches long, cylindrical, tapering to a narrow, flattened apex, supported on a short stalk, glaucous green or purplish, with orange-brown bracts before ripening, composed of five spiral rows of scales, eighteen to twenty scales in each row, which, on the opening of the cone, stand almost at right angles to its axis, the bracts being exerted with their mucros directed upwards. Scales quadrangular, with a cuneate base, about ½ inch in width and length; upper margin truncate and slightly emarginate; outer surface radially furrowed, densely pubescent towards the base. Bract lanceolate, nearly as long or quite as long as the scale, the mucro, often incurved, projecting beyond the scale about 1/16 inch. Seeds lying in slight depressions on the scale, their wings widely divergent and not extending to its upper margin. Seed, white on the inner side, shining dark brown on the outer side, about 1/8 inch long; seed with wing about 7/16 inch long; wing brownish, rather opaque, broadest about the middle. Cotyledons¹ five to six, which, in the seedling, are linear, pointed, and much longer than the succeeding leaves. (A. H.)

The Sikkim larch is confined, so far as we know at present, to a rather narrow area in the Himalaya, from eastern Nepal to Bhutan, but very possibly will be found farther east. It was discovered by Griffith, but not distinguished until Sir Joseph Hooker found it in E. Nepal in December 1848.² Here it was only a small tree 20 to 40 feet high, differing from the European larch, in having very long, pensile, whip-like branches. It is called "Saar" by the Lepchas, and "Boargasella" by the Nepalese, who said that it was only found as far west as the sources of the Cosi river. In Sikkim it is common in the interior valleys of the Lachen, Lachoong, and their tributaries from about 8000 to 12,000 feet elevation, and here attains a larger size, but is not found in the forests of British Sikkim. In *Illustrations of Himalayan Plants from Drawings by Cathcart*, where it is beautifully figured, Sir Joseph states that it grows to a height of 60 feet in deep valleys, but prefers the dry rocky ancient moraines formed by glaciers, and also grows on grassy slopes where the drainage is good. On my journey to Tibet in 1870 I saw this tree in the Lachoong valley, but nowhere forming a forest, and usually scattered singly in rather open places, where it seemed to me to have a much less erect and regular growth, with branches more drooping in habit than any other larch. Sir Joseph Hooker says that the wood is soft and white, but a specimen from the Chumbi valley, authenticated by cones, is described by Gamble as having red heart-wood with a slow growth, twenty-one rings to the inch, and a weight of 32 lbs. to the foot.

Though introduced by Sir Joseph Hooker, who sent seeds to Kew in 1848, this tree has, except in a few places in the south-west of England, failed to grow in Europe. He says that the seedlings raised from his seeds were 3 to 4 feet high in

¹ Masters, *loc cit.*

² *Himalayan Journals*, i. 255.

1855, and that some had withstood the severe winter of 1854-5 without protection, though others were killed, a difference which he attributes to some of the seed having been gathered from trees which grew at 8000 and some from trees at nearly 13,000 feet. Hooker¹ further states that hundreds of plants were raised and widely distributed by Kew, but in every case these succumbed in a few years to virulent attacks of *Coccus laricis*. As the climate of the Chumbi valley is much drier than that of Sikkim, it is quite possible that seed from that locality would give better results; but I have never been able to keep the tree alive at Colesborne for long, as it suffers from the dry climate, and seems to object to lime in the soil. Mr. Barrie, forester to the Hon. Mark Rolle, has been very successful in growing this tree from English-grown seed, and has sent me healthy young plants of it; but the seedlings I have raised at Colesborne both from imported and home-grown seed have always died, though protected by a frame.

REMARKABLE TREES

The largest specimen of the Sikkim larch we know of in this country is one at Coldrinick, near Menheniot, Cornwall, the seat of Major-Gen. Jago-Trelawney. I have not seen this tree, but the gardener, Mr. Skin, informs me that in 1905 it measured no less than 57 feet by 4 feet 6 inches in girth. It has very spreading branches, the width from point to point of the lowermost branches being 43 feet. The cones were admirably figured in the *Gardeners' Chronicle*,² and have produced fertile seed. The seedlings require careful treatment, as they easily "damp off."

A tree of the original introduction is growing at Strete Raleigh, Devonshire, the seat of H. M. Imbert Terry, Esq., who showed it to me in 1903, when it measured 40 feet high by 4 feet in girth. It is growing on poorish soil at a considerable elevation, where it is a good deal exposed to the damp south-west winds, and perhaps in consequence of this has thriven very well, and has borne fertile seed for some years past (Plate 109).

Another much smaller tree, which also bears cones, is growing at Leonardslee in Sussex. There is also an old tree at Pencarrow, in Cornwall, which in 1905 was only 12 feet high by 15 inches in girth, stunted and covered with lichen. It also bears cones.

Dr. Masters³ received flowering specimens in 1896 from The Frythe, Welwyn, Herts; but the tree from which they were obtained could not be found when Henry visited this place in 1906.

(H. J. E.)

¹ *Gard. Chron.*, *loc. cit.*² After this was printed a good illustration of the tree appeared in the same journal on 2nd March 1907, which shows that it is not only larger, but a better shaped tree than the one I have figured.³ *Gard. Chron.* xxvii. 296 (1900).

LARIX POTANINI, CHINESE LARCH

Larix Potanini, Batalin, *Act. Hort. Petrop.* xiii. 385 (1894); Masters, *Gard. Chron.* xxxix. 178, f. 68 (1906).

Larix thibetica, Franchet, *Jour. de Bot.* 1899, p. 262.

Larix Griffithii, Masters, *Jour. Linn. Soc. (Bot.)* xxvi. 558 (1902). (Not Hooker.)

A tree attaining in western China a height of 70 feet and a girth of 6 feet. Young branchlets bright yellow, with a scattered pubescence, densest near the base of the shoot, which is girt by a sheath of the previous season's bud-scales, showing within a ring of pubescence. Buds ovoid, with ciliate scales.

Leaves slender, up to an inch in length, ending in a sharp cartilaginous point, tetragonal in section, keeled above and below, with two bands of stomata, each of two lines, on both the upper and lower surfaces.

Staminate flowers, $\frac{1}{4}$ inch long, on a short but distinct stalk. Pistillate flowers ovoid, narrow and rounded at the apex; bracts closely appressed, on one side of the young cone with their tips pointing towards its apex, on the other side reflected about their middle with their apices pointing towards the base of the cone, ovate or oblong, rounded and entire at the apex, which is prolonged into a short mucro. The bracts in the pistillate flower, described above as seen in herbarium specimens, are probably all reflected at first; and gradually by the growth of the scale assume the erect position.

Cones cylindrical, rounded at the apex, $1\frac{3}{4}$ inch long, with the scales and bracts pointing upwards and outwards, or more or less spreading. Scales small, about $\frac{1}{3}$ inch long, almost orbicular, reddish brown, pubescent on the lower part of the outer surface; upper margin rounded or truncate, entire, thin, slightly inflected, not bevelled. Bract extending beyond the scale, exerted with the mucro about $\frac{1}{4}$ inch. Seeds in slight depressions on the scale, with their wings widely divergent and not reaching to its upper margin. Seed about $\frac{1}{3}$ inch long; seed with wing $\frac{1}{3}$ inch long; wing broadest just above the seed.

Larix Potanini has been collected in western China by Potanin, Prince Henry of Orleans, Pratt, and Wilson, who found it in the neighbourhood of the Szechuan-Thibetan frontier near Tachienlu at 7500 to 11,000 feet above sea-level. The same species, according to Franchet, was probably collected by Père Delavay farther south on the Likiang range in Yunnan at 11,600 feet altitude. Mr. A. Hosie, Consul-General in Szechuan, informs me that forty miles north-east of Tachienlu, there is a pure forest of this larch between 11,000 and 12,000 feet elevation on the southern slope of the mountain range, and extending for about a mile. It consists of fine straight trees, which he estimated to be about 70 feet high. At lower altitudes the larch gives place to silver fir and birch. The tree is known to the Chinese as "hung-sha," red fir, and produces the most valuable coniferous timber in western China.

Seed was collected by Wilson in 1904, and plants have been raised, which are growing well at Veitch's nursery, Coombe Wood.

This species, being a purely alpine tree of no great size, will probably be of no value as a forest tree, resembling in that respect its immediate allies *L. Griffithii* and *L. Lyallii*, between which it occupies an intermediate position as regards botanical characters.

(A. H.)

LARIX AMERICANA, TAMARACK

Larix americana, Michaux, *Fl. Bor. Am.* ii. 203 (1803); Sargent, *Silva N. Am.* xii. 7, t. 593 (1898), and *Trees N. Am.* 35 (1905); Kent, *Veitch's Man. Conif.* 389 (1900).

Larix americana, Michaux, var. *rubra*, Loudon, *Arb. et Frut. Brit.* iv. 2400 (1838).

Larix tenuifolia, Salisbury, *Trans. Linn. Soc.* viii. 314 (1807).

Larix microcarpa, Desfontaines, *Hist. Arb.* ii. 597 (1809); Lawson, *Agric. Man.* 388 (1836).

Larix laricina, Koch, *Dendrologie*, II. ii. 263 (1873).

Larix pendula, Masters, *Journ. Roy. Hort. Soc.* xiv. 218 (1892). (Not Salisbury.)

Pinus Larix americana nigra, Muenchhausen, *Hausv.* v. 226 (1770).

Pinus laricina, Du Roi, *Obs. Bot.* 49 (1771).

Pinus intermedia, Wangenheim, *Beit. Hölz. Forst. Nord Am. Hölz.* 42, t. 16, f. 37 (1787).

Pinus microcarpa, Lambert, *Pinus*, i. 58, t. 37 (1803).

Abies microcarpa, Poiret, *Lamarck's Dict.* vi. 514 (1804).

A tree attaining in America about 80 feet in height and 6 feet in girth. Bark separating in thin small polygonal or roundish scales about an inch in diameter, which are closely appressed, and show when they fall off the reddish cortex beneath. Young branchlets slender, often glaucous, glabrous, or with a few scattered hairs in the grooves between the pulvini; older branchlets glabrous, shining brown. Base of the shoot girt with a short sheath of the previous season's bud-scales, no ring of pubescence being visible. Short shoots small, blackish, glabrous. Terminal buds globose, slightly resinous, glabrous, with the basal scales subulately pointed. Lateral buds hemispherical, resinous, dark brown. Apical buds of the short shoots broadly conical, surrounded at the base by a ring of brown pubescence.

Leaves short and slender, not exceeding $1\frac{1}{4}$ inch in length, rounded at the apex, light green; upper surface flat or rounded, without stomata, except two broken lines near the tip; lower surface deeply keeled with two bands of stomata, each of one to two lines.

Staminate flowers sessile, shorter than in *L. europæa*. Pistillate flowers ovoid, reddish, very small; bracts pointing upwards and outwards, not reflected or recurved, $\frac{1}{8}$ to $\frac{1}{6}$ inch long, oblong, scarcely emarginate at the apex, reddish with a green midrib and mucro, the latter cuspidate and very short, about $\frac{1}{30}$ inch long.

Cones small, globose, consisting of three to four spiral rows of five scales each, reddish brown when ripe, $\frac{1}{2}$ to $\frac{2}{3}$ inch long. Scales gaping widely at the apex of the cone, longer than broad, about $\frac{2}{3}$ inch long; upper margin rounded, bevelled, slightly crenulate, not recurved or reflected. Bract concealed, minute, about $\frac{1}{8}$ inch long.

Seeds lying on the scale in minute depressions, with their wings only slightly divergent and not reaching to its upper margin, $\frac{1}{7}$ inch long; wing $\frac{1}{3}$ inch long, broadest just above the seed.

(A. H.)

DISTRIBUTION

The American larch is found in the United States from North Pennsylvania, Northern Indiana and Illinois, and Central Minnesota through the New England States, where, however, it is only found in cold and swampy places. In Newfoundland, Labrador, and the eastern provinces of Canada it occupies swampy ground, and extends from York Factory on Hudson Bay as far as Fort Churchill, $67^{\circ} 30' N.$, and west to Athabasca and Peace river districts, and in Alberta where it has been found forty miles S.W. of Edmonton.¹ Northwards it extends to the border of the barren lands. Mr. J. M. Macoun informs me that it was found by Mr. Camsell in the angle between the Snake river and the upper part of Peel river. This place is just within the Yukon district. He also states that it extends westward twenty-two miles up the Dease river, and northward along the upper Liard river to lat. $61^{\circ} 30'$. He has heard several people who have been on the Yukon speak of the larch, so that it must be quite common in some parts, though no definite data are as yet given.

The tamarack, as it is called in most parts of N. America, is a tree which I know but little in a state of nature, and which never seems to have received the attention from foresters which it deserves; for though it nowhere attains the size of the common larch, it seems able to thrive in undrained and swampy ground where that would die; and though a slow-growing tree in comparison with the common larch, its timber has the same valuable qualities as others of the genus.

Henry saw this species in Minnesota in 1906. On the Cass Lake Forest Reserve it occurs in the swampy ground between the pine-covered sand-dunes, in company with balsam fir, Thuya, black and white spruce, birch, and willow. The largest that he saw measured 81 feet by 4 feet 7 inches. The trees are remarkable for their buttressed roots, which branch and extend close to the surface and even above ground for as much as 6 feet. Seedlings were numerous in felled areas near Erskine, where the larch remaining uncut, occurs in swamps either pure or mixed only with birch. They grow very rapidly in the wet ground, taking root in mossy elevated patches and not in the water of the swamps; and averaged 10 feet high at seven years old, and were making leaders of 1 to 2 feet annually. He saw no stumps larger than 2 feet in diameter, and the tree in Minnesota rarely attains a greater size than 80 feet by 6 feet. In *Garden and Forest*, 1890, p. 60, there is, however, mention of a tamarack in Minnesota, which measured 7 feet 8 inches in girth and was estimated at 125 feet high.

In most parts of New England and over the greater part of British North America the tamarack is a well-known tree, but rarely attains any great size. The average in the neighbourhood of Ottawa is not over 50 to 60 feet, but when the tree is planted on drier, better land it will grow faster and attain 80 feet or more. I noticed that though it seeds freely the seedlings require more light than

Bell in *Scottish Geogr. Mag.* xiii. 283.

those of the spruce, balsam fir, and Thuya, which often grow with it, and it was only where clearings had been made, or in wet places on the edge of the groves, that they seemed able to thrive. Their growth is slow at first, but when established may be as much as two feet annually.

Dr. Bell gives the probable life of the white spruce in Canada as from 100 to 140 years, that of the black spruce 150 to 175 years, and that of tamarack 175 or 200 years. Of the latter he says:¹ About 1893 or 1894 the imported sawfly² came up from the direction of New York and got into the forests north of the Ottawa river. In a year or two it reached James bay and killed the tamarack throughout that district, which was only able to live three or four years after it was first attacked by the larva. This destruction continued to spread to the centre of Labrador, and now it has gone pretty well all over that great peninsula. But Mr. J. C. Langelier (*loc. cit.* p. 65), speaking of the same attack in the northern part of the province of Quebec, says that a great portion of the young trees were spared, and that the dead trees which remain standing are not attacked by rot, and would supply excellent railway ties.

REMARKABLE TREES

In this country there are not many large trees of this species, though it was introduced, according to Loudon,³ by the Duke of Argyll in 1760 at Whitton, near Hounslow. It has been entirely neglected by modern arboriculturists, and is seldom or never procurable in English nurseries. The largest trees that I know of are at Dropmore, where there is a well-grown tree 78 feet by 5 feet (Plate 110), and at Arley Castle, where there are three trees of nearly the same size standing together, of which the best measures 71 feet by 4 feet 8 inches. A fourth is nearly as large, and differs in having larger cones.

At Boynton, Yorkshire, there are two in a wet situation among other trees, about 50 feet high and sixty years old, which were raised by Sir Charles Strickland from seed produced by trees planted by his grandfather. These again have produced fertile seeds, from which seedlings are growing vigorously in a low frosty situation at Colesborne and have never suffered from frost or bug, though one of them in 1906 was attacked by *Peziza*. Sir Charles adds that on dry soil they have grown very badly.

At Beauport there are three rather stunted specimens of American larch, one of which, however, is 5 feet 10 inches in girth, and has the bark very smooth in comparison with the common larch. No specimen seems to have been sent to the Conifer Conference, but one is mentioned as growing in the grounds of Dalkeith Palace,⁴ which we have identified with *L. dahurica*. Several trees mentioned by Loudon are either not now in existence or were not correctly named.

(H. J. E.)

¹ *Can. For. Ass. Annual Report*, 1905, p. 59.

² According to Sargent this is *Nematodes Erichsonii*, Hartig, a European insect which was not much noticed in America before 1880, and which has recently attacked the larch in England. Cf. *supra*, p. 364.

³ *Op. cit.* 2400, 2401. The original tree at Whitton was between 40 and 50 feet high in 1837: it has long since been cut down.

⁴ *Veitch's Man. Coniferae*, 390 note (1900).

LARIX OCCIDENTALIS, WESTERN LARCH

Larix occidentalis, Nuttall, *Sylva*, iii. 143, t. 120 (1849); Lyall, *Journ. Linn. Soc.* vii. 143 (1864); Sargent, *Gard. Chron.* xxv. 652, f. 145 (1886), *Silva N. Amer.* xii. 11, t. 594 (1898), and *Trees N. Amer.* 36 (1905); Kent, *Veitch's Man. Coniferae*, 400 (1900); Mayr, *Fremdländ. Wald- u. Parkbäume*, 306 (1906).
Pinus Nuttalli, Parlatore, DC. *Prod.* xvi. 2, p. 412 (1868).

A tree attaining in America 200 feet in height and over 20 feet in girth; narrowly pyramidal in habit, the branches being much shorter than in the other species. Bark of young stems thin, dark-coloured, and scaly; becoming near the base of old trunks 6 inches thick and breaking into irregularly shaped oblong plates, often 2 feet in length and covered with thin reddish scales. Young branchlets covered with a minute dense pubescence intermixed with longer hairs in the grooves between the pulvini. In certain cultivated specimens the branchlets are glabrous from the first. Branchlets of the second year light brown, shining. Base of the shoot girt with a sheath of the previous season's bud-scales, no ring of pubescence being visible. Short shoots chestnut brown, shining. Terminal buds globose, with pubescent and ciliate scales, the lowermost of which are subulately pointed. Lateral buds hemispherical with pubescent and ciliate scales. Apical buds of the short shoots broadly conical, reddish brown, pubescent.

Leaves light green in colour, up to 1 $\frac{3}{4}$ inch long, rounded on the back, deeply keeled beneath, with stomatic lines as in *L. europæa*.

Staminate flowers raised on short stalks at maturity. Pistillate flowers ovoid; the bracts pointing upwards and outwards and not recurved, $\frac{1}{4}$ inch long, brownish in colour with a green midrib and mucro, oblong, emarginate at the apex; mucro $\frac{1}{10}$ inch long.

Cones ovoid, 1 $\frac{1}{4}$ to 2 inches long, with the bracts long-exserted and the scales opening early in the season to let out the seeds and then standing at right angles to the axis of the cone. Scales in six spiral rows, each row of nine to ten scales; orbicular, $\frac{1}{3}$ to $\frac{1}{2}$ inch long; upper margin entire or emarginate, thin, slightly recurved, not bevelled; outer surface densely pubescent. Bracts ovate-lanceolate, extending up to near the margin of the scale, beyond which the mucro projects $\frac{1}{8}$ to $\frac{1}{2}$ inch. Seeds lying in two deep depressions on the scale, their wings narrowly divergent and extending up to its upper margin; body of the seed $\frac{1}{8}$ inch long; wing pale coloured, short and broad, widest at the base; seed with wing $\frac{1}{4}$ to $\frac{2}{8}$ inch long.

VARIETIES

In the wild state the tree shows little variation, except in the pubescence of the branchlets, which in rare cases is entirely absent; while in other cases, noticed occasionally at high elevations, the amount of pubescence becomes so dense as to be almost similar in character to the tomentum of *Larix Lyallii*. In the few cultivated

trees in England, two distinct forms are apparent. Certain trees have pubescent branchlets and bear large cones, up to two inches in length, which have large scales purplish in colour before ripening, long exserted bracts and long-winged seeds. Other trees with glabrous branchlets bear small cones, about $1\frac{1}{4}$ inch in length, with scales green before ripening, shorter exserted bracts and small seeds with short wings. The former trees are more narrowly pyramidal in habit.

HISTORY

This splendid tree is the largest of the genus, and though it has been known to botanists for many years, it was till quite recently, on account of its being neglected by the early explorers of the limited region which it inhabits, one of the rarest exotic conifers in cultivation.

It was first discovered by David Douglas¹ in 1826 near Fort Colville on the Upper Columbia river; but was mistaken by him for the European larch. His specimens in the Kew Herbarium are labelled "in aqueous flats on the mountain valleys near Kettle Falls and in the Rocky Mountains, 1826." The tree was first described in 1849 by Nuttall, who found it on the Blue Mountains of Oregon in 1834.

It was introduced into cultivation in the Arnold Arboretum in 1881, seedlings having been imported from Oregon; but in the climate of New England these have remained small and stunted, though branches grafted on the Japanese larch have grown vigorously. Forty plants were sent from the Arnold Arboretum to Kew in 1881, and one tree survives (the fate of the other plants being unknown), which is remarkable for its beautiful straight stem and narrow, almost columnar habit. This tree bears large purplish cones, and is now (1906) 33 feet in height and 17 inches in girth.

Ten plants were subsequently sent in 1889 from the Arnold Arboretum to Kew, of which two survive. One of these trees is, however, identical in cones and pubescent branchlets with the tree of 1881, and may be erroneously labelled 1889; it has suffered damage at the top. The other tree, which has glabrous branchlets and bears small green cones, is not quite so narrow in habit, and measured in 1906 29 feet in height and $17\frac{1}{2}$ inches in girth.

The only other large tree in Britain with which we are acquainted is growing at Grayswood Hill, Haslemere; and measured in 1906 28 feet high by 19 inches in girth. It has pubescent branchlets, and bears purple cones, which are, however, smaller than those of the Kew tree, labelled 1881. Mr. Chambers informs us that this tree was obtained from Messrs. Dickson of Chester in 1889.

DISTRIBUTION

The western larch is confined to the more humid parts of the region, which extends from the western slope of the Rocky Mountains in British Columbia and

¹ *Comp. Bot. Mag.* ii. 109 (1836), where Douglas states that he measured trees 30 feet in girth.

Montana to the eastern slope of the Cascade Mountains in Washington and Oregon.

In British Columbia it is abundant and large in the Kootenay and Columbia river valleys, reaching as far north as the head of Upper Columbia lake, and attaining its most westerly point, where it was found by Prof. Dawson, in long. 124° E., on a tributary of the Blackwater river. It grows sparingly about the Shuswap lake and in the Coldstream valley near the head of Okanagan lake.

The tree, however, attains its greatest development in Montana, where it is abundant and constitutes a great part of the timber of the Flathead, Lewis and Clarke, and Bitter Root Forest Reserves; and is met with east of Missoula on the Big Blackfoot river. The tree can be most conveniently seen by the traveller on different points of the Great Northern Railway between Nyack and Bonner's Ferry. It attains also great perfection in Northern Idaho and North-East Washington, where it constitutes an important part of the timber of the Priest River Forest Reserve. It also occurs in Oregon, in the Blue Mountains, and on the foothills of the eastern side of the Cascade Mountains,¹ as far south as Mount Jefferson.

The western larch occurs between 2500 and 6000 feet altitude; and attains its maximum height and is most abundant in mountain valleys and on alluvial flats, where the average elevation is 3000 to 3500 feet. On the sides of the mountains, owing to the lack of moisture in the soil, it rapidly diminishes in size and vigour. It requires a wetter soil than either *Pinus ponderosa* or Douglas fir, and is restricted in its distribution where the rainfall is slight.

With regard to the opinion, prevalent even in America, that it grows in a semi-arid climate, my experience is entirely different. The meteorological stations are almost invariably in towns in the prairie regions, where the rainfall is small and trees only occur on the banks of streams; and the maps and statistics of the rainfall give on that account an imperfect picture of the climatic conditions which prevail in the forest regions between the Cascades and the Rocky Mountains. At Kalispell in the Flathead country, which is situated in a treeless plain, surrounded by densely forested mountains, the annual rainfall varies from 13 to 19 inches; whereas at Columbia Falls, placed on the edge of the plain and amidst the larch forests, the rainfall increases to from 20 to 29 inches; and in the mountain valleys, as at Lake Macdonald and Swan Lake, where *Thuja plicata* attains a large size, the rainfall must exceed 30 inches. The meteorological data of Columbia Falls, which is at 3100 feet elevation, give a fair idea of the climate in which *Larix occidentalis* thrives, though it is scarcely here at its best. The figures for 1905, which was a dry year, are:—

¹ Mr. Cohoon, Forest Assistant in the Northern Division of the Cascade Forest Reserve, wrote to me in 1906 as follows: "The only locality in which larch came under my observation in the reserve was on the east slope of the Cascade Mountains about 15 miles west of Duffur, Oregon. It did not occur abundantly, but was more or less scattered, in mixture with yellow pine, red fir, and lodge-pole pine. It was found on moist but well-drained soil at an altitude of about 2500 to 3000 feet." He adds that he never saw it west of the summit of the Cascades, which he has travelled over from Columbia river to California.

At Bridal Veil, Oregon, and other places on the Pacific slope, the term larch is erroneously applied to *Abies nobilis*.

	Precipitation in Inches.		Min. Temp.	Max. Temp.	Mean Temp.
	Snow.	Rain.	Fahr.	Fahr.	Fahr.
January	2.14	...	-1°	46°	24°
February	0.93	...	-35°	52°	18°
March	0.34	...	14°	63°	38°
April . . . . .	...	0.45	15°	76°	44°
May . . . . .	...	3.13	20°	83°	49°
June . . . . .	...	2.23	28°	89°	56°
July . . . . .	...	0.38	34°	96°	65°
August . . . . .	...	0.12	29°	96°	64°
September . . . . .	...	2.04	24°	83°	55°
October . . . . .	...	2.54	9°	60°	38°
November	2.47	...	-11°	56°	30°
December	2.79	...	3°	46°	25°
Total precipitation, 1905	19.56 inches.				

Average precipitation for ten years 21.70 inches.

Rain or snow fell on 76 days; 91 days were cloudy; 49 days were partially cloudy; and the sky was clear on 149 days.

The above figures show that the climate is an extreme one, the winter season being cold and severe and lasting five months, while in summer a high temperature is often reached.

The western larch grows usually mixed with other conifers; and the number of accompanying species and the proportions of the admixture are very variable, being dependent on the climate and altitude, and on the quantity of moisture in the soil. Douglas fir is the most common companion of the larch, and *Pinus ponderosa* steps in where the soil is dry. Engelmann's spruce and *Abies lasiocarpa* descend into the larch forests, but never constitute any large element of it. *Pinus monticola*, *Tsuga albertiana*, and *Abies grandis* are often met with in small quantity at low altitudes in the larch forests of Montana; farther west, in the Priest River Forest Reserve, *Pinus monticola* is more abundant than the larch itself between 2400 and 4800 feet. *Thuja plicata*, in regions with a moist climate, forms a notable part of certain larch stands, often to the exclusion of the other species which usually accompany the larch.

The following notes on a few of the larch forests visited by me will illustrate some different types in Montana.

Near Missoula, in Pattie Cañon, which is a very dry valley at 3500 feet elevation in a rather arid climate, the larch only grows on the cool northern aspect, and is mixed with Douglas fir and *Pinus ponderosa*. An acre contained, of trees over a foot in diameter, twenty larches, four firs, and three pines. An average good larch tree measured 143 feet by 9 feet 7 inches; and a tree which we cut down, 14 inches in diameter, showed 211 annual rings, the sapwood being $1\frac{1}{4}$ inch in thickness and containing thirty-one rings.

On the southern end of Lake Macdonald, at 3500 feet altitude in a humid climate, I saw a fine stand composed almost exclusively of larch and *Thuja plicata*. The soil was glacial clay, very deep, and covered with a thick layer of humus. The

Thuja only attained about 110 by 7 feet, and had been overtopped by the larch, which ran from 140 to 150 feet high, and 7 to 14 in girth. The trees were extremely dense upon the ground, standing often only 12 feet apart, and averaging 200 to the acre. The ground was covered with seedlings of *Thuja*, 3 to 6 feet high, and more than thirty years old. The *Thuja* trees were being felled for telegraph and telephone poles, but never had clean stems, being covered with dead branches to 6 to 20 feet above the ground, and with living branches above this, and when of a large size were always decayed at the heart. The larch, as usual, was quite sound.

A wood near Whitefish, on flat land in a moderately rainy district at 3000 feet altitude, was composed of about nine-tenths larch and one-tenth Douglas fir, *Pinus ponderosa*, and Engelmann's spruce. The larch were 160 feet high by 6 to 9 feet in girth, overtopping the other trees, and with clean stems up to 80 or 90 feet. A stump, 40 inches in diameter, showed 585 annual rings, the sapwood with forty-two rings being only an inch in thickness, and the bark two inches.

The largest tree which I saw was growing on a high bank beside the Stillwater Creek, some miles west of Whitefish. It measured 19 feet 4 inches in girth at 5 feet from the ground, but the top was blown off. Near it were many large trees, 12 feet to 15 feet in girth, but the tallest was only 151 feet in height.

With regard to the height attained by the western larch, Sargent in his *Report on the Forest Trees of North America*, 216 (1884), states that it ranges from 100 to 150 feet, but in the *Silva* he gives the maximum height as 250 feet. I could find no confirmation of the latter figure either at the Arnold Arboretum or Washington, and I am of opinion that 180 feet is rarely if ever exceeded. The tallest tree recorded by any accurate observer is, I believe, the one cut down by Ayres¹ in the Whitefish Valley at 3500 feet altitude, which measured 181 feet high, with a diameter of 3 feet on the stump, and scaled 3500 feet board measure. He mentions¹ also another tree growing on the middle fork of the Flathead river, which was 180 feet high by 4 feet in diameter.

J. B. Leiberger states in his account of the Priest River Forest Reserve that the larch in the sub-alpine zone, above 4800 feet elevation, averaged 60 to 100 feet in height, 1 to 2 feet in diameter, and eighty to a hundred years old; while in the white pine zone, from 2400 to 4800 feet, the trees were 150 to 200 feet in height, 2 to 4 feet in diameter, and 175 to 420 years old. Here the heights are evidently estimates, and cannot be relied on implicitly.

The western larch is rarely seen as pure forest, and then only as the result of forest fires. Mr. Langille in his account of the Cascade Forest Reserve, p. 36, says that the larch "has done more than any other species to restock the immense burns that have occurred on a part of the reserve. This is largely due to the fact that the thick bark of this tree resists fire better than any other species, and more trees are left to cast their seed on the clean loose soil and ashes immediately after a fire. The seeds are small and light, and are carried to remote places by the wind and covered deeply by the fall rains. In the spring a dense mass of seedlings covers the

¹ U.S. Geol. Survey, Flathead Forest Reserve, 256, 314 (1900).

ground and grows rapidly. The thickets become so dense that it is impossible to travel through them. In time only the fittest survive, and there remains a thrifty, vigorous stand of this valuable timber." In Montana the lodge-pole pine usually takes possession of burnt areas; but I saw near Belton on the Great Northern Railway a hillside which had been swept by a fire, leaving a good number of larch trees unharmed, all the trees of other species being destroyed, and larch seedlings were coming up in profusion. On the Stillwater Creek farther west I noticed a burnt area on which the lodge-pole pines were about 30 feet high; and amongst them larch seedlings were growing in openings exposed to sunlight during at least a part of the day. Here in time the lodge-pole pine will be supplanted by the larch. Sargent's statement,¹ that young seedlings of the western larch are able to grow up under the shade of other trees, which they finally overtop and subdue, requires modification. Seedlings never occur in the shade of the forest, and are most numerous in open places exposed to full sunlight; but on good soil, as on a recently burnt area, they will spring up in the partial shade of small pine trees. The western larch is not a fast grower in the young stage; at Belton seedlings twelve years old, growing on rather poor rocky ground, were from 7 to 12 feet high.

As the seed of the western larch had never been collected, so far as we knew, by any one except Mr. Carl Purdy's collector in 1903, I visited Montana in 1906, with the object of collecting a large quantity for Sir John Stirling Maxwell and Lord Kesteven. In the common larch the seeds do not fall out of the cones until spring, and their collection during winter is an easy matter. The western larch behaves very differently, as will be seen by the following notes of my observations in Montana. About the middle of August the squirrels begin to throw down cones, a sign that the seeds are nearly ripe. About the 10th September the leaves, which form a tuft at the base of the cone, begin to turn yellow, and in a day or two become brown and withered, showing that the supply of nutrition to the cone is stopped. The cones, which until now were purplish in colour, become brown, and the scales gape open widely, allowing the seeds to escape. By the 20th September all the cones on the trees have become quite brown, and have emptied all their seeds. The empty cones remain on the branches till the autumn of the following year, by which time their peduncles have rotted and the cones are ready to fall. For collecting seed the larch forests must be visited during the first three weeks of September; and localities where felling is being carried on should be chosen, as the cones occur only at the summit of very tall trees, which are troublesome to cut down, even if permission to do so has been obtained from their owners. The western larch appears to produce a good crop of seed once every two or three years, and this is general over the whole region. 1906 was a remarkably poor year, scarcely any cones having been formed. In 1905, judging from the old cones of that year still remaining on the trees, the crop of seed was very abundant.

(A. H.)

As I had long been trying to find a larch that would in England be less liable to the attacks of *Peziza Willkommii* than the common larch, I made inquiries as

¹ *Garden and Forest*, ix. 491 (1896), where there is an article on the tree, with an illustration of the trunk, fig. 71, showing the very thick bark.

to how seeds could be procured, and Prof. Sargent was good enough to do his best for me. Mr. Leiberg, in 1901, went on purpose to the Flathead Lake country, but found all the seed shed as early as September, and could only send a few seedlings by post. These heated on the way to England, and though I saved a few of them, they were always sickly, and most of them died before coming into leaf. Again I tried through the United States Forestry Bureau, who were also unable to get seed. In 1903, however, I procured a small parcel from Mr. Carl Purdy, and distributed the seed to many arboriculturists in England in 1904. These have germinated fairly well, and I hope that my efforts to make this grand tree better known may succeed.

The seedlings raised in 1904, from the seed which I distributed, have grown in several places, best perhaps at Murthly, under the care of Mr. Lowrie, where in September 1906 I saw some hundreds thriving very well, though not so large as common larch of the same age. At Walcot, in rather dry soil, they were 6 to 9 inches high. At Colesborne they grew slowly, and many were killed or injured in the seedbed by the frost of May 1905; but I have just planted out a number which were raised for me by Messrs. Herd of Penrith, and which are 12 to 18 inches high.

I visited Missoula in June 1904 on purpose to see the tree, and was fortunate enough to do so in company with Prof. Elrod of the Montana University, to whom I am greatly indebted for the excellent photographs of the tree here reproduced (Plate 111). They were taken on the Big Blackfoot river about twenty miles up the valley from Bonner, on the Northern Pacific Railway, where a large sawmill, managed by Mr. Kenneth Ross of the Big Blackfoot Lumber Company, has its headquarters. Guided by this gentleman we reached the logging camp in the Camas prairie and found the larch growing in deep bottom land at about 3500 feet, mixed with *Pinus ponderosa* and Douglas fir, but far exceeding both of them in size. The tree grows on slopes and in ravines where there is a good depth of soil not liable to dry up, and best on slopes with a north and east aspect, and on the rich detritus at their foot, and along the sides of the river. It differs strikingly from other larches in habit when adult, having very short branches, which are not produced singly or at regular intervals but grow in irregular groups of four or five, starting near together on the trunk. It forms a tall, very narrow column, and as it gets old loses many of its branches. It carries its girth to a great height and is, when grown in a thick forest, sometimes clear of branches for over 100 feet. The tallest tree I have heard of was figured in the *Butte Miner* of 29th February 1904, and was said to be the largest in Montana, 233 feet high and 24 feet in girth at or near the ground. This tree grew on the Upper Clearwater between Salmon and Seely lakes. It could be seen for miles above the surrounding trees, and must have contained over 2000 feet of timber. The best I saw, however, were from 150 to 180 feet in height, with a girth at 5 feet of 10 to 15 feet.

Frank Vogel, a timber surveyor who has had much experience with this tree, told me that it grew up to 6000 feet elevation on the hills above the Blackfoot river, and that he saw no difference between these trees and those lower down except in

size. The age of those of which I counted the rings, and which would be about the same age as the one photographed, was 330 to 350 years, these trees showing no signs of decay. The bark in dense forest is very thin for such large trees, sometimes only 2 to 3 inches thick, and though in older and more isolated trees it attains a much greater thickness, as much as 9 to 15 inches near the ground, it struck me as not being so thick and rugged as the bark of old European larch.

The undergrowth in the forest was not dense, and was composed of *Berberis aquifolium*, *Cornus canadensis*, *Linnæa borealis*, *Symphoricarpos*, *Thalictrum*, with violets, strawberries, and in some places that lovely little orchid *Calypto boreale*. There were abundant seedlings of larch and Douglas fir springing up wherever there was enough light and moisture, but in the drier parts of the forest pine only was seen. The young cones were already formed on 29th May, and I came away with the impression that though this tree may not rival the European or Japanese larches in rapidity of growth, it will be valuable in the mountains of Central Europe and will probably succeed on the better soils of England and Scotland.

With regard to the timber of the western larch, Prof. Sargent says that "it surpasses that of all other American conifers in hardness and strength, it is very durable, beautifully coloured, and free from knots; it is adapted to all sorts of construction, and beautiful furniture can be made from it. No other American wood, however, is so little known." Through the kindness of Mr. K. Ross I was able to bring back from the St. Louis Exhibition a door and frame made from this wood which fully bears out Sargent's high opinion of it.

Until a few years ago the timber of the western larch was invariably called tamarack, and was of no great commercial importance. The use of this name, which is properly applied to *Larix americana*, the timber of which is little esteemed, proved prejudicial to the reputation of the western larch in the eastern states. Of late years the timber merchants of Idaho and Montana insist on the use of the term larch; and large quantities of this lumber are now being exported even as far east as New York. Coarse grades are used for joints, beams, and railway ties. Finer grades are sawn into planks, used for flooring, and are converted into materials for indoor finish, as ceiling, laths, mouldings, panelling, etc. The timber is remarkably free from knots, and is variable in colour, being often nearly white, though it is usually reddish in tint.

(H. J. E.)

LARIX LYALLII, LYALL'S LARCH

Larix Lyallii, Parlatore, *Enum. Sem. Hort. Reg. Mus. Flor.* 1863, *Journ. Bot.* i. 35 (1863), and *Gard. Chron.* 1863, p. 916; Sargent, *Gard. Chron.* xxv. 653, f. 146 (1886), *Silva N. Amer.* xii. 15, t. 595 (1898), and *Trees N. Amer.* 37 (1905); Kent, *Veitch's Man. Coniferae*, 399 (1900).

A tree attaining in America 80 feet in height and 12 feet in girth, but usually considerably smaller. Bark of young stems and branches thin and pale grey, on larger stems loose and scaly, on older trunks 2 inches thick and fissuring into irregular plates covered by reddish-brown loose scales. Young branchlets covered with a dense greyish tomentum, concealing the pulvini, and partly persistent on older branchlets, which become greyish black in colour. Short shoots stout and greyish pubescent. Bud-scales fringed with long cilia. Base of the long shoots girt with a sheath of the previous season's bud-scales, the uppermost of which are loose, membranous, and reflected.

Leaves bluish green, rhombic in section, deeply keeled on both surfaces, 1 to 1½ inch long, rigid, ending in a sharp cartilaginous point.

Staminate flowers ovoid, acute at the apex, ½ inch long, raised on stalks ⅓ inch long. Pistillate flowers ovoid, with the bracts reflected about their middle, their mucros curving outwards; bract oblong, ⅓ inch long, truncate at the apex, the midrib being prolonged into a rigid mucro about ¼ inch long.

Cones ovoid, acute at the apex, 1½ to 2 inches long, on a short tomentose stalk: scales numerous, loosely imbricated, thin, ovate, of a beautiful pink colour before ripening, ½ inch long, fringed with matted hairs; outer surface sparingly pubescent: bracts extending up to the margin of the scale, with their mucros projecting beyond about ¼ inch and at first directed upwards; when ripe the scales spread at right angles and finally, together with the bracts, become much reflexed. Seeds in slight depressions on the scale, with their wings narrowly divergent and not reaching its upper margin. Seed together with wing about ⅞ inch long; wing pale pink in colour, broadest near the base.

This species has been supposed to be an alpine form of *L. occidentalis*; but is readily distinguished from it by the structure of the leaves, the tomentum of the branchlets, the beautiful pink cones, which have fringed scales, and the pink-winged seeds.

(A. H.)

This tree was discovered by Dr. D. Lyall when surgeon to the International Boundary Commission in British Columbia in 1858, and though I have raised seedlings which I believe to be this species, it has not as yet been introduced into cultivation either in America or Europe, though it is a tree which must have been seen by thousands of travellers while crossing the Rocky Mountains in the Canadian Pacific Railway. Plate 112 shows a typical tree growing near Laggan, and is from a negative which I purchased at Victoria.

It is a strictly alpine tree, of somewhat limited range, its northern limit being

about 51° N. on the Rocky Mountains, not extending to the moister climate of the Gold or Cascade ranges in British territory, nor has it as yet been discovered in the more northern parts of British Columbia. Southwards, it extends along the Cascade Mountains of Northern Washington to Mount Stewart on the north fork of the Yakima river, and along the continental divide of the Rocky Mountains to the middle fork of Sun river and to Pend d'Oreille pass in North-Western Montana.¹ In its northern habitat—near Laggan, Alberta—I have seen it from about 5000 up to 7000 feet. Though Mr. J. Macout reports it on a mountain near Morley as low as 4500 feet, yet Wilcox,² who must have seen as much of this tree as any one who has written of it, says it is rarely seen below 6000 feet, and that its extreme range of altitude might be placed between 5600 and 7600 feet.

Lyall's larch is a very beautiful tree of moderate size, from 50 to 70 feet high being about the average, with a girth of 5 to 6 feet, but on Mount Stewart Mr. Brandagee reported that it attained as much as 4 feet in diameter. Its growth is extremely slow, Wilcox having counted 30 rings of growth in a branch only $\frac{3}{4}$ inch in diameter; whilst a tree cut by Brandagee on Mount Stewart which showed 562 annual rings was only $16\frac{1}{2}$ inches in diameter under the bark.

Mr. M. W. Gorman says:³—Near Lake Chelan it was not seen at all in the moist valleys, and was generally found to favour the passes and sheltered sides of the crest lines and divides, and here it ranges in altitude from 5800 to 7100 feet. The best grove seen was at about 6700 feet elevation near War Creek pass. The tree ranges in height from 50 to 90 feet, and in diameter from 10 to 25 inches. The mature tree has a rather thick greyish bark, and is well fruited with oval, mostly erect persistent cones. The branches are mostly lateral, very brittle, and quite small in proportion to the tree. The foliage changes colour with the first severe frosts about October 1.

L. Lyallii has to contend with a climate as severe as, and very similar to that of the Altai Mountains, the snow usually lying till late in June or even July, and snow and frost often occurring in July and August. The bark is rough and greyish and the branches short, irregular, brittle, and easily broken by a heavy snowfall. Wilcox says that the trees growing at the highest altitude have a curious development not found on those only a few hundred feet lower. The tufts of leaves spring from a hollow woody sheath, which is sometimes more than an inch long on the trees at high altitudes, whilst elsewhere this is not present.

The seed appears to ripen and shed early like that of the western larch, for though I have made several attempts to procure it from friends visiting the Rockies they have been, like myself, always too early or too late, and though I tried to bring home seedlings in 1893 they died on the journey home.

It is not, however, at all likely to succeed in this country, except possibly on the higher parts of the Grampian Mountains, and even there I fear the climate will be too damp, and the winter too short for it.

(H. J. E.)

¹ Sheldon, in *Forest Wealth of Oregon*, says that it is "rare on the high peaks of the Wallowa Mountains."

² *The Rockies of Canada*, 63 (1900).

³ *U.S. Geol. Survey, Eastern Part of Washington Forest Reserve* (1899). Mr. Gorman calls the tree *L. occidentalis*; but his specimens, which we have seen, are labelled *L. Lyallii* by himself, and are this species.

LYALL'S LARCH IN MONTANA

Larix Lyallii occurs in five isolated areas in the mountains of Northern Montana, between 113° and 115° E. long. and 47° 25' and 49° N. lat.

One of these localities was discovered by Prof. Elrod and myself in our ascent of the unexplored peak of St. Nicholas, which lies just west of the continental divide, about ten miles east of Nyack on the Great Northern Railway. Here about 1000 trees grow on a rocky precipitous slope, with a strictly northern aspect, and extend in scattered groves over about a mile of ground between 6600 and 7500 feet altitude. The tree is, owing to lack of moisture in the soil, unable to exist on the sunny southern slopes, where *Pinus albicaulis* thrives at similar altitudes. Separate groves of Engelmann's spruce accompany the Alpine larch. The largest tree measured 71 feet by 5 feet 2 inches; and another tree, felled by us, which was 8 inches in diameter, showed 220 annual rings, the sapwood with 25 rings being half an inch thick. Younger trees up to 40 feet high are gracefully pyramidal in shape, with wider branches than *L. occidentalis*; older trees have twisted and irregular branches and flattened crowns, the result of age, as is the case in all species of larch. The branches are remarkably brittle. On another part of the mountain, but still on the northern aspect, eighteen trees in two groups were seen at 8250 feet elevation, the tallest of which was only 10 feet high. The trees in Montana bore in 1906 only a few cones, but the crop in the preceding year had been plentiful. I procured only twenty or thirty seeds, which are now being raised at Kew. The cones in this species resemble those of the western larch in the manner in which they quickly cast their seeds in September.

The western larch in this region did not mingle with the Alpine larch, the former ascending, in company with Douglas fir, the northern slope up to 5900 feet; and between this elevation and 6600 feet, where the lowermost Alpine larch was found, no trees were growing.

Two other localities farther south are mentioned by Ayres,¹ who states that on the summit of the continental divide (long. 113°, lat. 47° 25'), between the Sun river and Willow Creek, there is a fine forest of the species, with trees about 70 feet high and 15 inches in diameter. Twenty miles due west on the summit of the range north of Pend d'Oreille pass there are a few scattered trees.

In the Whitefish range and in the mountains between the Kintla and Chief Mountain lakes, the tree is common on northern slopes from the Canadian boundary line to about 15 miles south of it. In the Whitefish range, Ayres² reports that the trees attain a maximum size of 80 feet by 6 feet in girth, the largest growing about the heads of basins where the snow lingers late into summer or lies in banks throughout the season. I visited the Whitefish range, which is a few miles from Fortine, on the Great Northern Railway, late in September, in company with Mr. Eastland, forest ranger, and at 7000 feet altitude could distinguish numerous groves of Alpine larch, extending over the mountains for an immense distance, as the foliage,

¹ *U.S. Geol. Survey, Lewis and Clarke Forest Reserve*, 42, 43 (1900).

² *U.S. Geol. Survey, Flathead Forest Reserve*, 268 (1900).

which had turned yellow at this season, rendered the trees very conspicuous; but in all cases the groves were confined to strictly northern slopes. We encamped in a small grove, where the trees did not exceed 40 feet in height, and observed numerous seedlings; but were forced to descend on account of a heavy fall of snow and to leave the larger and more important forests unvisited.

Further east, in the Kintla lake region, Ayres¹ reports that the mountain slopes are best wooded on the northern slopes, where the Alpine larch reaches a height of 80 feet and a diameter of 30 inches. It is more vigorous here than in any other locality seen by Ayres, who considers that the tree will produce timber suitable for mining purposes.

(A. H.)

¹ U.S. Geol. Survey, Flathead Forest Reserve, 277 (1900).

PINUS LARICIO¹

- Pinus Laricio*,² Poiret, *Lamarck's Dict.* v. 339 (1804); Lambert, *Genus Pinus*, i. 11, t. 4 (1832); Loudon, *Arb. et Frut. Brit.* iv. 2200 (1838); Forbes, *Pinetum Woburnense*, 23 (1839); Parlato, DC. *Prod.* xvi. 2, p. 386 (1868); Masters, *Gard. Chron.* xx. 785, fig. 142 (1883); xxi. 18, fig. 1 (1884); iv. 692 (1888), *Journ. Linn. Soc. (Bot.)* xxxv. 624 (1904); Willkomm, *Forstliche Flora*, 226 (1887); Mathieu, *Flore Forestière*, 596 (1897); Kent, *Veitch's Man. Coniferae*, 338 (1900).
Pinus nigra, Arnold, *Reise nach Mariazell*, 8 (1785); Kirchner, *Lebengesch. Blütenpfl. Mitteleuropas*, 231 (1906).
Pinus austriaca, Höss, *Flora*, viii. Beiträge, 113 (1825); *Gard. Chron.* ix. 275, figs. 49, 50 (1878).
Pinus nigricans, Host, in Sauter, *Versuch Geog. Bolan. Schilderung Umgeb. Wiens*, 23 (1826).
Pinus taurica, Loddiges, *Cat.* (1836).
Pinus caramanica, Bosc. ex Loudon, *op. cit.* 2201 (1838).
Pinus dalmatica, Visiani, *Fl. Dalmat.* i. 199 (1842).
Pinus monspeliensis, Salzmann, ex Dunal, *Mém. Acad. Montpellier.* ii. 82 (1851).
Pinus Salzmanni, Dunal, *loc. cit.*
Pinus calabrica, cebennensis, and poiretiana, Hort, ex Gordon, *Pinetum*, 168 (1858).
Pinus Fenzleyi, Carrière, *Rev. Hort.*, 1864, p. 259.
Pinus Fenzlii, Antoine et Kotschy, ex Carrière, *Conif.* 496 (1867).
Pinus pindica, Formanek, *Verhandl. Naturf. Verein Briinn*, xxxiv. 20 (1896); Masters, *Gard. Chron.* xxxi. 302, figs. 95, 96 (1902).

A species very variable in habit, dimensions, and foliage, comprising several different geographical forms, which under cultivation preserve in a great measure their peculiarities. The following description is drawn up from wild specimens of the Corsican tree, which is the finest form.

A tree attaining 150 feet in height and 20 feet in girth. Bark on old trees about an inch thick, deeply fissuring into irregular longitudinal plates, which exfoliate in small rounded scales, leaving exposed pale brown, slight oval depressions where they fall off. Buds $\frac{1}{2}$ to 1 inch long, elongated, abruptly contracted to an acuminate apex, light brown in colour, tinged with white, the lowermost scales loose and reflected, the uppermost bound together by white resin. Branchlets stout, glabrous, brown in colour; leaf-bases very prominent, keeled, and imbricated, persisting for several years on the older leafless branchlets.

Leaves, in pairs, densely covering the whole branchlet on barren shoots, forming an apical cup-like tuft above, directed upwards and forwards below; deciduous in the fourth or fifth year; stout, 4 to 6 inches long, about $\frac{1}{16}$ inch wide, straight or curved, often twisted,³ serrulate, ending in a short callous point; semi-terete in section, with

¹ The generic description of *Pinus* will be given in a later part. There is no English name in common use for the whole species. The different forms are well known, as the Corsican, Austrian, and Pyrenean Pines.

² The oldest name for the species is *Pinus nigra*, Arnold, which has lately been revived by some German writers. We adopt the name *Pinus Laricio*, Poiret, as it has been in general use for more than a century.

Pinus pallasiana, Lambert, *Genus Pinus*, i. 13, t. 5 (1832), is impossible to recognise, being supposed by some to be *Pinus Laricio* and by others to be *Pinus Pinaster*.

Pinus tyrenaiaca, Lapeyrouse, *Hist. Pl. Pyrén.*, *Suppl.* 146 (1818), points, so far as the locality is concerned, to the Pyrenean variety of *Laricio*; but the description is doubtful. Mr. H. L. de Vilmoir, who gives a history of this name in *Bull. Soc. Bot. France*, xl. p. lxxvii (1893), considers it to refer to *Pinus Brutia*; but M. Calas, in his account of the *Pin Laricio de Salzmann*, p. 22, controverts this opinion, and believes the description to apply to the Pyrenean *Laricio*.

³ The twisting of the leaves, supposed to be characteristic of the Corsican variety, is an inconstant character.

twelve lines of stomata on the convex surface and eight lines on the flat surface; resin canals median, surrounded by stereome cells, meristele elliptic, fibro-vascular bundle branched. Basal sheath about $\frac{1}{2}$ inch long, brown near the base, whitish above, becoming on old leaves short, lacerated, and blackish.

Male flowers clustered, three to ten or more in number, on the lower half of the branchlet of the first year, which grows beyond the inflorescence and bears leaves above; later, when the flowers drop off, these fertile branches appear to be bare of leaves in their lower half. The male flowers are upright, yellow, cylindrical, stalked, about an inch long; connective crest large, purplish, finely toothed. Female flowers single or two to three at the top of the young branchlets, very shortly stalked and bright red in colour, remaining as small ($\frac{1}{2}$ inch diameter) globular cones till the beginning of the second year.

Cones ripe at the end of the second year, solitary or in pairs or threes, sub-terminal, sessile; variously directed, upwards, horizontally, or even curving downwards; shining brown; ovoid-conic, 2 to 3 inches long by an inch in diameter, straight or curved, symmetrical, ending in a narrow apex. The cones open in the spring or summer of the third year and soon after the escape of the seeds fall off. Scales about an inch long; concealed part thin, dark reddish brown below and light brown above; apophysis or visible part shining yellowish brown, raised, rounded at the upper margin, with a transverse keel, curved on each side of the central umbo, which is reddish brown and bears a minute or obsolete prickle. Seeds greyish or brownish, more or less mottled, about $\frac{1}{6}$ inch long; wing three or four times as long, striated light brown, straight on one side and gently curved on the other, about $\frac{1}{4}$ inch wide at the broadest part, which is at the middle or just below it. Seedling with six or seven cotyledons.

The different geographical forms may be arranged as follows:—

1. Var. *corsicana*, Loudon, *loc. cit.* (var. *poiretiana*, Antoine, *Conif.* 6:1840), Corsican Pine. Occurs in south-east Spain, Corsica, southern Italy, Greece, and Crete.

A tall tree with straight stem and slender branches. Leaves light green in colour, not extremely dense upon the branchlets, the whole aspect of the foliage being lighter in colour and sparser in quantity than in the Austrian pine. Buds not very resinous. Cones usually without radiating cracks on the apophyses.

Var. *calabrica*, Loudon, *loc. cit.*, is scarcely distinguishable. As seen under cultivation at Les Barres, it has perhaps slightly denser foliage than the Corsican variety growing beside it.

2. Var. *austriaca*, Loudon, *loc. cit.* (*Pinus nigra*, Arnold; *Pinus austriaca*, Höss; *Pinus nigricans*, Host; *Pinus Laricio*, var. *nigricans*, Parlatore). Austrian Pine. Austria, Balkan Peninsula, Crimea, Caucasus, Asia Minor.

Shorter tree, with numerous stout branches. Leaves dark green in colour, extremely dense upon the branchlets, giving the whole tree a dense dark crown of foliage. Buds resinous, whitish, stouter than in the Corsican pine. Cones usually showing radiating cracks in the apophyses.

Var. *pallasiana*, Endlicher, *Syn. Conif.* (*Pinus pallasiana*, Loudon, *op. cit.* 2206).

This name is given in England to trees with numerous stout branches, the lowermost of which ascend parallel to the trunk; but in foliage scarcely different from the Austrian pine.¹ The cones are usually larger than in that variety and have the radiating cracks strongly marked. This form is supposed to have come from the Crimea. The Laricio which occurs in the Crimea, Asia Minor, and the Caucasus appears, however, to be identical with the Austrian form.

Var. *caramanica*, Loudon, *loc. cit.* (var. *Karamana*, Masters, *Gard. Chron.* 1884, xxi. 480, fig. 91). This is the Austrian pine as regards the foliage; but producing extraordinarily large cones, up to four inches or more in length. It is supposed to be identical with a form introduced into Paris by Olivier, who sent seeds in 1798 from Caramania in Asia Minor; but is perhaps only a mere sport of the common Austrian pine. The only specimens known to us are two trees at Syon, grown on the lawn west of the mansion; and one of these measured, in 1903, 72 feet by 8 feet 6 inches.

3. Var. *tenuifolia*, Parlatore, *loc. cit.* (vars. *pyrenaiaca et cebennensis*, Grenier et Godron, *Flore de France*, iii. 153 (1856). *Pinus monspeliensis*, Salzmänn. *Pinus Salzmanni*, Dunal). Pyrenean Pine. Cevennes and Pyrenees.

Small trees, often stunted in growth, with remarkably slender leaves, only half the thickness of the other forms. Young branchlets orange-coloured. Cones smaller than in the Corsican variety. Owing to its slow growth, the annual shoots are very short, and the older branchlets remain slender and bare of leaves for a great distance behind the short tuft of leaves at their extremities.

Pinus leucodermis, Antoine, treated by us as a distinct species, is considered by many authorities to be only an alpine form of Laricio; and there appear to be similar forms occurring in high regions elsewhere, as *Pinus Fenzlii*, Carrière, which resembles *P. leucodermis* in having short leaves, almost appressed together in the bundles.

Pinus pindica, Formanek, reported as growing in the Pindus and the Thessalian Olympus, is not recognised by Halacsy;² and is probably only a slightly aberrant form of the ordinary Corsican variety. It has been fully described and figured in *Gardeners' Chronicle*, *loc. cit.*, by Dr. Masters.

Horticultural varieties of Laricio are few and unimportant. Beissner³ mentions pendulous, variegated, and dwarf forms. A golden variety⁴ of the Austrian pine, said to have been raised or introduced by Mr. Mongredien of the Heatherside Nursery, has the leaves, especially those on young growths, tipped with gold. Ilsemann⁵ saw a tree, in which the leaves were beautifully variegated with yellow, growing wild in a forest in Hungary. A peculiar form of Austrian pine with stout falcate leaves has been observed at Breslau.⁶

¹ Probably some trees called *Pallasiana*, on account of their habit, are really of Corsican origin.

² *Consp. Fl. Græcæ*, iii. 452 (1904).

³ *Nadelholzkunde*, 243 (1891). Masters saw at Moser's Nursery, Versailles, in 1903, a dwarf variety of very compact habit with dense bright green foliage: *Gard. Chron.* xxxiv. 338 (1903).

⁴ *Gard. Chron.* xvi. 507 (1881) and ii. 730, 785 (1883).

⁵ *Gartenflora*, 1897, p. 643.

⁶ Baenitz, *Gartenflora*, 1903, p. 58.

INTRODUCTION

According to Loudon,¹ the Corsican variety was introduced into England, as long ago as 1759, under the name *Pinus sylvestris, e maritima*, which was adopted by Aiton.² In France, the tree in the Jardin des Plantes at Paris was planted in 1774; but the date of introduction of the first seed is probably earlier. The Austrian pine was introduced¹ in 1835 by Lawson of Edinburgh. Var. *pallasiana* was first raised by Messrs. Lee and Kennedy, Hammersmith, from seeds sent to them about the year 1790 from the Crimea by Professor Pallas.¹ Captain Cook¹ imported seed in 1834 from the Sierra de Segura in the south of Spain; but the plants raised were probably indistinguishable from the ordinary Corsican variety; and there is no record of the introduction of the Pyrenean or Cevennes variety, of which we know of no large trees in this country.

DISTRIBUTION

The species has a widespread distribution, extending westwards from Spain into the Cevennes in France, finding its northerly limit in Austria, and descending into Corsica, Italy, Sicily, the Balkan peninsula, Greece, Crete, and Cyprus, it re-appears in the Crimea and in Asia Minor, and reaches its most easterly point in the Caucasus.

In Spain, a form considered by Willkomm to be identical with the Corsican variety occurs scattered through the plateaux and mountains of the south-eastern and central provinces, at altitudes between 1000 and 3500 feet. The largest forests occur in the Serrania de Cuenca, and in the sierras of Segura and Cazorla, the most southerly point reached being in the last-named mountain in N. lat. 37° 40' and W. long. 3°.

PYRENEAN LARICIO.—The form³ which occurs in the Pyrenees and the Cevennes is remarkable for its stunted growth and slender leaves. It grows on the Spanish side of the Pyrenees in the province of Aragon, not far from Venasque, between the rivers Esera and Cinca. From this locality, which was visited by Mr. H. L. de Vilmorin in his investigations of the Pyrenean Laricio,⁴ seeds were regularly sent to Paris for many years early in the 19th century, by M. Boileau, pharmacist at Bagnères-de-Luchon.

M. Calas, who has written an elaborate memoir⁵ on this variety, accompanied by a map of its distribution and numerous illustrations of the forests reproduced from photographs, discovered it in 1890 on the north side of the Pyrenees near Prades. Here it covers a scattered area of about 3600 acres in the hills south of the river Têt and north of Mount Canigou, the district being called Conflent; and grows on glacial clay at elevations between 1880 and 3300 feet. In most places the original forest has been ruined by sheep-grazing and fires, and usually only small isolated

¹ *Op. cit.* 2204, 2206, 2208, 2209. The date for the Corsican pine is not improbable, as Loudon (viii. t. 315) gives a figure of a tree at Kew, which was 85 feet high in 1838.

² *Hort. Kew.* iii. 366 (1789).

⁴ *Ibid.* p. lxxvii.

³ Cf. Durand, in *Bull. Soc. Bot. France*, xl. p. ccxxviii (1893).

⁵ *Le Pin Laricio de Salzmann*, pp. 50, tt. 1-19. Published at Paris by the Minister of Agriculture in 1900.

groups of trees are to be seen, in the ravines and on the precipices. There are, however, two woods of considerable extent; and one of these, situated in the basin of the stream of Masos, is considered by M. Calas to be the finest which he has seen, as regards the density, regularity, size, and vigour of the trees, which are, however, only about 80 to 90 years old. The best trees in the district are 50 to 60 feet high by 3 to 4 feet in girth.

In the Cevennes, this variety occurs in three localities. In Hérault, near Saint-Guilhem-le-Désert,¹ it covers, between 1700 and 2300 feet elevation, about 2400 acres, of which 1900 have lately been purchased by the Government. The soil is dolomite limestone and is extremely poor and shallow; and the trees growing either on southern arid slopes or on wind-swept plateaux are in a worse condition than elsewhere. They usually have twisted stems and average 15 feet in height; attaining at their best 30 feet high by 3 feet in girth.

Another locality² occurs north of Bessèges, in the valley of the river Gagnières, which forms the boundary line between the departments of Gard and Ardèche. The tree grows here at 650 to 1100 feet elevation on siliceous soil, and covers a scattered area of 2500 acres, half of which belongs to the State. It often attains, on northern slopes and on slightly better soil than usual, 60 feet high by 4 feet in girth. This appears to be the only locality where the tree is regularly felled, the timber being sold for pit-props. The maritime pine has been planted in the district in the open spaces caused by forest fires, and though slightly faster in growth than the native Laricio, has proved to be a poorer tree, on account of the inferior quality of its timber.

M. Fabre discovered in 1897 a third locality in the Cevennes, at the Col d'Uglas, eight miles west of Alais in Gard. The area is only 250 acres; but is interesting, on account of *Pinus sylvestris* growing wild in company with *Laricio* in the upper part of the forest.

The Pyrenean pine has been planted in a few localities in Ardèche, Hérault, Aude, and Pyrénées Orientales; and has done slightly better than the Austrian pine tried with it. Calas considers it to be a useful tree, on account of its capability of growing on the worst possible soils; and is of opinion that its meagre growth in the wild state is entirely dependent on the poor conditions of soil and climate to which it is subjected.

CORSICAN PINE.—This species is widely spread in Corsica in the great mountain range and its ramifications, which occupy the centre of the island. On northern slopes it grows between 2700 and 5500 feet elevation, the lower margin of the forest being often contiguous with dense woods of *Quercus Ilex* or with scattered groves of *Quercus lanuginosa*. On southern sunny slopes it only descends to 3700 feet, the zone below that altitude being usually occupied by *Pinus Pinaster*, the two species mingling slightly at the line of junction. The forests of *Laricio*, often of great extent, belong almost entirely to the State and to the Communes, and are all treated by the selection

¹ Here this variety was first discovered in France by Salzmann in 1851.

² First mentioned in 1856 by Grenier and Godron, *loc. cit.*

method. The pine usually occurs pure; but in the ravines small and unimportant groups of silver fir are often seen, and the edges of the streams are bordered in many places by *Alnus cordifolia*. The beech in Corsica attains as high an elevation as *Laricio*, and in some cases the two species are mixed, and a struggle occurs for predominance. Birch is occasionally a component of the pine forest, but is comparatively rare. The soil on which *Laricio* grows is usually extremely poor, consisting of debris of granite rocks, and contains very little humus or decayed vegetable matter.

The following observations which were taken in 1906, at 3200 feet altitude, in the midst of the *Laricio* forest at Vizzavona, show the climate in which the tree thrives:—

	Precipitation in inches.	Days of Fall of		Temp. Fahr.	
		Rain.	Snow.	Max.	Min.
January	10.98	4	5	47°	18°
February	3.74	3	13	46°	16°
March	4.05	5	6	64°	21°
April	3.46	12	4	59°	27°
May	5.28	13	1	75°	32°
June	0.31	7	...	75°	43°
July	1.61	8	...	77°	46°
August	0.12	2	...	79°	48°
September	1.73	3	...	77°	39°
October	7.60	5	...	66°	41°
November	14.61	14	1	61°	30°
December	15.44	8	11	59°	16°
Total	68.93 inches.	84 days rain.	41 days snow.		

Snow and low but not extreme temperatures are common during nearly six months of the year, from November to the beginning of May. The sky is generally clouded more or less completely during a greater part of the year; a clear blue sky only being recorded on 77 days out of the whole year.

The *Laricio* forests are easy of access, owing to the railway, which goes through the heart of the mountains from Ajaccio to Bastia; and in spite of a heavy fall of snow I succeeded in seeing some of the most important forests in the last week of December 1906. The finest is Valdoniello, which lies about twenty miles west of Corte railway station, the road to it passing through the magnificent gorge of the Scala di Santa-Regina. This forest occupies the upper basin of the river Golo, which has a north-easterly exposure, and its wooded area covers 6682 acres lying between 3100 and 5100 feet altitude. The soil is very dry and extremely poor, consisting of granite debris; and the few beech and silver fir that were seen could only obtain a footing in the ravines. The forest is divided into two series, one of which, about 4000 acres in extent is being regularly felled, whilst the other series at a greater elevation is left untouched as a zone of protection. In the first series

there are 109,000 trees over 16 inches in diameter, 4000 of which are decayed or diseased. Only trees over 9 feet in girth are marked for felling; and these are being cut down gradually, two or three trees in each spot, so that gaps are left in which seedlings may spring up. Though good seed years occur about once every three years, natural regeneration is always difficult on account of the poverty and dryness of the soil, and only occurs in open spaces exposed to sunlight. As a great deal of the best timber has been removed in past years, the number of excessively large trees is limited, there being only thirteen over 14 feet in girth. The largest tree now standing, the "Roi des Laricios," is growing in a dense part of the forest at 3850 feet altitude, and measured 143 feet in height by 18 feet 9 inches in girth, with a clean stem to 100 feet. Plate 113, from photographs taken by me, shows the stem of this tree and a dense stand of pines. Plate 114, from a negative kindly lent us by M. A. André, Inspector of the French Forest Service, shows very well the peculiar habit assumed by the *Laricio* in old age, the crown becoming remarkably flattened, owing to the bending over of the leading shoot and the increase in size of the upper branches, which become very stout and horizontal or even curve slightly downwards. The frontispiece is reproduced from a sketch taken in Corsica by the late Robert Elwes of Congham, Norfolk.

In this forest the presence of a considerable number of diseased trees is probably explained by the fact that some twenty years previously most of the large trees had been tapped for resin, an operation which was not justified by its financial results, and which exposed the trees to the attacks of fungi. In many parts of the Valdoniello forest, as in *parcelle F*, the trees are very tall, and stand very close together, and have beautifully clean stems, showing that the tree bears crowding without injury. The foliage of the trees in Corsica struck me as being denser than is the case usually in isolated trees growing in England; and I agree with Prof. Fliche that the canopy of *Laricio* is considerably denser than that of the Scots pine, and as a corollary that plantations should not be over-thinned. In Corsica, as only trees of large size are saleable, no thinning operations are ever attempted.

The railway passes through another fine forest, that of Vizzavona, which is about 3400 acres in extent. The trees here are as a rule younger than those at Valdoniello, and in many parts of the forest are mixed with beech, between 3000 and 4000 feet. In one place it was evident that, owing to an excessive felling of *Laricio* several years ago, the young forest coming up will consist almost entirely of beech. In pure stands of young but tall pines there is usually a slight undergrowth of beech and holly. Near the forester's house I measured a large tree, 145 feet high by 12 feet 3 inches in girth, which was growing at 3200 feet altitude.

With regard to the size attained by *Laricio* in Corsica, a tree in the forest of Pietropiano with a short stem measured 23 feet in girth. In the forest of Marmano trees have been felled which were clean in the stem to 115 feet, and yielded 950 cubic feet of dressed and squared logs. At Aitone there is a fine forest of *Laricio* which I was unable to visit from Valdoniello, as the pass across the mountain was impassable owing to deep snow. I was informed that the forest of Asco has been

practically untouched by the axe, and contains many very old trees of peculiar habit.

The *Laricio* grows with extreme slowness in the mountains of Corsica, trees 40 inches in diameter averaging about 360 years old, and those over 5 feet in diameter are often as much as 700 years.

The timber of young trees is valueless in Corsica, as it contains practically only sapwood, which rapidly decays on exposure to the air. The sapwood is white in colour, and always considerable in thickness, varying on an average from 8 inches in young trees (77 years old) to 2 to 3 inches in old trees (250 years old and upwards). The heartwood, which is reddish brown, only develops in quantity when the trees attain an advanced age, exceptionally at 120 to 150 years, usually at 300 years. At the latter age the trees average 3 feet in diameter, and are considered to be mature and at the most profitable period for felling. Most of the timber is exported in the form of logs to Italy, where it is much esteemed, and is used for shipbuilding purposes generally. The logs are squared in the forest, all the sapwood being chipped off except a little at the four corners. Saleable logs must be at least 23 feet in length, and have a minimum section at the small end of 1 square foot. They fetch at Bastia, after a long haulage by road and railway, 36 to 40 francs per cubic metre, or about 10d. to 11d. per cubic foot. A small proportion of the timber in the forests is cut up into planks and joists for local use. The timber is very strong but heavy, and often contains a great deal of resin; when of the first quality it is considered to be as good as American pitch pine. It is very seldom used in France, and the reasons for this are not very clear.

I could obtain no information as to the collection of the seed of *Laricio* in Corsica, though I made inquiries when visiting the forests and also at the Conservator's office in Ajaccio. Mr. M. L. de Vilmorin, however, kindly informs me in a letter that the annual collection amounts to about three or four tons, of which his firm disposes of about one-half. The main localities for collecting are near Corte and Calacuccia, and at Vivario, which is not far from Vizzavona. The cones are put in the ovens which the villagers use for drying chestnuts, and as the amount of heat is not regulated with any precision, the seed is often over-heated. Though the crop of cones in the forest varies very much in different years, there has been no difficulty so far in procuring always a quantity of seed sufficient to meet the demand.

In Sardinia the Corsican pine is recorded from only one locality, the valley of the Flumini Maggiore, where it was collected by Moris.¹

CALABRIAN PINE.—In Sicily the Corsican pine is common, according to Schouw,² on Mount Etna, where it forms woods between 4000 and 6000 feet. It is, however, in Calabria, in Sila and Aspromonte, that *Laricio* occurs in abundance, and there is little doubt that the tree here is identical with that of Corsica. Schouw,² who compared specimens from the botanical garden at Naples with the large Corsican pine growing in the Jardin des Plantes at Paris, is convinced of their absolute identity. Longo, who has recently written an article³ on the flora

¹ Parlatore, *Fl. Italiana*, iv. 53 (1867). Moris's specimens, though without flowers or fruit, are probably *Laricio*, according to Parlatore. ² *Ann. Sci. Nat.*, III Ser., iii. 234 (1845). ³ *Annali di Botanica*, iii. 1-17, tt. 1-6 (1905).

of Calabria, gives five plates, reproductions from photographs, of the Calabrian forests, and a plate showing the variation in the cones; but he has added little to our knowledge of these interesting forests in his short description of them. He states that the finest one is the State forest of Gallipano. (A. H.)

As I could find no account of this tree in its native country, and it was then little known in England; from the information I received from Signor Siemoni, chief of the Forest Department at Rome, I visited Cosenza, a town in Calabria, in April 1903. Here I was kindly received by Signor Carlo Pagliano, Inspector of Forests, who directed me to a village called Spezzano Grande, two hours' drive from Cosenza, from where I rode with Signor D. Greco, the sub-inspector, to the Sila Mountains, on which the largest forests of this tree now exist. The snow was still lying on the pass at about 4800 feet, but on the plateau beyond this it had melted except in shaded places. The forest is composed mainly of pine, here called Pino della Sila, Pino Rosso, or Pino Butello, mixed with beech in some places; but the forest has been considerably diminished by felling in former times, when the dockyards of Naples drew a large part of their timber from this district. The inspector told me that the only place he knew of where virgin forest of this tree still remained, was on a mountain called Femina Morte in the forest of Carigleone, in the district of Cattanzaro, 60 to 70 kilometres south-east of Cosenza. The average size of the trees which I saw being cut for the sawmill was not above 80 to 90 feet by 6 to 8 feet in girth, and smaller where they grew densely. These trees were 80 to 90 years old, and the heartwood, 10 inches in diameter, was reddish. In places where fire and cattle had not destroyed them, the natural reproduction was very good, and the seedlings when once established were making 2 to 3 feet of growth every year. The trees grew best in a south aspect on a soil which appeared to be decomposed granite, and, as far as I could learn, there is no limestone in this district. On my way back I visited Potenza in the Basilicata, whence, according to M. de Vilmorin's information, the seeds of the tree originally were introduced; but if the tree ever existed in the district, I could hear nothing of it.

AUSTRIAN PINE.—The Austrian pine has been the subject of a monograph by Prof. A. von Seckendorff¹ which gives very elaborate details of its literature, economy, and distribution in Austria, with maps and illustrations of remarkable trees in various places, which should be consulted by those who wish to know more than the brief résumé which I give. It occurs as a wild tree abundantly only in Lower Austria in an area extending from Mödling, near Vienna, south to near Pitten and south-west to Reichenrau, especially on the Alpine chalk formation, and attains an elevation of about 4000 feet. It attains a very great age, the rings of one felled near Stixenstein showing no less than 584 years, though the tree was only 65 feet high and about 6 feet in girth. In very rocky situations it grows so slowly that a tree near Mehadia was 270 years old, with a trunk only 8 feet high and about a foot in girth at the base.

Among the trees most remarkable for size may be mentioned a splendid tree at Vostenhofer (fig. ii. of Seckendorff) which is about 75 feet high and 21 feet in girth.

¹ *Beiträge zur Kenntniss der Schwarzföhre* (Vienna, 1881).

It is divided into 4 stems near the ground and has a diameter of branches of about 25 yards. A tree called the Broad Pine at Mödling, near Vienna (fig. iii.), has an umbrella shape, very unusual in this species. It is only about 35 feet high but is no less than 60 feet broad. A tree called the Cross or Picture Pine in the Grossen Föhrenwalde (fig. v.) is considered the finest tree there. It measures about 65 feet high, of which two-thirds are clean trunk, and is 9 to 10 feet in girth at about 9 feet from the ground. The tallest specimen which is mentioned is not much over 90 feet, very much less than those I saw in Bosnia, some of which were considerably over 100 feet and probably over 120 feet, with clean stems to two-thirds of their height.

On good ground, however, in Austria this pine forms very fine timber; an example (shown on fig. viii.) at Gutenstein, near Zellenbach, is said to be 280 years old with an average height of 30 metres. Another of the same age at Fahrafelde is so like the growth of the tree in Bosnia that the photograph illustrating it (fig. ix.) shows the best form of this tree very well.

A hybrid between this tree and *Pinus sylvestris* was described by Reichhardt¹ as growing in the Forest of Merkenstein. (H. J. E.)

In Hungary, according to Pax,² the Austrian pine is only found at Mehadia on the lower Danube, where there are woods on dry stony mountain slopes. He noticed it, however, as a mere shrub at Talmacsel in the valley of the river Alt. In Styria its occurrence as a wild tree is doubtful. In Carinthia there are limited areas of this species on calcareous soil on the southern slopes of the Dobratsch. It is also recorded from Istria, Carniola, Croatia, and the island of Cherso. Ascherson³ mentions one locality in Galicia. In Bulgaria⁴ it grows in several localities in the Rilo-Dagh, and in the Rhodope Mountains above Stanimaka.

An excellent account of the distribution and forest conditions of this species in the western states of the Balkan peninsula is given by Beck.⁵ The most extensive forests in this region lie in south-eastern Bosnia and extend across into Servia, in the district of *Novibazar*. Fine pine forests occur at Semec, on the slopes of the Lim valley, and on the hills between the Lim and Ceatina rivers. Between the middle part of the course of the river Drina in Bosnia and the river Morava in Servia the tree usually grows on palæozoic rocks, though it is occasionally seen on limestone. In Servia the forests of Austrian pine are less extensive, but extend from Ivica to Kapaonik. In middle Bosnia, where the tree is found growing on serpentine, and in western Bosnia, it is not at all common.

Elwes saw the tree growing abundantly in the valley of the Drina, as already mentioned in our account of *Picea Omorika*, and brought home a quantity of seed from this locality in 1901, which he distributed under the MS. name of *Pinus Laricio*, var. *bosniensis*, believing at the time that it was not the same variety as the common Austrian pine; but he now considers that the difference observed is no more than might be caused by a good soil and a more southerly and warmer climate.

¹ *Verh. Zool. Bot. Ges. Vienna*, xxvi. p. 462.

³ *Syn. Mitteleurop. Flora*, i. 213 (1897).

² *Pflanzenverb. in Karpathen*, 104 (1898).

⁴ Velenovsky, *Flora Bulgarica*, 518 (1891).

⁵ *Veg. Illyrischen Länder*, 139, 226 (1901).

In Herzegovina, according to Beck, the tree grows down the Neretva valley to the Plasa Planina and the southern slope of the Prenj Planina. In Montenegro it is comparatively rare, *Pinus leucodermis* having been often mistaken for it. It occurs scattered through Albania. In Dalmatia there are peculiar forests of Austrian pine, in which there is a dense undergrowth of evergreen Mediterranean shrubs and *Juniperus Oxycedrus*; and Beck describes the most remarkable of these, which occur at about 2500 feet elevation, on the peninsula of Sabioncello and the island of Brazza. The greatest altitude in these regions at which the Austrian pine was seen growing by Beck was 5300 feet on the west slope of Mount Dinara in south-western Bosnia, on the Dalmatian frontier.

In Greece, *Laricio*, probably of the Corsican variety, occurs in the mountains, often forming extensive woods, and Halacsy¹ mentions various localities in the provinces of Epirus, Thessaly, Eubœa, Ætolia, Peloponnesus, and in Crete. In Cyprus² *Laricio* is only met with on the summit of Troodos and on some crests to the west, at 4000 to 5000 feet altitude, just above the zone of *Pinus halepensis*, the two species mingling slightly together at the line of junction, as is the case in Corsica. Mr. Madon, who cut down a hundred trees, says that the timber is of no value, on account of the large amount of sapwood in immature trees, until it has reached the age of 250 years. Hartmann,³ who has recently visited Cyprus, gives an elaborate account of the *Laricio* forest. He states that pure woods of this species are rarely met, as in its lower zone, from 4000 to 4500 feet, it grows mixed with *Pinus halepensis*; and above this, to the summit of Troodos, it is accompanied by *Juniperus foetidissima*. It attains a height of 80 feet and a girth of as much as 16 feet.

In Asia Minor, according to Tchihatcheff,⁴ it grows mixed with silver fir on Olympus in Bithynia at 2700 to 5000 feet altitude, and in the same province, on Mount Samanly, at 1600 to 2100 feet, and in the island of Thasos, where it forms with *Juniperus excelsa* a wood in the littoral region. He records it near Soma in the mountains of Mysia; in the valley of the Meander in Troas; between Mughla and Eskischer in Caria; in the Antitaurus, where it forms mixed woods with *Juniperus excelsa*, *Abies cilicica*, cedar, and oak; and in various localities in Pisidia, Isauria, and Cilicia.

In the Crimea⁵ it grows on dry, poor, calcareous soil, forming woods on the western slopes of the mountain chain which extends along the coast of the Black Sea. The Crimean pine has been made a distinct variety, *pallasiana*, but it is probably identical with the Austrian pine.

According to Radde,⁶ *Pinus austriaca*, as he terms it, is rare in the Caucasus. Steven discovered it in 1840 in the neighbourhood of Gelentschik; and Kusnezoff has since found it at a place called Wulanskaja, 35 kilometres south-east of Gelentschik, where there is a small open grove with sound trees attaining 2 metres in girth. Radde adds that it grows near the Black Sea at Bulanka. (A. H.)

¹ *Consp. Fl. Græca*, iii. 452 (1904).

² *Forests of Cyprus; Parly. Paper, Cyprus*, No. 366 of 1881, *Encl. No. 2*, pp. 28, 34.

³ *Mitt. Deutsch. Dendrol. Ges.* 1905, p. 172.

⁴ *Asie Mineure*, ii. 497 (1860).

⁵ Antoine, *Conif.* 6 (1840).

⁶ *Pflanzenverb. in Kaukasusländern*, 169, 184 (1899).

CULTIVATION: CORSICAN PINE

Of all the conifers introduced into England, of which great expectations have been formed, none except the larch has shown such good results as the Corsican pine, which has proved a hardy and vigorous grower on almost all soils, and in almost all parts of Great Britain and Ireland. It has not, however, been long enough in the country to have established a position in the English timber market, and until it does it is difficult to say much of its economic value in the future. All accounts of this wood for estate purposes, though often used long before it has attained sufficient age to give the best results, agree in saying that though rough and knotty when grown singly, it is at least as good as Scots pine; probably more durable and stronger when used before maturity. Though it does not grow so fast on very barren and stony soils as the Austrian pine, it is far better from a timber point of view, and occupies less space. Its greatest defect is the difficulty of transplanting it when young on account of its very scanty root system, and as this often, indeed usually, entails considerable loss on both nurserymen and planters, the cost of getting a crop of *Laricio* established is very much higher than in the case of the Scots pine.

I have been most successful in avoiding a high death-rate by purchasing two-year seedlings with as many roots as possible from French nurseries in the spring, not before the middle of March, planting them at once in nursery rows on as sandy a soil as possible, and transplanting them to their permanent habitation in March or April, two years afterwards. But the plants will not then be large enough for the better class of land, and may require another transplantation before finally going out, by which time they will have cost 40s. to 50s. per 1000, and in some cases much more. The seedling has a very long primary root at first with very little fibre. By cutting this tap-root when the plant is only a year old, without lifting it from its seed-bed, it may be induced to make more roots, but if left unprotected for the first winter on wet or heavy soil a great many of the seedlings will be thrown out of the ground altogether. In my own ground I prefer to sow the seed in boxes, as their growth in the open ground is slow in comparison with what are raised in France. In order to overcome this difficulty some nurserymen adopt the practice of lifting all their one-year seedlings before winter sets in, and laying them in until spring, when they are lined out for two seasons' growth before being again transplanted.

I have on two occasions tried sowing the seed in the field where I wished the trees to grow, but with little success. The seedlings remain so small for the first two or three years that they cannot be seen among the grass, which soon covers them, and though this species seems to suffer less than any tree from being planted among coarse grass, it takes five or six years before the seedlings become conspicuous, and it will also be found that in some places they are too thick, and in others have entirely failed.

The Corsican pine is distasteful in the young state to hares and rabbits. An experiment to test this was made some years ago at Tortworth Court, where Lord Ducie planted a young *Laricio* in the centre of a rabbit warren, which, until the ground was covered with snow, the teeming population of the spot did not touch;

and even then, when starving, after an attempt to consume the young needles of the buds, they abandoned the experiment.¹

Captain the Hon. R. Coke, a very close observer of trees, sends us the following notes from Holkham:—

“In distinguishing between *P. Laricio* and *P. austriaca*, one must apparently be guided rather by the general appearance and habit of the trees, than by any hard and fast rules. *Laricio* always looks well-bred in comparison with the coarseness of *austriaca*. Even when the former develops great limbs, coarse in themselves, the more delicate foliage will distinguish it from its Austrian relative. A good instance of this may be seen at Wolterton, where a fine specimen of each are growing side by side.

“Though the curved or twisted leaves are usually considered to mark the Corsican, yet this feature has been noticed in trees thoroughly Austrian in every other respect; moreover, some Corsicans have straight leaves. Sometimes the branches being produced in regular whorls up the stem is considered to be the mark of a *Laricio*, but all Corsicans do not follow this rule.

“When planting the sandhills at Holkham at various times between 1855 and 1890, Lord Leicester took the precaution of wiring in *austriaca* against rabbits and omitting to do so in the case of *Laricio*. This was done because it had been found that the *P. Laricio*, which were all raised from the seed of the old trees at Holkham introduced from Corsica in the early part of the 19th century, were unharmed by rabbits, which eagerly devoured *P. austriaca*. At the present time, of the trees growing on the sandhills, namely, *P. Laricio*, *P. austriaca*, *P. sylvestris*, *P. maritima*, practically the only one which reproduces freely is the *Laricio*, as the rabbits, though no longer numerous, seem to be able to distinguish this tree from its congeners, and leave it untouched. On the other hand, some trees bought as *Laricio* from an English nurseryman, which had every appearance of being genuine, were recently planted to fill up gaps in a belt at Holkham, and in this case the rabbits ignored the nurseryman's label, and made short work of the so-called *Laricio*.”

Mr. J. D. B. Whyte, agent to Lord Iveagh, confirms the statement that rabbits will eat Austrian, and will not touch Corsican pines when planted together; but though the gamekeeper says that he has never anywhere seen a Corsican damaged by rabbits, Mr. Whyte does not think that the question has been fully tested at Elveden. This tree and the Austrian pine are sometimes planted in the Eastern counties as belts and hedges, but do not form so dense a shelter, or bear clipping so well as the Scots pine.

The Corsican pine is apparently less liable than some other pines to the ravages of insects and fungi. A specimen, however, sent in July 1905 to Kew by Mr. Wellwood Maxwell of Kirkennan, near Dalbeattie, showed a branch attacked by *Peziza Willkommii*, and Sir Herbert Maxwell showed me a similar case on a tree at Monreith.

On the sandhills of the Norfolk coast, near Holkham, are a number of Austrian

¹ Hutchison, in *Trans. Scot. Arb. Soc.* vii. 55 (1875).

and Corsican pines, planted on what appears to be pure drift sea sand, but Colonel Feilden suggested to me that their health and vigour may be due to the presence of lime, produced by sea-shells in the underlying beds. These trees were, as I was told by Mr. Donald Munro, forester to the Earl of Leicester, partly raised from seeds produced by the old trees in the garden at Holkham, and planted thirty to forty years ago, together with *Pinus insignis*, *P. Pinaster*, and *P. sylvestris*, to form a shelter belt and bind the loose drifting sand. Though some of the trees had preserved the peculiar leaf, colour, and habit of the Corsican and Austrian varieties, there were many others which could not be identified with certainty. A great number of seedlings have sprung up on the south or landward side of the hills, of which the largest were twelve to thirteen years old and 9 to 10 feet high; and many smaller ones of various ages were growing freely even in wet spots among tall rushes. Plate 115 shows the appearance of these seedlings. Rabbits and hares do not seem very abundant here, and I saw none of the Corsican seedlings barked, though one or two of the much scarcer *Pinasters* had suffered.

Mr. Richards, forester to Lord Penrhyn, is enthusiastic as to the merits of this tree, and writes to me that in North Wales it will grow where all other trees fail, that it stands wind better than any other conifer, and if planted in March and April few deaths take place. He grows it from seed collected in March and April and sown in May. He says there are many trees on the Penrhyn estate 80 to 90 feet high, but I did not see any quite so large as this. He considers that the timber is very good, better than that of any conifer he knows.

Captain Rutherford, agent to the Earl of Carnarvon at Highclere, also speaks very well of this tree, and sends me the dimensions of two not over seventy years old, one of which contains 201, the other 150 cubic feet, and a plank which he was good enough to give me certainly bears out his good opinion of the timber. It has pale red heartwood and yellowish sapwood, though it seems somewhat coarser in grain, and inferior to the wood of the Calabrian variety which I brought from Italy.

The Corsican pine¹ has not proved hardy in New England. It may be occasionally seen in the middle States, but there is no evidence, in large or old specimens, that this tree will really become a valuable acquisition for American plantations.

CULTIVATION: AUSTRIAN PINE

This tree is often sold as Corsican pine, but should never be planted knowingly except upon land where no better tree will grow, or to form a shelter belt on windy exposed hillsides of chalk or limestone, or on the sea-coast. For though a tree of extraordinary hardiness and rapid growth, it produces such a mass of large branches, and is so much inclined to fork, that its timber is extremely coarse, rough, and knotty, and would be unsaleable except at a very low rate or for pit-props. My father planted many of this tree, and I have found that though they make girth more rapidly than any other pine, they only thrive on sunny situations, where

¹ *Garden and Forest*, x. 471 (1897).

they have plenty of light and air; and though the great bulk of timber they produce in a short time may make them worth planting on such soils, yet I doubt the possibility of getting a sale at remunerative prices in most districts. In mixed or pure plantations their lower branches die off and leave large snags which are difficult and costly to remove, and though the very resinous nature of the wood may fit it for some purposes, I have never heard of its being utilised to any extent, except for pitwood. Austrian pine¹ has been planted very successfully as a shelter belt on the southern shore of Belfast Lough, about forty yards from the sea, in heavy clay; and behind it hardwoods and other trees are doing well. The tree has been extensively planted in many provinces of Austria and Hungary, mainly, according to Seckendorff, with the object of improving the soil for other trees; it has been recommended for this purpose on the poorer limestone soils of England, but the cost of so doing would in my opinion make the operation very unprofitable.

Though there is no reason why the Austrian pine should not sow itself in Great Britain, as the seeds ripen in hot years freely, yet I have never seen self-sown plants except near Sarsden Park, Oxfordshire, the property of Lord Moreton, and here only two or three young trees have sprung up on the rough limestone close to some old quarries.

The Austrian pine, according to Schübeler, is hardy in Norway as far north as Stenkjaer, at the upper end of the Thronhjem fjord. A tree in the Botanic Garden at Christiania, which Schübeler says was planted in 1842, is over 40 feet high, but was not a fine specimen when I saw it in 1906.

The Austrian pine² has been largely planted in the northern United States as an ornamental tree, and in youth is a handsome tree; but it generally succumbs to the attacks of boring insects before it has lost its bushy juvenile habit, and an Austrian pine in the United States more than fifty feet high is exceptional.

An account of Austrian turpentine,³ which is derived from *Pinus Laricio*, is given by Georg Schmidt in an inaugural dissertation before the University of Berne in 1903.

CULTIVATION: CALABRIAN PINE

The Calabrian variety of *Laricio* was introduced into France by M. de Vilmorin in 1819-21, and a full account of its development at Les Barres was given in a catalogue of the trees cultivated there, published at Paris in 1878 by the Forest Department.⁴ From this it appears that the tree has proved superior to other pines as a forest tree, and is especially recommended for planting in mixture with oak, which it rapidly surpasses in height, but without injuring it, on account of the slight development of its lateral branches. It has attained on this poor sandy soil a considerable size, and the young trees raised from seed grown there have preserved their superiority in the second and third generation. It produces seed abundantly there, but has the same defect as *P. Laricio* of being difficult to transplant. It is not easy to distinguish from the Corsican variety. M. Maurice de Vilmorin tells

¹ *Journal of Forestry*, 1879, p. 165.

³ *Harzbalsam von Pinus Laricio* (Bern, 1903).

² *Garden and Forest*, ix. 453 (1896) and x. 470 (1897).

⁴ Cf. Pardé, *Arb. Nat. de Barres*, 61 (1906).

me that "in nearly every place where this variety has been planted in France, it has proved to be in comparison with true Corsican pines the larger and finer of the two."

In Calabria the cones are gathered in December before they open, and kept till the following July, when they are spread out in the sun, and the seed falls out naturally, not being sown till the year after. I brought back in 1903 a sack of this seed which proved very good, and a large quantity of plants were raised from it by Prof. Fisher at Cooper's Hill, where they grew extremely well; better, as it seemed to me, than the Corsican pine, and much better than they did on my limestone soil. A number of these were sent to Culford, the seat of Earl Cadogan, in Suffolk, where his forester, Mr. Hankins, says that they stood the drought of 1906 very well on sandy soil. So far as I can see at present, the tree is quite hardy, and grows as fast or faster than the Corsican variety. It is equally difficult to transplant. Time alone will prove whether this tree has any economic value in England, but its superiority over the Corsican pine will be, I expect, only on soils deficient in lime, which the latter endures; and on granitic sand, in the warmer parts of England, it would certainly be worth a trial, either as a pure plantation, or, as recommended at Les Barres, in mixture with oak or beech.

A tree¹ reputed to be of the variety *calabrica* is growing in the Royal Botanic Garden, Belfast, and was 39 feet high by 3 feet in girth in 1905. It is said to be columnar in habit. A tree at Glasnevin, growing on the side of a hill, measured in 1906 41 feet by 4 feet, and is pyramidal in habit, with branches ascending at an angle of 45°. It is reported to have been planted in 1888, when four years old from seed.

REMARKABLE TREES

CORSICAN PINE.—One of the oldest, if not the oldest tree in England, stands near the entrance gate of Kew Gardens, and in 1903 measured 86 feet by 9 feet 3 inches. It was figured in the *Gardeners' Chronicle*, 1888, iv. 692, fig. 97, and according to J. Smith² was brought to England by Salisbury in 1814, when a seedling only 6 inches high.

In the pleasure ground at Holkham are three large trees which the Earl of Leicester believes to have been brought to England by a relative early in the nineteenth century, but the date of planting is somewhat uncertain. In 1907 they measured 85 feet by 11 feet, 80 feet by 9 feet 11 inches, and 80 feet by 9 feet 4 inches. Plate 116 shows two of these trees.

The tallest I have seen is at Brocketts, Herts, the seat of Lord Mountstephen, which, growing in a sandy soil and sheltered situation, was, when I measured it in 1905, no less than 119 feet by 8 feet 6 inches.

At Arley Castle, six fine trees, all over 100 feet high, measure 10 feet 8 inches, 9 feet 8 inches, 7 feet 9 inches, 8 feet 1 inch, 7 feet 8 inches, and 6 feet in girth respectively. Plate 117 shows the largest of these. Two of them have the habit of var. *Pallasiana*, but are indistinguishable in cones and foliage from

¹ Mentioned in *Gardeners' Chronicle*, 1870, p. 1537, as a prominent sort, distinct from the Caramanian or Corsican varieties.

² *Records of R. Bot. Gardens, Kew*, 286.

the others. At Albury, Sussex, there is one over 100 feet high by only 6 feet 9 inches in girth. At Highclere, Berks, in Great Pen wood, on sandy soil, are the best plantation *Laricios* which I have seen. At about 70 years old they measure about 90 feet high by 7 to 8 feet in girth, and have clean boles for about half their height: several of these, however, are forked at some distance from the ground. At Bayfordbury there is a tree which in 1906 was 94 feet by 8 feet 7 inches, and in many other places we have seen specimens 80 to 90 feet high, which need not be specially mentioned.

AUSTRIAN PINE.—Of the Austrian pine we have seen no specimens in England which rival the Corsican in height, though at Wolterton Park, Norfolk, the seat of the Earl of Orford, there are two large trees about 85 by 9½ feet, which show the characteristic difference in habit and in the colour of the leaves very clearly. From Grigor's account of this place in the *Eastern Arboretum*, p. 114, they seem to have been planted before 1840. Among the largest is a large spreading tree of this type at Nuneham Park, the seat of the Right Honourable L. Harcourt. Another at Canford Manor, Dorset, measured 83 feet by 9 feet; and at Williamstrip Park, on rather heavy soil, which this tree by no means seems to dislike, there is one of nearly the same dimensions, the largest I know in Gloucestershire.

Var. *Pallasiana*.—The best authentic specimen I know is a fine tree at Elveden, Suffolk, the property of Lord Iveagh. It is a flourishing tree with the foliage and cones of the Austrian variety, and measured when I saw it in 1907 94 feet by 8 feet 3 inches (Plate 118). Prof. A. Newton of Cambridge informs me that this tree was raised from seed sent by his eldest brother General Newton of the Coldstream Guards from Balaclava in 1854. The parent tree stood in a garden, which was used as a cemetery during the early days of the occupation of the Crimea. In the historic gale of 14th November 1854 the tree was blown down, and the graves covered with rubbish, and a cone was sent home in memoriam.

Other noteworthy trees are as follows:—

At Dropmore . . .	108 feet by 11 feet 5 inches	<i>fide</i> A. Henry, 1904.
„ Beauport . . .	85 „ by 11 „ 5 „ „ „	„ „
„ Penrhyn . . .	95 „ by 11 „ 4 „ „ „	„ „
„ Smeaton-Hepburn .	64 „ by 6 „ 5 „ „ „	„ 1905.

At Chiswick House there is a good-sized tree, remarkable for having an immense growth of the character of what is usually called "witches' broom."

M. Gadeau de Kerville has figured¹ a very fine example of this pine, which was considered to be of the Calabrian variety by M. L. Corbiere (though this identification seems to me somewhat uncertain), which measured in 1894 35 metres (about 110 feet) high and 3.84 metres in girth. This tree is growing at Vatimesnil (Eure) in the park of M. de Vatimesnil, who believes it to have been planted by his ancestor about the year 1780. If this is correct, it is the oldest and probably the largest planted tree of the species either in France or England.

¹ *Les vieux arbres de la Normandie*, fasc. iii. p. 317, plate ix.

PINUS LEUCODERMIS, HERZEGOVINIAN PINE

Pinus leucodermis, Antoine, *Oestr. Bot. Zeitung*. xiv. 366 (1864); Beck v. Mannagetta, *Weiner Illust. Gartenzeit*, 1889, p. 136, and *Veg. Illyrischen Länder*, 353 (1901); Ascherson u. Graebner, *Syn. Mitteleurop. Flora*, i. 212 (1897).

Pinus Laricio, Poiret, var. *leucodermis*, Christ, *Flora*, l. 81 (1867); Masters, *Journ. Linn. Soc. (Bot.)* xxxv. 626 (1904).

An alpine tree attaining rarely 90 feet in height and 6 feet in girth. Bark ashy grey, fissuring into irregular plates, averaging 6 inches in length and 3 inches in breadth. Buds like those of *P. Laricio*, but darker brown in colour. Young branchlets glaucous. Leaves in pairs, persisting five or six years, densely covering the branchlets, except at the base of each year's shoot, which is bare for a short distance, forming an apical cup-like tuft, and on the rest of the branchlet directed forwards and slightly outwards; the two leaves in each bundle only slightly divergent; dark green, stiff, short, 2 to 3 inches in length, ending in a sharp cartilaginous point; basal-sheaths as in *P. Laricio*. According to Koehne,¹ the structure of the leaf differs from *P. Laricio* in the resin-canals not being surrounded by stereome cells; and Masters states that the hypoderm projects in wedge-shaped masses into the substance of the leaf, which is not the case generally in forms of *Laricio*.

Cones short-stalked, ovoid-conic, with a flat base, about 3 inches long, resembling generally those of *Laricio*, but differing in the uniform dull brown colour of the whole cone, the umbo being of the same colour as the rest of the apophysis. The lower scales of the cone have very prominent pyramidal apophyses, and the umbo has a well-marked short spine directed backwards. Concealed part of the scales light brown on both surfaces. Seeds as in *P. Laricio*. (A. H.)

Pinus leucodermis was discovered in 1864 by Maly, who introduced it into cultivation the same year in the Belvidere, Vienna. The best account of the tree is given by Beck, who considers it to be specifically distinct from *Laricio*, and names it the Panzerföhre or Smré of the Herzegovinians. It is found in four distinct areas in Bosnia, Herzegovina, and Montenegro; and as the most southerly of these is on the Montenegro-Albanian frontier (lat. 42° 25'), it is probable that it also grows on the Peristeri² mountain, which lies west of Monastir in Albania. The most northerly locality (lat. 43° 40'), where it was discovered by Beck, is the Prenj Planina in the heart of Herzegovina. Here it occupies an area of about sixty kilometres in diameter, surrounding the western part of the Bjelasnica mountain, and forms a coniferous belt at from 4600 to 5500 feet elevation, rising solitary or in small groups to 5800 feet. Another area is the Bjela Gora, where the political boundaries of Bosnia, Montenegro, and Herzegovina unite around Mount Orjen. Reiser found it also in the Sinjavina Planina in Montenegro. Its occurrence in Servia is not yet established.

¹ *Deutsche Dendrologie*, 37 (1893).

² This must not be confused with another mountain of the same name, east of Janina in the Pindus range.

It seems to resemble *P. Cembra* in its way of growth, and is confined to mountains of Triassic and limestone formation, where it forms a zone of scattered forest just below the limit of trees, usually not more than 1000 feet in depth, and finds its lowest level at 1000 metres on the Preslica planina, according to Reiser, near the railway station of Bradina; ascending on the Prenj and Orjen mountains to 1700 or 1800 metres. At the lowest elevation it is mixed with beech; at the highest with *P. montana*, *Juniperus nana*, and *J. sabina*.

In some places at the upper levels, where the snow lies very deep, it becomes very stunted, not rising more than 2 to 4 metres from the ground, but does not assume the procumbent habit of *P. montana*. It roots itself so firmly on the dry bare rocks of these mountains that no wind can hurt it, and it endures the burning sun and bitter winds of this region without injury. I am indebted to Herr Reiser of Serajevo for the photographs showing the habit of this tree (Plate 119).

In the upper Idbar valley there is a forest where *P. leucodermis* grows mixed with spruce, silver fir, Austrian pine, and yew, as well as with beech, ash, sycamore, *Pyrus torminalis*, and *Acer obtusatum*. Its smooth grey bark,¹ divided into irregular segments, makes it very easy to distinguish from the Austrian pine, but Beck does not think the name of whitebark pine so applicable as that of Panzerföhre or armoured pine. The tree attains under favourable circumstances a height of 90 feet, with a diameter of 6 feet at the age of 294 years.

Of its timber Beck says nothing, but a story which was current in Bosnia when I was there in 1899, and which doubtless has some foundation, leads one to suppose that it is very hard. A Bosnian Turk was said to have bought a lot of trees of this species, which he felled and floated down the Narenta, and sold the timber as that of larch.

With regard to the occurrence of this species elsewhere, Christ described as a new species, *Pinus Heldreichii*,² specimens which were collected on Mount Olympus in Thessaly. Afterwards, in a letter to Dr. Masters, he stated that this is only a remarkable alpine variety of *Pinus Laricio*, very reduced, and approaching in some respects *Pinus montana*. Halacsy³ considers that this tree, which grows on Mount Olympus in company with the ordinary form of *Laricio* and with *Abies Apollonis*, is identical with *Pinus leucodermis*.

A tree referred to this species has been recently found in southern Italy by Dr. Biagio Longo. He mentions⁴ two localities, the alpine zone of the Calabrian Apennines from Orsomarso to Mount Montea, and the mountain of La Spina in the province of Basilicata, where it grows in the zone of the beech, and rivals that tree in thickness of trunk; but the foresters in the Sila mountains do not recognise this as a distinct species, or did not know of its discovery when I was there in 1903.

Seeds were sent by Beck to Kew in October 1890; and five plants were raised, which have grown with remarkable slowness, being only 9 to 12 inches high in 1901.

¹ The bark is figured in Hempel u. Wilhelm, *Bäume u. Sträucher*, i. 161, fig. 84 (1889).

² Christ, in *Verh. Naturf. Ges. Basel*, iii. 549 (1863), but later, in *Flora*, l. 83 (1867), he states that *Pinus Heldreichii* is identical with *P. leucodermis*, which he considers to be only an alpine variety of *P. Laricio*.

³ *Consp. Fl. Græca*, iii. 453 (1904).

⁴ *Annali di Botanica*, iii. 13, 17 (1905), iv. 55 (1906).

One of these trees, planted out in a bed near the pagoda, is barely 3 feet high at present. Another which was sent to Colesborne was planted in a high exposed situation in my park, where it grows very vigorously on oolite soil.

When in Bosnia, on my way to collect seeds, I was obliged to return home suddenly, but my companion, Mrs. Nicholl, who visited the Prenj mountain, procured a quantity of seeds which I sowed in 1902, and which have grown as fast as either the Corsican or Austrian pines, and look more healthy and vigorous on my soil than any other pine I have raised. They form a much better root-system when young than either the Austrian or Corsican pine, and in consequence are much more easy to transplant. I moved a number in September last just before a period of drought, and they have passed through a severe winter with very few deaths; I therefore believe that the tree will be a good one for planting in dry limestone soils, and may have a greater ornamental if not economic value than the Austrian pine.

(H. J. E.)

GYMNOCLADUS

Gymnocladus, Lamarck, *Dict.* i. 773 (*ex parte*) (1783); Bentham et Hooker, *Gen. Pl.* i. 568 (1865).

Guilandina, Linnæus, *Gen. Pl.* 518 (*ex parte*) (1742).

DECIDUOUS trees, belonging to the division Cæsalpinieæ of the order Leguminosæ. Branches stout and without thorns. Leaves large, alternate, bipinnate, the number of pinnæ being either odd or even; pinnæ and leaflets usually alternate. Stipules foliaceous, early deciduous.

Flowers polygamous or diœcious, terminal or axillary, in racemes or racemose corymbs, on long pedicels. Calyx tubular, lined with a glandular disc, ten-ribbed, five-lobed, the lobes narrow and nearly equal. Petals four to five, slightly unequal, imbricated, inserted on the margin of the disc, spreading. Stamens ten, free, shorter than the petals and inserted with them, those opposite the calyx lobes longer than the others; anthers oblong. Ovary rudimentary or absent in the staminate flowers, sessile or sub-sessile in the polygamous and pistillate flowers; style short and dilated above obliquely into a two-lobed stigma.¹ Ovules four or numerous.

Pod oblong, thick, coriaceous, dark brown, flattened, beaked at the apex, slightly curved or falcate, on stalks $\frac{1}{2}$ to 2 inches long, pulpy between the seeds. Valves two, narrowly winged on the margins. Seeds on long slender stalklets; seed-coat thick and bony; embryo surrounded by a layer of horny albumen.

Only two species are known, one occurring in China and doubtfully hardy in this country, the other a native of N. America and cultivated in England.

GYMNOCLADUS CHINENSIS, CHINESE SOAP TREE

Gymnocladus chinensis, Baillon, *Compt. Rend. Assoc. Franç. Avanc. Sc.* 1874, p. 418, t. 4, and *Bull. Soc. Linn. Paris*, 1875, p. 33; Oliver, in Hooker, *Icon. Plant.* xv. 9, t. 1412 (1883);

Hemsley, *Journ. Linn. Soc. (Bot.)* xxiii. 207 (1887).

Dialium sp.?, Hanbury, *Science Papers*, 238, fig. 5 (1876).

A tree attaining 40 feet in height. Young shoots rusty pubescent. Leaves 1 to 3 feet long; pinnæ alternate or sub-opposite, all composed of numerous (twenty

¹ The stigma of *Gymnocladus chinensis* is not correctly shown in Hook. *Icon. Pl.* t. 1412.

to twenty-four) leaflets, which are $\frac{3}{4}$ to $1\frac{1}{2}$ inch long, alternate, oblong, rounded at the base, obtuse or rarely acute at the apex, densely silky appressed pubescent beneath, on short pubescent petiolules; rachis densely pubescent, swollen at the base, and forming a conical sheath enclosing the bud.

Flowers polygamous, in pubescent racemes, those with staminate flowers shorter than the others. Calyx pubescent, with subulate lobes. Petals oval-oblong. Ovary glabrous with four ovules. Pod, 4 inches long by $1\frac{1}{2}$ inch broad, glabrous. Seeds, two to four, black, globose, smooth, $\frac{3}{4}$ inch in diameter.

This tree is rather rare in China, though specimens have been collected in the provinces of Anhwei, Kiangsi, Chekiang, Hupeh, and Szechuan. Near Ichang it grows at 1000 to 2000 feet altitude. The pods, called *fei-tsao*, after being steeped in water, produce a liquid esteemed for washing the hair and cleansing silk articles.

Plants¹ were raised at Kew from seeds sent by me in 1888; but died in a year or two. Seeds, which could be easily procured from Shanghai, where they are sold in the shops, might be tried in the warmer parts of England and Ireland, as the tree is worth cultivating on account of its beautiful delicate foliage.

(A. H.)

GYMNOCLADUS CANADENSIS, KENTUCKY COFFEE TREE

Gymnocladus canadensis, Lamarck, *Encycl.* i. 733 (1783); Loudon, *Arb. et Frut. Brit.* ii. 656 (1838).

Gymnocladus dioicus, Koch, *Dendrologie*, i. 5 (1869); Sargent, *Silva N. Amer.* iii. 69, tt. 123, 124 (1892), and *Trees N. Amer.* 554 (1905).

Guilandina dioicus, Linnæus, *Sp. Pl.* 381 (1753).

A tree attaining in America over 100 feet in height and 9 feet in girth. Bark fissured, dark grey, and roughened by small persistent scales. Young shoots covered with short pubescence. Leaves (Plate 125, fig. 4) 1 to 3 feet long, with 5 to 11 pinnæ, which are usually alternate but occasionally sub-opposite, the two or rarely the four lower pinnæ simple, the others composed of six to fourteen alternate pinnate leaflets. Leaflets 2 to 3 inches long, on pubescent stalklets, ovate, rounded at the base, acuminate at the apex, entire and ciliate in margin; under surface with scattered long hairs.

Flowers usually diœcious, the inflorescence of the staminate tree a short racemose corymb, that of the pistillate tree a long raceme. Calyx tomentose, with five narrow oblong lobes. Petals five, tomentose, longer and broader than the calyx-lobes. Ovary pubescent; ovules ten or more.

Pod, 6 to 10 inches long by $1\frac{1}{2}$ to 2 inches broad, minutely pubescent. Seeds,

¹ Cf. Nicholson, *Garden and Forest*, 1889, p. 139.

five to ten, surrounded by dark-coloured sweet pulp, ovoid, $\frac{3}{4}$ inch long, and covered by a hard dark brown shell.

In the young leaf¹ of *Gymnocladus canadensis*, the rachis is prolonged an inch or more above the insertion of the upper pinnæ; and the axes of the pinnæ are similarly prolonged beyond the leaflets. These terminal appendages are very slender and tendril-like, and disappear before the leaf attains its full size. They have been supposed to be rudimentary tendrils, such as occur normally in a developed state in many leguminous plants; but they may represent simply degenerate terminal leaflets.

Sargent states that this species is diœcious; and that in order to obtain fruit male and female trees must be close together. C. M. Hovey,² however, writing from Boston, states that he knows a solitary tree, no other being within two miles, which produces fruit and fertile seeds, from which he has raised many plants. The so-called pistillate flowers have stamens, which doubtless are usually not fully developed; but it is possible that in some cases they may produce good pollen.

The flowers³ in America are visited by bees, which are attracted by the nectar secreted by the inner wall of the calyx tube.

IDENTIFICATION

In summer the foliage of the tree is unmistakable. In winter the fewness of the branches and the stoutness of the branchlets, which are very short in adult trees, are remarkable. The latter show the following characters:—

Twigs coarse, grey, glabrous, with numerous small brown lenticels and wide, circular, orange-coloured pith. Leaf-scars large, obcordate, slightly oblique on prominent pulvini, with a narrow raised yellowish margin and a whitish convex surface, marked by three to five irregular tubercles, which are the scars of the vascular bundles. Buds very small; two to three vertically superposed, in the axil of each leaf-scar, the lower one rarely developing; projecting slightly out of circular depressions in the bark, which form pubescent rings around the buds. Each bud shows two to three minute scales, which become accrescent and green in the spring at the base of the shoots. No true terminal bud is developed, the tip of the branchlet falling off in summer and leaving at the apex of the twig a circular scar.

DISTRIBUTION

The Kentucky Coffee tree, though occupying a wide area in North America, is nowhere common. It is found scattered amongst other trees on hillsides where the soil is rich, and in alluvial land beside rivers. It is met with in central

¹ Cf. B. D. Halstead, in *Torreya*, ii. 5 (1902).

² *Garden*, xiv. 240 (1878).

³ Robertson, *Trans. Acad. Sc. St. Louis*, vii. 165 (1897).

New York and western Pennsylvania, through southern Ontario and southern Michigan to the valley of the Minnesota River and to eastern Nebraska, eastern Kansas, south-west Arkansas, the Indian territory, and central Tennessee.

The tree is noted¹ in America for its habit of suckering from the roots when it is cut down. After a tree is felled the ground around to a distance of often 100 feet becomes filled with numerous suckers; and this is one of the ways in which the trees are reproduced in the American forests. The tree never develops any epicormic branches, and is very seldom attacked by any insect or fungus.

(A. H.)

An article by Sargent in *Garden and Forest*, ii. p. 75, gives an excellent account of this tree, and states that by far the largest and handsomest that he has seen was planted in 1804 directly in front of the historical Verplanck mansion at Fishkill-on-Hudson, and was, in 1889, 75 feet high and a little over 10 feet in girth below the point where it divides into three stems at 3 feet from the ground. Though it was struck by lightning in 1887, the tree is an extremely graceful and well-shaped one, as the picture shows.

The tree grows well as far north as Ottawa, where I saw two spreading trees about 40 feet high, planted in front of Rideau Hall, the residence of the Governor-General. The gardener informed me that they were the latest trees to come into leaf, and, though they flowered in good seasons, produced no fruit.

At Mount Carmel, Illinois, I measured a tree in the forest 92 feet by 8 feet, one of the few remaining relics of the splendid trees described by Ridgway, one of which was 109 feet high, with a clear stem 76 feet to the first limb, but only 20 inches across the stump. Dr. Schneck has measured one in the same locality no less than 129 feet high. It is, however, nowhere an abundant tree in this district, but grows scattered through the richer bottoms.

The tree from which a specimen log in the Jessup collection in the American Museum of Natural History was cut, grew not far from St. Louis, and although only 18 inches in diameter was 105 years old. This represents the average rate of increase of the tree growing naturally in the forest, cultivated trees in favourable conditions growing much more rapidly.

CULTIVATION

Gymnocladus canadensis was introduced into England by Archibald, Duke of Argyll, who had a tree in cultivation² at Whitton in 1748. This tree was afterwards removed to Kew, on the establishment of the gardens there by the Princess of Wales, mother of George III., who obtained it and many other interesting trees as a present from the Duke of Argyll in 1762. This tree died³ about 1870; and as old trees reported by Loudon at Syon and elsewhere cannot now be found, it goes to show that the tree lives little over 100 years in England.

¹ *Garden and Forest*, vii. 358 (1894).

² Aiton, *Hort. Kew.* v. 400 (1813).

³ J. Smith, *Dict. Econ. Plants*, 235 (1882), mentions this tree as if it was still living in 1882; but according to Nicholson it had died several years previously to that date.

According to Nicholson,¹ it is very easy to transplant, and bears drought well. It is propagated either by seeds or by root-cuttings. Pieces of the roots, 4 to 5 inches long, placed in prepared beds and kept moist, will develop in the first year into plants three or four feet high. Some of the cuttings, however, will not start into growth until the following year.

I have raised seedlings from American seeds, which, being large and hard, should be soaked in warm water for some days before sowing. The seedlings grow slowly, and should be kept under glass for a year or two before planting out.

In spite of Loudon's assertion to the contrary, it appears to flower very rarely in England, the only record being at Claremont, where Mr. Burrell² says it produces flowers freely early in summer. Pods have never been produced, so far as we know, in this country.

It is a rare tree in cultivation; but though stiff and peculiar in habit, it is not at all ungainly when well-grown, even when bare of leaves. It comes into leaf very late in the season, and it drops its leaves early in autumn, the stalks, however, often remaining on the tree for weeks. The foliage, like that of many leguminous plants, shows the phenomenon of sleep, the leaflets drooping and closing together soon after sunset in summer.

REMARKABLE TREES

There are two trees at Claremont, which were about 55 feet high in 1888. When I measured them in 1907 the largest was 60 feet by 6 feet 7 inches, and seemed quite healthy; the other was broken.

A tree at Chiswick House measured, in 1903, 53 feet high by 3½ feet in girth. Another at Barton, Suffolk, was in 1904 57 feet high by 5 feet 2 inches in girth at two feet from the ground, and divided above this into two stems. In the Botanic Garden at Cambridge there is a good specimen, which was 45 feet by 3 feet 9 inches in 1906. There are three smaller trees in the Oxford Botanic Garden.

At Kayhough, Kew, in the garden of Mr. Charles Wright, there is a healthy and well-shaped tree, which was in November 1905, 40 feet high by 2 feet 9 inches in girth, with a bole of 6 feet, dividing into two main stems. This tree was purchased from a nurseryman at Kingston in 1878, when it was said to be twenty-two years old, and was then about two-thirds its present height. After transplanting, it made no growth for three years; but since then it has grown steadily though very slowly, and has not been injured in any way by severe winters, though it has never flowered. It has been much surpassed in rate of growth by an *Ailanthus* in the same garden. There is a tree of about the same size growing close to Mr. Clarke's house at Andover, Hants, which is fifty to sixty years old and measures 43 feet by 2 feet 10 inches. There are several small trees in Kew Gardens, the largest one being near the main entrance.

It seems evident that the tree, to attain a large size, requires a much greater

¹ *Garden*, xxiv. 29 (1883).

² *Garden*, xxxiii. 229 (1888) and xlv. 404 (1894).

degree of summer heat than it gets in England, for in the south of France it becomes a splendid tree. I saw in the Museum Gardens at Chambéry, in the grounds of the Castle formerly belonging to the Dukes of Savoy, a tree which, though forked near the ground, had two tall clean trunks each about 100 feet by 5 to 6 feet. The leaves were only just appearing on 18th May, and many of the large bean-like pods full of greenish pulp, which had fallen in the winter, lay on the ground. Seeds from these pods germinated, but the seedlings, with one exception, withered soon afterwards. It is not uncommon in Savoy, and I saw a fine specimen, 81 feet by 9 feet 6 inches, in the Public Gardens at Aix-les-Bains, which in October 1906 had ripe pods on it. It is known in France by the name of "Bonduc."

In the old Botanic Garden at Padua a splendid tree was in 1895, according to Prof. Saccardo,¹ 135 years old, 21 metres high, and 2.60 metres in girth. When I saw it in 1905 the trunk was broken off at about 12 feet, but long shoots, which were in flower, had been produced from the stump.

(H. J. E.)

¹ *L'Orto Botanico di Padova* (1895).

CEDRELA

Cedrela, Linnæus, *Gen. Pl.* 109 (1764); Bentham et Hooker, *Gen. Pl.* i. 339 (1862).
Toona, Roemer, *Synops.* i. 131 (1846).

TREES, belonging to the order Meliaceæ, with unequally pinnate leaves, without stipules, and composed of numerous opposite or sub-opposite stalked leaflets.

Flowers in panicles, perfect, regular. Calyx short, four- to five-cleft. Petals, four to five, nearly erect, imbricated, free. Stamens, four to six, free, inserted at the top of a four- to six-lobed hypogynous disc; filaments subulate, anthers versatile. Ovary sessile on the disc, five-celled, each cell containing in two series eight to twelve pendulous ovules. Fruit, a coriaceous or woody capsule, composed externally of five valves, and almost filled up internally by a central column, between which and the valves are five thin cells, containing the seeds, which are numerous, compressed, and with one or two wings.

The genus is divided into two sections:—

I. *Eu-Cedrela*.—Seed with a single wing on its lower side. Nine species in tropical America.

II. *Toona*.—Seed with either two wings, one at each end, or with a single wing above. Eight species in India, Indo-China, China, and Australia, all in tropical regions except *Cedrela sinensis*.

CEDRELA SINENSIS

Cedrela sinensis, A. Jussieu, *Mém. Mus. Par.* xix. 255, 294 (1830): *Rev. Hort.* 1891, p. 573, figs. 150, 151, 152; Hemsley, *Journ. Linn. Soc. (Bot.)* xxiii. 114 (1886).
Toona sinensis, Roemer, *Synops.* i. 138, 139 (1846); Diels, *Flora von Central China*, 425 (1901).
Ailanthus flavescens, Carrière, *Rev. Hort.* 1865, p. 366.

A tree of moderate size, attaining in China a height of 60 to 70 feet. Bark scaling off in narrow longitudinal strips, 1 to 2 inches in width, and leaving exposed in parts the reddish inner bark below. Young shoots covered with minute pubescence. Leaves (Plate 125, fig. 7), large, 1 to 2 feet in length. Leaflets, eleven to nineteen, about 4 inches long, on pubescent stalklets (nearly $\frac{1}{4}$ inch long), opposite or sub-opposite, divided into two unequal parts by the midrib, the upper part larger and rounded at the base, the other part usually cuneate at the base; apex

caudate-acuminate; margin repand, minutely ciliate, distantly and minutely serrate or with occasional short teeth; nerves, fifteen to eighteen pairs, usually dividing and forming loops close to the margin; upper surface dark green, glabrous; lower surface pale green, glabrescent.

Flowers fragrant, in pubescent terminal panicles, which are a foot or more in length; pedicels short. Calyx with five short, rounded, ciliate lobes. Petals five, white, oblong, sub-cordate at the base, converging at the apex. Stamens five, alternating with five staminodes. Fruit about an inch long; valves, opening longitudinally from above downwards. Seed with an oblong wing attached to its upper side, the wing two to three times as long as the body of the seed.

In summer the large pinnate leaves give the tree much the appearance of *Ailanthus*; but the bark is different, and the leaflets of *Cedrela* are devoid of the glandular teeth near the base, which are so characteristic of *Ailanthus*. In winter the following characters are available (Plate 126, fig. 2):—

Twigs stout, brown, minutely pubescent; lenticels small, scattered; pith white, circular in section. Leaf-scars large, alternate, slightly raised, obcordate or oval, with five bundle-dots. Terminal bud, much larger than the others, broadly conical, of four to six triangular scales, which are swollen externally and hollowed internally, brown, shining, with acuminate pubescent tips. Lateral buds minute, solitary, inserted immediately above the leaf-scars, hemispherical, showing three to five shining brown scales.

Lubbock,¹ who gives a detailed account of the structure and development of the buds, the scales of which are modified leaves, states that the terminal bud usually dies in winter, but sometimes lives, and then is always later in developing in spring than the lateral buds.

Cedrela sinensis is a native of northern and western China. It is very common in the neighbourhood of Peking, and was found in Kansuh, beyond the Great Wall, by Piasetski. According to von Rosthorn and Wilson, it is wild in the forests of the province of Szechuan. It is commonly cultivated in central China, where it never attains a great size, mainly because the Chinese spoil its growth by lopping off in spring the young shoots, which are much esteemed as food. These are eaten after being chopped and fried in oil. The tree is known to the Chinese as the *hsiang-ch'un*.² The timber is good, reddish in colour, and often used in making furniture.

The tree was first made known to Europeans by Père d'Incarville, who sent dried specimens from Peking to Paris in 1743. In China it has been well known from classical times, and references to it occur in the earliest Chinese literature.

Cedrela sinensis was introduced in 1862 by Simon, who sent a living plant from Peking to the Museum at Paris, which was described by Carrière in 1865 as *Ailanthus flavescens*. On the tree flowering in 1875 it was recognised to be *Cedrela sinensis*. This tree, which was planted in the nursery attached to the garden of the Museum, had attained in 1891 a height of 40 feet; and, when Elwes saw it in 1905, it was very little taller, and about 4 feet in girth.

Many trees have been raised in the vicinity of Paris, both by seed and by root-

¹ *Journ. Linn. Soc. (Bot.)*, xxx, 478 (1894).

² Cf. name given to *Ailanthus*, p. 32.

cuttings; and it appears to be perfectly hardy in the north of France, having sustained without injury the severe winter of 1879-1880. Its large fragrant foliage renders it perhaps more suitable than the *Ailanthus* for planting in towns. It is said by Nicholson to be now largely used in Holland for that purpose.

The tree is rather rare in England, and we have seen no specimens remarkable for size. There is a tree in Kew Gardens which measured in November 1905 33 feet by 2 feet 4 inches. This is probably of the same age as an *Ailanthus* of equal height growing beside it. A tree much about the same size is growing and thriving in Messrs. Veitch's Nursery at Coombe Wood. Mr. Cassels informs me that young trees of *Cedrela* are planted in some of the London County Council parks, as Meath Gardens and Bethnal Green.

Cedrela sinensis is also cultivated in the United States,¹ where a tree flowered at Meehan's nurseries, Germanstown, in 1895. Another only eight years old had attained in the same year 20 feet in height in western Virginia. Professor Sargent thinks it might be used as a street tree in New England, though introduced plants have proved rather tender in that climate. It has frequently flowered in France, but has never produced fruit there. There is no record of its having flowered as yet in England.

Mouillefert² speaks of this tree as one which, in his opinion, has a great future in Europe on account of the high quality of its wood, which he compares to that of mahogany and that of the so-called cedar of the West Indies (*Cedrela odorata*). He says that the tree grows fast from seed, attaining 5 feet in the third year, and adds that on calcareous soil of middling quality at Grignon a tree about twenty-five years old measured 10 metres high.

(A. H.)

¹ *Garden and Forest*, 1896, pp. 260, 279.

² *Principales Essences Forestières*, 471, 472 (1903).

PTEROCARYA

Pterocarya, Kunth, *Ann. Sc. Nat.*, sér. I. ii. 345 (1824), Bentham et Hooker, *Gen. Pl.* iii. 399 (1880).

DECIDUOUS trees belonging to the order Juglandæ, with large, alternate, compound, imparipinnate leaves; leaflets serrate; stipules absent. Buds scaly or naked, the lateral ones often multiple, two to three in a vertical row above the insertion of the leaf. Pith chambered. Flowers monœcious, numerous in long pendent catkins. Male catkins usually several, arising singly in the leaf axils; in some species (*caucasica*, *stenoptera*) lateral on the preceding year's shoots, with an occasional catkin on the current year's shoot; in other species (*rhoifolia*, *Paliurus*) all on the new shoots. Stamens nine to eighteen in several series on the axis of a three- to six-lobed scale, to which a bract is adnate on the back, the scale representing two bracteoles and one to four perianth segments. Female catkins solitary, terminating the young shoot. Female flowers with a bract and two bracteoles at the base; perianth four-lobed, adnate to the ovary, which contains one ovule, and is surmounted by a short style, divided above into two papillose stigmatic divisions. Fruit catkins long, with numerous nut-like fruits, which have in most species two lateral wings, in one species a single orbicular wing all round, due to the enlarged bracteoles of the flower, the bract persisting little changed at the base of the fruit. Nutlet, with a thin pericarp and a hardened endocarp, the latter divided below into four imperfect cells, and containing one seed, which is four-lobed below. Cotyledons bi-partite, each division being again deeply divided, forming four linear segments; carried above ground in germination.

Pterocarya and *Juglans* have similar foliage, and agree in the chambered pith of the twigs. They are readily distinguished when in fruit, that of *Pterocarya* being always small and winged. When specimens in leaf only are obtainable, the best mark of distinction lies in the buds, which in *Pterocarya* are either without scales or are enclosed in a long conical beaked funnel-like covering, composed of membranous scales—differing in either case from the short buds of *Juglans* with two to three external scales.

Seven species of *Pterocarya* are known, occurring in Persia, the Caucasus, China, Tonking, and Japan. A hybrid species has been obtained in cultivation, which will be described under *P. caucasica*. The seven species which occur in the wild state may be arranged as follows:—

SECTION I. CYCLOPTERA, Franchet, *Journ. de Bot.*, 1898, p. 318.

Fruit surrounded by an orbicular wing, composed of the connate bracteoles, which cover the nutlet at the base.

1. *Pterocarya Paliurus*, Batalin, *Act. Hort. Petrop.* xiii. 101 (1892); Franchet, *loc. cit.*; J. H. Veitch in *Journ. R. Hort. Soc.* 1903, xxviii. 65, fig. 26. China: mountains of Szechwan, Hupeh, and Chekiang.

Tree 40 feet. Twigs pubescent and glandular. Buds naked. Leaf-rachis villous or pubescent, not winged. Leaflets seven, coriaceous, oblong-ovate, with sub-acute apex, glabrous below except along the midrib. Fruits samara-like, the nutlet in the centre of an orbicular wing, 2 inches across, several on a raceme a foot long.

This species was introduced in 1903 by Mr. E. H. Wilson from the mountains of Central China; and young plants, which seem perfectly hardy, are now growing at Messrs. Veitch's Nursery, Coombe Wood. The tree when in fruit presents a remarkable appearance, and is well worth trial, as it should prove hardier than *P. stenoptera*, which grows at a lower level.

SECTION II. DIPTERA (*Sectio nova*).

Fruit with two lateral wings, the developed bracteoles, which do not cover the nutlet at the base.

* *Buds naked, without scales.*

2. *Pterocarya stenoptera*, C. DC. China, Tonking.

Tree 60 feet. Twigs bristly-pubescent. Leaf-rachis winged. Leaflets nine to twenty-five, coriaceous, underneath glabrescent with pubescent tufts in the axils of the nerves. Fruit with long lanceolate upright glabrous wings. In cultivation. See description below.

3. *Pterocarya hupehensis*, Skan, *Journ. Linn. Soc. (Bot.)*, xxvi. 493 (1899). China: mountains of Hupeh.

Small tree about 30 feet. Twigs glabrous. Leaf rachis not winged, glabrous except for some tomentum near its insertion. Leaflets five to nine, lanceolate; under surface with brown scurfy scales and glabrous except for stellate rusty tomentum in the axils of the nerves. Fruit minutely glandular, with sub-orbicular wings, $\frac{1}{2}$ inch diameter. Introduced by Mr. E. H. Wilson in 1903. Young plants are now growing at Coombe Wood and seem to be perfectly hardy.

4. *Pterocarya Delavayi*, Franchet, *Journ. de Bot.* 1898, p. 317. China: mountains of Yunnan.

This species, which I have not seen, appears closely to resemble the last, differing mainly in the fruits being covered with short hairs. Not introduced.

5. *Pterocarya caucasica*, C. A. Meyer. Persia, the Caucasus.

Tree attaining 100 feet. Twigs glabrous except for some pubescence at the

tips. Rachis of the leaf not winged. Leaflets fifteen to twenty-seven, membranous; under surface without glands and glabrous except for stellate pubescence on the nerves and in their axils. Fruit, $\frac{1}{2}$ inch broad, glabrous; wings semi-orbicular. In cultivation. See description below.

** *Buds long, conical, beaked at the apex, enclosed during summer and autumn by a membranous funnel-like covering, composed of several scales.*

6. *Pterocarya macroptera*, Batalin, *Act. Hort. Petrop.* xiii. 100 (1893). China: mountains of Kansuh.

Small tree, about 20 feet in height. Twigs glabrous. Rachis of the leaf not winged, rusty-tomentose. Leaflets nine to eleven, acute, rusty-tomentose on the midrib and nerves beneath. Fruit: nut pubescent, wings broadly ovate, pilose, $1\frac{1}{4}$ in. long by 1 inch broad. Not introduced.

7. *Pterocarya rhoifolia*, Siebold et Zuccarini. Japan.

Tree, rarely attaining 100 feet. Twigs glabrous. Rachis of the leaf not winged. Leaflets fifteen to twenty-one; under surface glandular with tomentum along the midrib and veins and in their axils. Fruit, 1 inch wide; wings rhombic, broader than long, glabrous. Introduced. See description below.

PTEROCARYA CAUCASICA

Pterocarya caucasica, C. A. Meyer, *Verz. Pflanzen Caucasus*, 134 (1831); Loudon, *Arb. et Frut. Brit.* iii. 1452 (1838).

Pterocarya fraxinifolia, Spach, *Hist. Nat. Veg.* ii. 180 (1834); Lavallée, *Arb. Segrez. Icones.* 73, t. 21 (1885).

Pterocarya Spachiana, Lavallée, *op. cit.* 69, t. 20.

Pterocarya sorbifolia, Dippel (*non S. et L.*), *Laubholz.* ii. 327 (1892).

Juglans fraxinifolium, Lamarck, *Encyc. Meth.* iv. 502 (1797).

Juglans pterocarpa, Michaux, *Fl. Bor. Am.* ii. 192 (1803).

Rhus obscura, Bieberstein, *Fl. Taur. Cauc.* i. 243 (1808).

A tree attaining 100 feet in height and 10 feet or more in girth, usually however smaller, and tending to branch into several stems at no great height above the ground. Bark dark grey and furrowed. Shoots glabrous. Leaves (Plate 125, fig. 1) 16 to 20 inches long, on a stalk 2 to 3 inches long, only slightly swollen at its base; rachis not winged. Leaflets fifteen to twenty-seven, opposite or sub-opposite, sessile or sub-sessile, 3 to 5 inches long; oblong or oblong-lanceolate; acute, acuminate, or obtuse at the apex; unequal and rounded or narrowed at the base; dark green above; under surface lighter green, without glands, glabrous except for some stellate pubescence along the nerves and in their axils; thin in texture; sharply and finely serrate. Staminate catkins several, each in the axil of a leaf-scar on the preceding year's shoot, rarely one or more on the current year's shoot; scale usually five-lobed, stamens twelve to fifteen. Fruiting catkins up to eighteen inches long.

Fruit $\frac{1}{2}$ inch broad; wings semi-orbicular, concave below, conspicuously veined; nutlet with beaked apex.

Seedling.¹—The caulicle terete, erect, and about two inches in length, raises the two cotyledons well above the ground. Each cotyledon is shortly stalked, about an inch in width, and deeply bipartite, the two primary divisions being again divided for nearly two-thirds of their length, the whole forming four linear-oblong obtuse diverging segments. The cotyledons are palmately five-nerved at the base, the three middle nerves each ending at the base of a sinus and sending divisions into the segments. The young stem is slightly glandular near the apex. The first five leaves are alternate, simple, lanceolate or ovate, rounded at the base, acute or acuminate at the apex, penni-nerved, serrate, and vary in length from 1 to 2 inches. Succeeding leaves are compound, unequally pinnate, and with many leaflets.

IDENTIFICATION

In summer this tree is only liable to be confused with *Pterocarya rhoifolia*, which has scaly buds. It is distinguished from all species of *Juglans* by its naked buds.

In winter the following characters are available:—Twigs stout, olive green, glabrous except at the minutely pubescent, glandular tip. Leaf-scars oblique on the twigs, their lower part projecting, large, obcordate, marked by three crescentic prominences, which are the fused cicatrices of the vascular bundles. Pith pentagonal in cross section, chambered in longitudinal section. Buds without covering scales, consisting of a short shoot and three to four undeveloped leaves, which are stalked below, enlarged and lobed above, rusty brown in colour, minutely pubescent and glandular. Lateral buds multiple, two to three superposed vertically above each leaf-scar; the uppermost one like the terminal bud, but smaller and stalked; the lowermost close to the upper margin of the leaf-scar, minute and rudimentary.

VARIETY AND HYBRID

1. Var. *dumosa*, Schneider, *Laubholzkunde*, 94 (1904); *Pterocarya dumosa*, Lavallée, *Arb. Segrez.* 217 (1877). This is a shrubby form, with yellowish brown twigs, and small closely-set leaflets, about $2\frac{1}{2}$ inches long. The fruit and flowers are unknown; but it is probably a horticultural variety of *P. caucasica*.

2. *Pterocarya Rehderiana*, Schneider, *op. cit.* 93. This is a hybrid between *P. caucasica* and *P. stenoptera*, which was described by Rehder in *Mitth. Deut. Dendrol. Gesell.* 1903, p. 116. It grows in the arboretum at Segrez; and plants of it are now cultivated in the Arnold Arboretum,² Massachusetts, where it is perfectly hardy. It is intermediate in character between the two species. The leaflets in texture, serration, etc., resemble those of *P. caucasica*, being a trifle smaller; but

¹ Cf. Lubbock, *Seedlings*, ii. 521, fig. 662 (1892)

² Two seedlings were raised by Elwes from seeds of this tree, one of which is now about eighteen inches high, and shows evidence of its hybrid origin in the leaves.

the rachis shows here and there a very slight wing, like that of *P. stenoptera*, only never serrate in margin. The fruits have oval wings, shorter and broader than those of *P. stenoptera*, the nut being more beaked than in that species. The veining of the fruit-wings resembles *P. caucasica*.

DISTRIBUTION

Pterocarya caucasica has been found in the northern provinces (Astrabad and Ghilan) of Persia, and in Russian Armenia, as well as in the Caucasus. According to Radde,¹ it occurs in the marshy delta of the Rion in company with *Alnus glutinosa*, and along the coast of the Black Sea, mixed with oak, beech, and hornbeam. It grows sometimes as a tree, but oftener as a tall shrub, on the banks of streams. It extends up to about 1200 feet only in Kachetia, and is met with as far eastward as Talysch, on the coast of the Caspian Sea, where in damp places it forms the principal underwood. It is not found wild in the interval between the lower Rion on the west and the lower valley of the Alazan on the south side of the central Caucasus, and is again absent from here to the province of Talysch.

Mr. Younitsky of the Russian Forest Service has kindly sent me the following account of the tree in the Caucasus. He says it is only found in certain stations, rarely over 1200 feet elevation, and always in moist or very wet places, to which it is better adapted than even the alder. In the young stage the tree is very delicate and susceptible to spring frosts, requiring shelter when young; and when older does not bear shade well. Very large trees occur, of 100 feet in height and 10 feet in girth, and logs of it are obtained bare of branches for 50 feet, with a girth of 5 feet at the smaller end. It grows very rapidly in youth, making a height of 30 feet in ten years. The wood is light and soft, resembling much that of the lime-tree, and is chiefly used for making boxes and packing-cases. The bark is used for sandals and roofing. The leaves contain a poisonous matter, and when thrown into water intoxicate the fish, which rise to the surface and are easily caught. The tree is rarely cultivated, but is recommended for planting in the wettest situations, where it will thrive better than almost any other tree.

CULTIVATION

Pterocarya caucasica was introduced into France by the elder Michaux on his return from Persia in 1782. According to Bosc the first tree was planted at Versailles, others a little time after being planted about the Museum in Paris. According to Mouillefert,² there are still growing at the Trianon, Versailles, and at the Museum, Paris, two fine specimens which are probably original trees.³ The tree flowered and produced fruit in 1826 in the park at Malesherbes, according to a note by Gay in the Kew Herbarium. There is a tree 80 feet high and 9 feet in girth in the Old Botanic Garden at Geneva, which was seen by Elwes in 1905.

¹ Radde, *Pflanzenverbreitung in Kaukasusländern*, 109, 139, 159, 182, 205, etc.

² *Traité des Arbres*, ii. 1195 (1898).

³ I could not find either of these trees in 1905.—H. J. E.

This species was introduced into England some time after 1800, the largest tree mentioned by Loudon in 1838 being one 25 feet high and fifteen years planted at Croome; but it is long since dead. (A. H.)

I have raised numerous plants of *Pterocarya* from seed sent me from the Caucasus by the late Dr. Radde in 1903, some of which was distributed by the Royal Horticultural Society. The seedlings grow fast, attaining 2 feet or more in height at two years old, but do not ripen their wood well when young, and are extremely liable to be injured by frost if not protected in spring.¹ The leaves appear about the same time as those of *Liriodendron*. The tree does not seem to dislike lime in the soil, and should be planted out when 3 or 4 feet high, in a situation where the ground is not liable to drought in summer, or near running water.

REMARKABLE TREES

This is one of the most ornamental hardwoods that we have; and is well worth planting in warm and sheltered positions in the south of England, where it thrives from Kent to Devonshire.

By far the largest and finest tree of this species known in England is at Melbury, Dorsetshire, the seat of the Earl of Ilchester. This magnificent tree (Plate 121) is growing on a sheltered bank below the house, on soil which contains lime, close to the finest specimen I know of *Picea Morinda*. It is no less than 90 feet high by 11 feet in girth, and has a straight clean bole about 15 feet long, spreading out into a symmetrical head of branches, and when I saw it in September 1906 had many catkins of fruit hanging on it.

Its spreading habit is shown by a fine tree at Claremont Park, near Esher, Surrey, which grows on deep sandy soil, and is a noble ornament of a lawn. The illustration of this tree (Plate 122) is from a photograph taken in 1903, when it measured about 50 feet in height, with a bole of only 4 feet high but no less than 18 feet in girth. It divides into eight large limbs, each of which is about 4 feet in girth, and the foliage spreads over an area of 30 yards in diameter. The tree is believed by Mr. Burrell, the gardener, to be about eighty years old, and seems to be decaying at the heart. The bark is very rough and deeply furrowed, and the leaves and flower-buds were just appearing, after a very mild winter, on 6th March. A self-sown seedling from it was about 2 feet high.²

Another fine tree is growing at Tortworth Court, from which I gathered ripe seed in October 1900, one of which grew in the following spring. The Earl of Ducie has raised several young trees from the same parent in other seasons. At Linton Park, Kent, there is a fine tree, which was about 50 feet high in September 1902, but not so large as the one at Claremont. Ripe fruiting specimens were sent from Devonshire by Sir John Walrond in 1888, which were figured by

¹ The severe frost of 20th-22nd May 1905 seriously injured all my young trees, and it is evident that this tree should only be planted in situations where spring frosts are not severe.

² Mr. Burrell found a seedling in the summer of 1899. See *Garden*, 1902, lxii. 234, where a figure and description of the tree are given. See also *Garden*, 1894, xlv. 404, fig., and *Gard. Chron.* 1894, xvi. 192. According to a note in the Kew Herbarium, the Claremont tree was, in 1887, 45 feet high by 13½ feet in girth.

Dr. Masters in the *Gardeners' Chronicle*, but I have been unable to procure particulars of the tree from which the specimens were obtained.

In the Botanic Garden, Cambridge, there is an old tree which was 58 feet high in 1903, with eight stems, girthing from 3 feet to 4 feet 3 inches; and from the roots of another tree which was blown down about 1885 a number of strong stems, about twenty, have sprung up, which average about 50 feet in height and $2\frac{1}{2}$ feet in girth. These particulars, which have been kindly sent me by Mr. Lynch, the curator, show the remarkable power of the tree in producing root-suckers (Plate 123).

A tree at Fota, near Queenstown in Ireland, seen by Henry in 1903, measured 42 feet high by 3 feet 9 inches in girth. It produced flowers and fruit in 1902.

Dr. Masters¹ recommends it for planting in towns, and says that there was a good specimen in the Chelsea Botanic Garden (since cut down) in 1891. There are said to be good specimens in some of the towns in Holland. (H. J. E.)

PTEROCARYA RHOIFOLIA

Pterocarya rhoifolia, Siebold et Zuccarini, *Abh. Bayr. Ak. Wiss. Math. Phys. Kl.* iv. 2, 141 (1845); Maximowicz, *Mé. Biol.* viii. 637 (1872); Shirasawa, *Icon. Ess. For. Japon.* text 35, 1. 16 (1900).

Pterocarya sorbifolia, Siebold et Zuccarini, *loc. cit.*; Rehder, *Mitt. Dendrol. Deut. Gesell.* 1903, p. 115.

A tree attaining, according to Shirasawa, 100 feet in height, with a straight stem 10 feet in girth. Bark greyish brown with deep longitudinal fissures. Shoots glabrous. Leaves (Plate 125, fig. 3) 8 to 16 inches long, on a stalk about 2 inches long, which is swollen at its insertion; rachis without wings. Leaflets, fifteen to twenty-one, usually opposite, sessile or sub-sessile, $2\frac{1}{2}$ to 5 inches long, oblong-lanceolate, acuminate at the apex, unequal at the base, which is rounded or somewhat narrowed; dark green above; under surface lighter green, with glandular scales, and some tomentum on the midrib and nerves and in their axils; somewhat thicker in texture than the leaves of *P. caucasica*; margin sharply and finely serrate.

Flowers appearing with the leaves. Staminate catkins two to three at the base of the young shoots; scale three-lobed, pubescent, bearing nine to twelve short-stalked stamens. Pistillate catkins, solitary, terminal at the end of the young shoot, later apparently lateral owing to the growth of the upper axillary bud. Fruiting catkins, 8 to 10 inches long; fruit an inch across; nut with a short, scarcely beaked apex; wings rhombic, broader than long, without any hollow at their base, inconspicuously veined.

The above description applies to the glabrous form, which is in cultivation in England and is common in Japan. In wild specimens from Yezo the leaves appear to be much more pubescent, the rachis and nerves being often covered with dense long hairs.

¹ *Journ. R. Hort. Soc.* 1891, xiii. 86.

This species is readily distinguished by the peculiar buds, which are formed early, and by the scars at the base of the shoot, left by the fall of the bud-scales of the previous year. The buds at first are long, conical, with a curved beak, and are covered by a funnel-shaped membranous sheath, which is composed of two external and two to three internal glabrescent glandular scales. The scales fall off in November, leaving four or five narrow scars at the base of the buds, which in this stage resembles in structure those of *P. caucasica*, but are whitish and densely tomentose. Lateral buds usually solitary at some distance above the leaf scars. Twigs quite glabrous, otherwise as in *P. caucasica*. (A. H.)

In Japan this is a large tree known as *Sawa gurumi*, which I saw in the central provinces of Hondo, where it grows to a height of 50 to 60 feet, old trees attaining a girth of 8 or 10 feet. It generally grows on the banks of streams in mixed forest, and did not seem to be very common or to be valued for its timber, though I got a specimen of the wood from the Government sawmills at Atera, which is now at Kew.

Sargent found it very abundant on the slopes of Mt. Hakkoda, in the north of Hondo, at 2500 to 4000 feet elevation, where it attains as much as 80 feet in height, being next to the beech the largest deciduous tree in the forest. It is a broad-topped tree with stout spreading branches, and when covered with its long hanging slender racemes of fruit, is very handsome. It is hardy at the Arnold Arboretum near Boston and produces seeds there.

Pterocarya rhoifolia is recorded by Diels¹ as having been collected by Von Rosthorn in the province of Szechuan in China.

It seems to have been introduced into cultivation by the Duke of Bedford, to whom seeds were sent from Japan in 1889. Young plants from some of this seed were raised at Kew in 1890; and these have now attained about 12 feet in height. They are the only specimens we have seen in England. (H. J. E.)

PTEROCARYA STENOPTERA

Pterocarya stenoptera, C. de Candolle, *Ann. Sc. Nat. sér. IV.* xviii. 34 (1862); Lavallée, *Arch. Segrez. Icones*, 65, t. 19 (1885); Franchet, *Journ. de Bot.* 1898, p. 317.

A tree, 50 to 60 feet in height, with a girth of stem of 6 or 8 feet. Bark rough. Leaves (Plate 125, fig. 2) about a foot in length; rachis covered with bristles, slightly swollen at its insertion, and having on each side a conspicuous irregular membranous wing, occasionally slightly serrate in margin. Leaflets nine to twenty-five, opposite or alternate, terminal leaflet often wanting; coriaceous; under surface with a few scattered glands, and some pubescence on the midrib and nerves and in their axils; oblong or oblong-lanceolate; acute at the apex, unequal and rounded or narrowed at the base, finely and sharply serrate in margin, 3 to 5

¹ *Flora von Central China*, 274 (1901).

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inches long. Male catkins, arising as in *P. stenoptera*; scale glandular, four-lobed; stamens six to ten. Female catkins 8 inches long; bract minute, bracteoles oblong and longer than the style, perianth with four subulate lobes. Fruit: catkins a foot or more in length; nut with conic beak-like apex; wings linear-oblong and erect.

The above description applies to the form in cultivation, which is also common in the wild state. The species is, however, very variable as regards the amount of pubescence, the twigs being often glabrous and the leaf-rachis only slightly pubescent. In many wild specimens the wing of the rachis is very slight.

This species is readily distinguishable in summer by the winged rachis of the leaf. In winter the twigs are slender and covered with a rusty-red bristly pubescence; but in other respects resemble those of *P. caucasica*. The buds, more slender than in that species, but similar in structure and position, are greyish in colour.

This is a common tree in the central and southern provinces of China, extending in a slightly different form into Tonking.¹ It is usually met with in the plains and low hills, along rivers and water-courses; and never grows to be a large tree. It is recorded from near Moukden in Manchuria, where it was collected by James; but was probably only cultivated there. It is usually called *ma-liu*² by the Chinese; and is much planted in the streets of Shanghai, where it is often called "Chinese ash" by the European inhabitants. As the climate of the regions where it grows naturally is very different from that of England, it is liable to be injured by spring frosts, and fails from want of heat in autumn to ripen its wood. The timber is considered in China to be of little value.

The tree was introduced into Europe apparently by Lavallée, who received the seeds from Siebold, about 1860. It supported at Segrez very low temperatures in 1870 and 1871; but succumbed during the severe winter of 1879-1880. Lavallée considered it to be about as hardy as the common walnut.

The only specimen that we have seen in England of any size is at Tortworth, where Elwes measured in 1905 a tree 32 feet high by 2 feet 3 inches in girth, believed by Lord Ducie to have been planted about twenty years. It is in a shady and sheltered valley and produced small racemes of fruit in 1905. (A. H.)

¹ *Var. tonkinensis*, Franchet, *Journ. de Bot.* 1898, p. 318. A geographical form, distinguished by large leaflets, up to 6 inches long, and linear wings to the fruit, which diverge at a wide angle.

² Henry, "Chinese Names of Plants," *Journ. China Branch R. Asiat. Soc.* xxii. 256 (1887).

CLADRASTIS

Cladrastis, Rafinesque, *Cincinnati Literary Gazette*, i. 66 (1824); and *Neogeniton*, i. (1825); Bentham et Hooker, *Gen. Pl.* i. 554 (1865).
Maackia, Ruprecht et Maximowicz, *Mit. Biol.* ii. 440, t. ii. (1856).

DECIDUOUS trees or shrubs belonging to the division Papilionaceæ of the order Leguminosæ. Leaves alternate, unequally pinnate; leaflets opposite, sub-opposite or alternate, on stout petiolules, entire in margin, and without stipels. Flowers in panicles or racemes, on slender pedicels; calyx with four or five short unequal teeth; corolla papilionaceous, petals unguiculate, standard nearly orbicular, wing and keel-petals oblong; stamens ten, free or slightly united at the base; anthers versatile; ovary with numerous ovules; style incurved, subulate; stigma terminal, minute. Pod linear, flattened, thin, thickened on the upper margin; valves membranous; seeds four to six.

Four species of *Cladrastis* have been described, constituting two sections, which have been considered by Sargent and other botanists to form two distinct genera, *Cladrastis* and *Maackia*. The difference in the buds of the two sections is remarkable; but analogous differences occur in other genera, as *Carya* and *Pterocarya*; and in the absence of important differential characters in the flowers and fruit, it is advisable to unite the sections into one genus.

SECTION I. EU-CLADRASTIS.

Buds several together, compressed into a cone, and concealed in the base of the petiole of the leaf. Leaflets usually alternate. Flowers in panicles; calyx five-toothed.

1. *Cladrastis tinctoria*, Rafinesque. Kentucky, Tennessee, Alabama, and N. Carolina.

Shoots glabrous. Leaflets seven to eleven, oval or ovate, acuminate, almost completely glabrous.

2. *Cladrastis sinensis*, Hemsley. Central and western China.

Shoots rusty pubescent towards the base. Leaflets nine to eleven, oblong-lanceolate, obtuse or sub-acute, rusty pubescent towards the base and along the midrib.

SECTION II. MAACKIA.

Buds solitary, axillary, not concealed. Leaflets opposite or sub-opposite. Flowers in racemes; calyx four- or five-toothed.

3. *Cladrastis amurensis*, Benth. et Hooker. Amurland, E. Manchuria, Korea, and Japan.

Shoots pubescent. Leaflets nine to eleven; deltoid, ovate or oval; obtuse or acute; densely appressed pubescent; calyx four-toothed.

4. *Cladrastis Tashiroi*, Yatabe.¹ Loochoo Islands.²

Allied³ to *C. amurensis*, but always a small shrub; with smaller leaflets, acute and not truncate or rounded at the base as in that species, glaucescent and scarcely pubescent beneath. Flowers and pods also smaller; calyx five-toothed.

CLADRASTIS TINCTORIA, YELLOW-WOOD

Cladrastis tinctoria,⁴ Rafinesque, *Neogeniton*, i. (1825); J. D. Hooker, *Bot. Mag.* t. 7767 (1901).

Cladrastis fragrans, Rafinesque (name only), *Cincinnati Literary Gazette*, i. 66 (1824).

Cladrastis lutea, Koch, *Dendrologie*, i. 6 (1869); Sargent, *Silva N. America*, iii. 57, tt. 119, 120 (1892), and *Trees N. America*, 568 (1905).

Virgilia lutea, Michaux, *Hist. Arb. L'Amér.* iii. 266, t. 3 (1813); Loudon, *Arb. et Frut. Brit.* ii. 565 (1838).

A tree attaining 60 feet in height, and rarely 12 feet in girth. Bark smooth and silvery grey. Branchlets brittle, glabrous. Leaves (Plate 125, fig. 5) alternate, unequally pinnate, 8 to 12 inches in length. Leaflets seven to nine, usually alternate; the terminal one largest, articulate and directed to one side, often broadly rhombic; the others gradually diminishing in size towards the base of the leaf, 3 to 4 inches long by 1½ to 2 inches wide, on stout pubescent petiolules, oval or ovate, entire and non-ciliate in margin; base broadly cuneate or rounded, apex acuminate; upper surface light green and glabrous; lower surface pale green with occasional hairs on the midrib and veins. Rachis of the leaf terete, glabrous, with the base swollen and hollowed out, enclosing the buds, which are usually four, the largest and uppermost one developing, the others minute and rudimentary.

Flowers in nodding terminal panicles, 10 to 20 inches long, white, with a yellow spot at the base of the standard. Pedicels slender and not grouped in pairs. Calyx campanulate, enlarged on its upper side; teeth five, short, obtuse, nearly equal. Corolla papilionaceous with clawed petals; standard nearly orbicular; wings oblong and two-auricled at the base; keel-petals free, oblong, and sub-cordate or two-auricled at the base. Stamens ten, free. Ovary linear, stalked, villose; ovules numerous. Pod glabrous, short-stalked, linear, glabrous. Seeds four to six, attached by slender stalklets, oblong-compressed, without albumen.

¹ *Tokyo Bot. Mag.* vi. 345, t. 10 (1892).

² Cf. Ito and Matsumura, *Journ. Science College, Imp. Univ. Tokyo*, xii. 436 (1899).

³ Judging from the description, as I have seen no specimens. There are specimens in the Kew Herbarium (*Cladrastis*, sp. ? Hemsley, *Journ. Linn. Soc. (Bot.)* xxiii. 201 (1887)) which were collected by Millett, probably in the vicinity of Canton, which are very near to the Loochoo species.

⁴ This name is adopted as being the first one with a description published under the correct genus.

SEEDLING

A plant, raised from seed sown at Colesborne on 2nd March, showed the following characters on 7th July:—Root white, fleshy, tapering, 3 inches long, giving off numerous lateral fibres. Caulicle striated, glabrous, 1½ inch long. Cotyledons two, sub-sessile, oblong, tapering slightly at the base, broader towards the rounded apex, green above, white beneath, coriaceous, entire. Stem terete, with a few scattered hairs below, densely white pubescent above. Leaves, all with petioles swollen at the base; first pair opposite, on pubescent stalks, simple, ovate, entire, 2 inches long by 1½ inch broad. The third, fourth, and fifth leaves are alternate; the third simple and like the first pair; the fourth and fifth trifoliolate on a stalk 2 inches long, terminal leaflet ovate, lateral leaflets oval and smaller.

IDENTIFICATION

Cladrastis tinctoria is readily distinguishable in summer by the pinnate leaves with alternate leaflets, of which the terminal one is directed to one side of the leaf; and by the swollen base of the petiole, which encloses and conceals the buds.

In winter the following characters are available (Plate 126, fig. 4):—Twigs zig-zag, shining, brown or grey, terete, glabrous; lenticels minute, numerous. Leaf-scars alternate, obliquely set on slightly prominent pulvini, oval, whitish, with five bundle-dots on the outer rim, the centre of the scar being occupied by a projecting cone, which consists of four buds compressed together and superposed one above the other, the uppermost one the largest, all pubescent. Terminal bud not formed, the apex of the twig showing a small circular scar or a short stump, indicating where the top of the branchlet fell off in early summer.

DISTRIBUTION

Cladrastis tinctoria is one of the rarest trees in the American forest, growing only in a few isolated localities in central Kentucky, central and eastern Tennessee, northern Alabama, and the south-western part of N. Carolina. It is met with on limestone ridges and cliffs, usually in rich soil, and frequently overhangs mountain streams. (A. H.)

CULTIVATION

The yellow-wood is a favourite ornamental tree in American gardens, where, according to Sargent,¹ it adapts itself readily to varied conditions of soil and climate, though it requires deep rich soil in order to attain its full size and beauty. It has a tendency, however, which in England is equally marked, to divide into several spreading stems, which are rather brittle and liable to split the trunk. Its long racemes of white fragrant flowers make it a very pretty tree early in June, but in our climate these are not produced as freely as in America, and I have never seen fruit ripened in this country. In autumn the leaves turn a bright yellow.

¹ *Garden and Forest*, i. p. 92.

Sargent¹ gives an illustration of a beautiful specimen in a garden near Boston which, 35 years after planting, was 35 feet high and had a spread of nearly 60 feet. I saw several in this district, but none so large as those which I have seen in England.

Though it germinates quickly, and seems easy to raise from seed, the tree is now seldom planted in England, but may be recommended for warm sheltered situations in good soil in the south and east, though perhaps the damp climate of the west does not suit it; and as most of the trees mentioned by Loudon have disappeared, it seems to be short-lived in this country. The seedlings which I have raised from American seed are fairly hardy, and after the first two years grow better than many American trees on my soil.

This species was introduced into cultivation in England in 1812, by John Lyon, a Scotsman who travelled in Carolina, Georgia, and Florida.

REMARKABLE TREES

The largest tree known to us is at Syon (Plate 124), which in 1904 was no less than 60 feet in height by 7 feet in girth and still a fine tree, though its trunk is decaying inside. There is another in Kew Gardens, near the Director's office, which measures 35 feet high, with a bole of 3 feet girthing 5 feet 4 inches and dividing into six main stems, which sub-divide into numerous upright branches. At the Knaphill Nursery near Woking is a very well grown tree about 45 feet high and 8 feet in girth, the head spreading to 16 yards in diameter.

At Highclere there is a tree which measures 42 feet by 7 feet with a spread of branches of 45 feet. Although there is some decay near the root the tree seems to have become more vigorous recently. At Blenheim there is an old specimen, with a stem divided close to the ground, and forming rather a large bush than a tree. At Cornbury Park there is also a fair-sized tree. At Barton, Suffolk, a tree planted² in 1832 was in 1904 25 feet high with a short bole, 5 feet 6 inches in girth, dividing into three wide-spreading main branches.

We have not seen any large enough to mention in Scotland or Ireland.

TIMBER

The wood, according to Sargent, is heavy, hard, strong, and close-grained, and is susceptible of a fine polish. At one time it was used in Kentucky for making gun-stocks; but is too rare to have any commercial importance. It produces a yellow dye.
(H. J. E.)

¹ *Garden and Forest*, i. p. 92.

² Bunbury, *Arboretum Notes*, p. 1.

CLADRASTIS AMURENSIS

Cladrastis amurensis, Bentham et Hooker, *Gen. Pl.* i. 554 (1865); Maximowicz, *Mél. Biol.* ix. 72 (1873); Franchet et Savatier, *Enum. Pl. Jap.* i. 115 (1875) and ii. 327 (1879); J. D. Hooker, *Bot. Mag.* t. 6551 (1881); Shirasawa, *Icon. Ess. Forest. Jap.* text 85, pl. L. figs. 1-12 (1900).
Maackia amurensis, Ruprecht et Maximowicz, *Mél. Biol.* ii. 418, 441 (1856) and 534 (1857); Maximowicz, *Prim. Fl. Amur.* 87, 390, t. v. (1859); Morren, *Belgique Horticole*, 1890, p. 301, t. 18; *Gartenflora*, 1875, p. 152.

A small tree, attaining 40 or 50 feet in height, with bark peeling off in old trees like that of a birch. Young shoots minutely pubescent. Leaflets (Plate 125, fig. 6) seven to eleven, opposite or rarely sub-opposite, the terminal one articulate, the lateral ones on short, stout pubescent petiolules; 2 to 3 inches long; deltoid, ovate or oval; base truncate or rounded; apex obtuse or acute; entire; upper surface dark green and minutely pubescent; lower surface pale green, densely appressed pubescent; rachis pubescent, swollen at the base.

Flowers greenish white, on long pedicels, in simple or occasionally branched erect terminal dense racemes. Calyx teeth four, short, broad, unequal. Petal-claws long, slender; standard obovate, emarginate; wings oblong, obtuse, two-auricled at the base; keel petals partially coalesced, one-auricled. Stamens slightly connate below. Pod, 2 to 3 inches long, oblong, flattened, brown, slightly appressed pubescent; seeds, one to five, oblong.

In specimens from the Asiatic continent the leaflets are larger and much less pubescent than in the Japanese tree, which has been distinguished by Maximowicz as var. *Buergeri*,¹ and is characterised by very dense appressed pubescence on the lower surface of the leaflets and white tomentose shoots.

In winter the twigs (Plate 126, fig. 5) are shining, glabrous; leaf-scars on prominent pulvini, semicircular, marked by a central large tubercular bundle-scar and two minute dots close to the upper margin; true terminal bud absent, the top of the branchlet having fallen off in early summer and leaving a short stump at the apex of the twig. Buds solitary, dark brown, shining, pubescent towards the apex, showing two scales visible externally.

Cladrastis amurensis occurs in Amurland as far north as lat. 52° 20', and grows throughout Eastern Manchuria and Korea, the largest tree seen by Maack being only 35 feet high and 1 foot in diameter. According to Shirasawa, it is met with in Japan on moist rich soils in the temperate parts, ascending to 4300 feet in the central chain of the main island, and attaining a height of 50 feet and a diameter of 28 inches. It was collected by Elwes in the forest near Asahigawa in central Hokkaido, where, however, it was not abundant or conspicuous. It is called *Inu-enju* in Japan.

Cladrastis amurensis was introduced from the Amur in 1864 by Maximowicz; and has been spread throughout Europe by the St. Petersburg Botanical Garden. It probably came into England about 1870.

¹ *Mél. Biol.* ix. 72 (1873).

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It is propagated either by seed or by root-cuttings. At Kew it is rather a shrub than a tree, and produces flowers when quite young, which appear late in the season, in the end of July or the beginning of August. It ripens its fruit in October, the pods remaining on the tree during winter.

The timber, according to Shirasawa, is hard and tenacious, and is used in building and in making furniture. Elwes purchased planks of it at Sapporo, which are of a yellowish-brown colour, and seem to be of good quality for cabinet-making.

(A. H.)

CLADRASTIS SINENSIS

Cladrastis sinensis, Hemsley, *Journ. Linn. Soc. (Bot.)* xxix. 304 (1892).

A tree attaining 70 feet in height and 10 feet in girth. Young shoots rusty pubescent towards the base. Leaflets nine to eleven, alternate, entire, oblong-lanceolate, obtuse or acute at the apex; broad and rounded, rarely cuneate, at the base; lower surface with appressed pubescence most marked towards the base and along the midrib. Leaf-rachis pubescent, with swollen base enclosing two or three buds. Leaf-scars on older shoots, oblique on prominent pulvini, orbicular; the raised circular rim, discontinuous above, surrounding a central densely pubescent depression, in which lie two or three buds, the upper one of which is the largest.

Flowers pinkish-white, fragrant, in large terminal, rusty-pubescent panicles. Calyx rusty-pubescent; teeth short, broad, rounded. Petals long-clawed, erect, free; standard broadly obovate, bifid; wings and keel-petals oblong. Stamens slightly connate at the base; ovary pubescent. Pod linear-oblong, flattened, with thickened margins.

This tree, which resembles *Sophora japonica* in habit and foliage, was discovered by Pratt, in 1890, in Western Szechuan, where E. H. Wilson subsequently saw large trees at 7000 feet altitude in the Hsiang Ling range, west of Mt. Omei. It also occurs in the high mountains of the Fang district in Hupeh, from whence seeds were sent home by Wilson in 1901. Plants raised at Coombe Wood were, in 1906, 5 feet high, and for so far have proved perfectly hardy. The tree has beautiful flowers, and, growing at high altitudes in western China, should thrive in this country.

(A. H.)

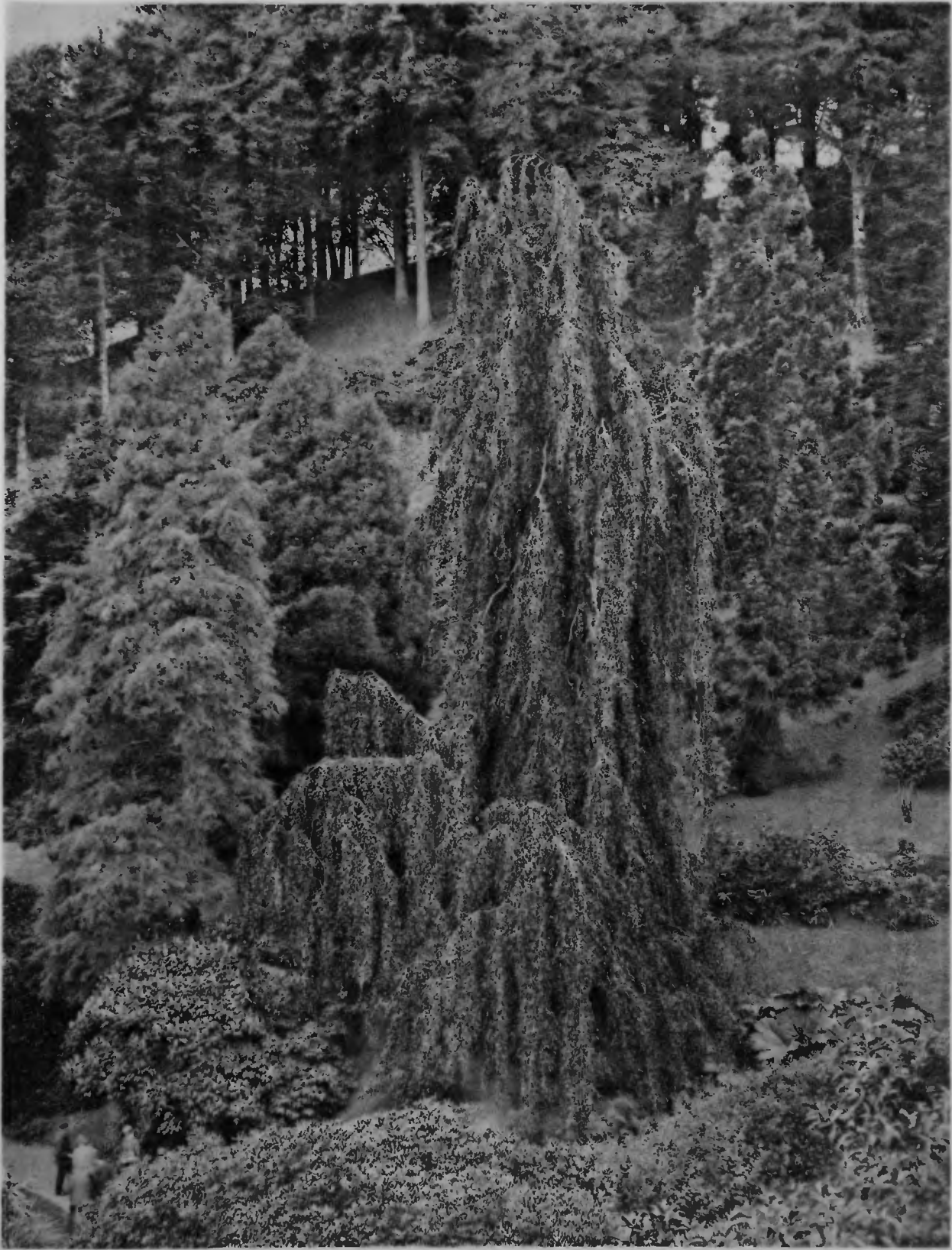
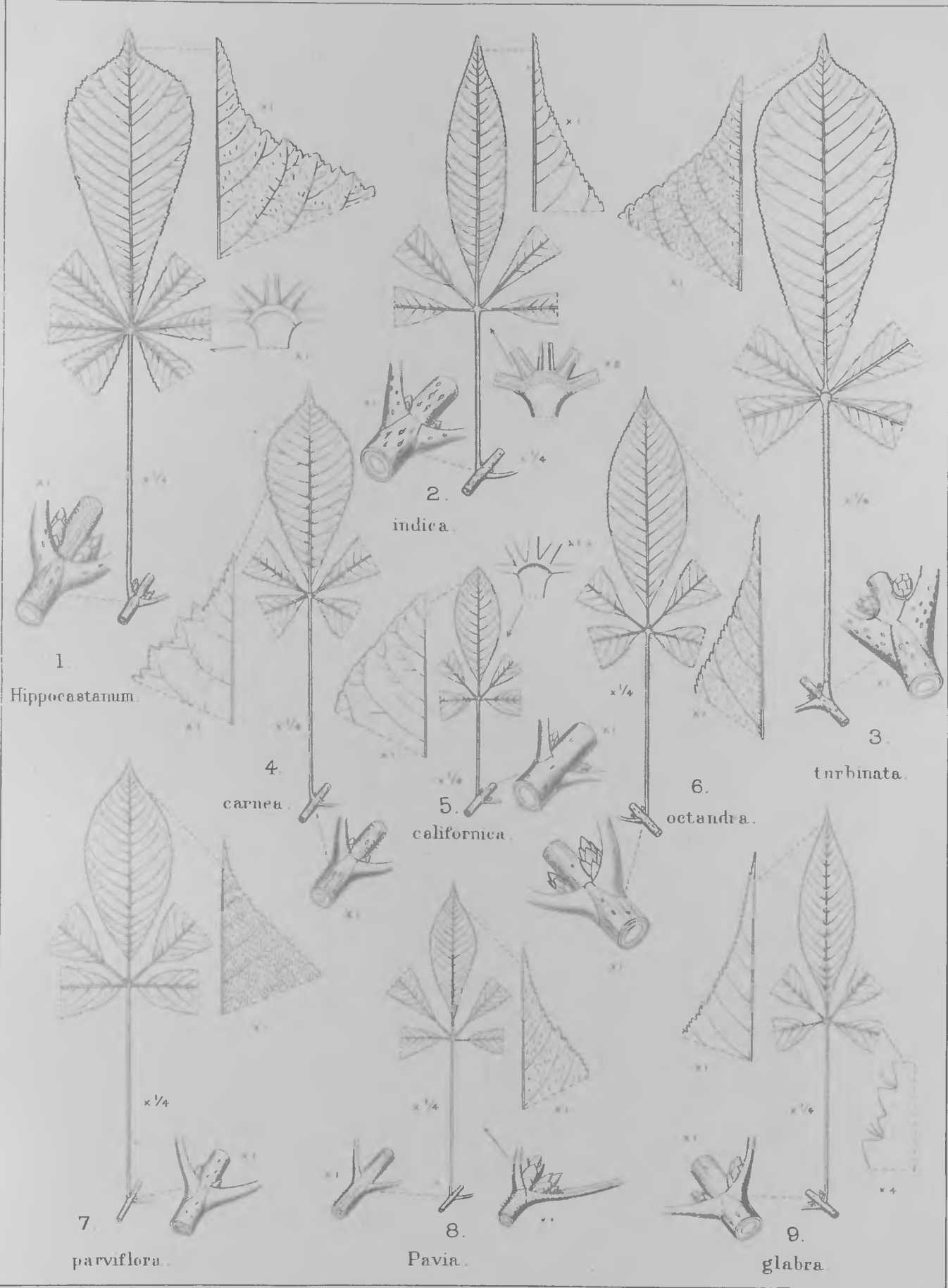


PLATE 58 A.

WEeping BEECH AT ENDSLEIGH

(See Page 10)

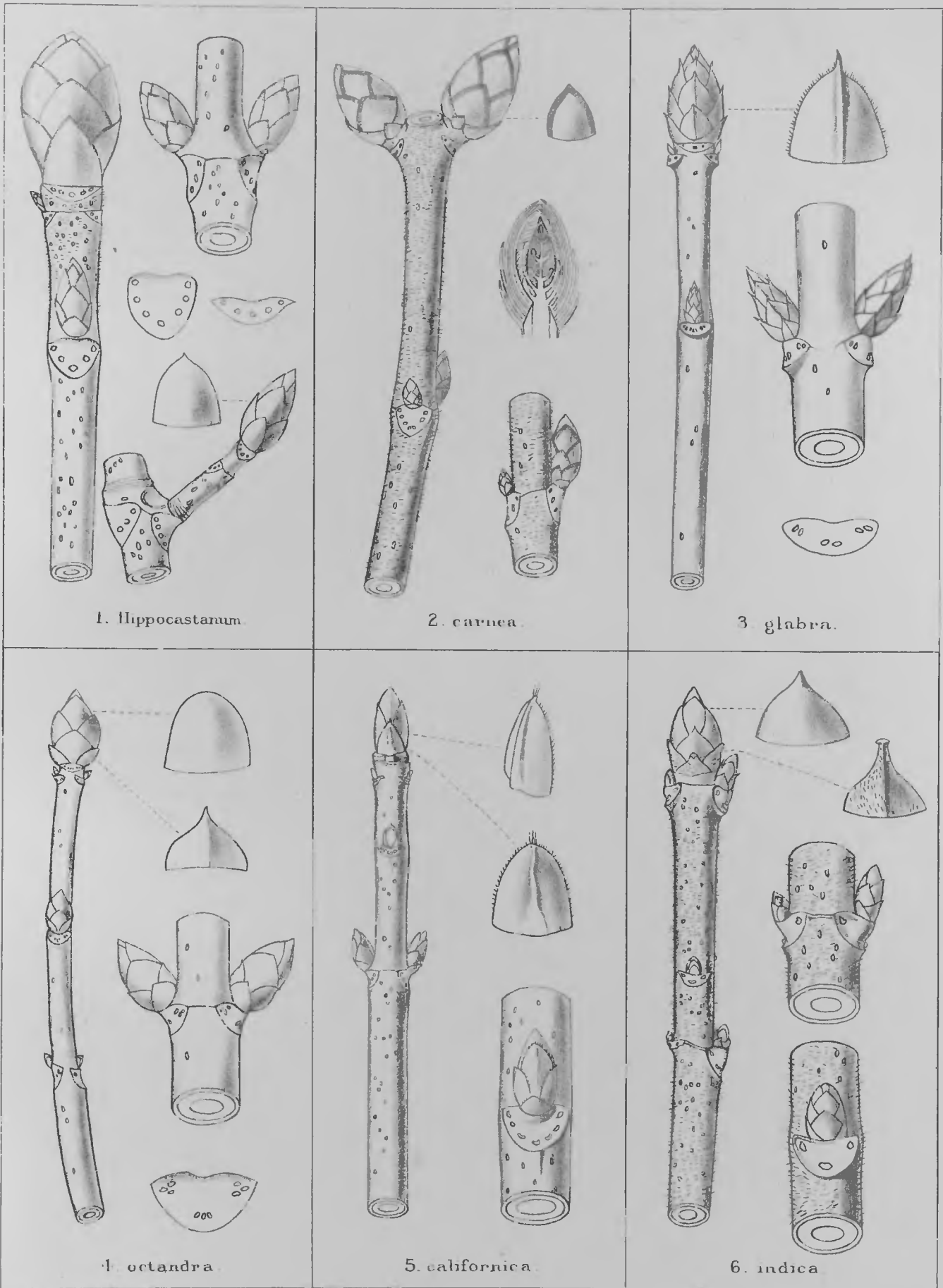


Hutt del, Hurb lith.

PLATE 61

AESCULUS

69-12130





HORSE CHESTNUT AT COLESBORNE

PLATE 63.



WEeping HORSE CHESTNUT AT DUNKELD



ÆSCULUS INDICA AT BARTON



PLATE 66.

ÆSCULUS TURBINATA IN JAPAN



PLATE 67.

HOOKER'S HEMLOCK AT MURTHLY



PLATE 68.

WESTERN HEMLOCK AT DROPMORE



WESTERN HEMLOCK AT MURTHLY

PLATE 69.



HEMLOCK SPRUCE AT FOXLEY



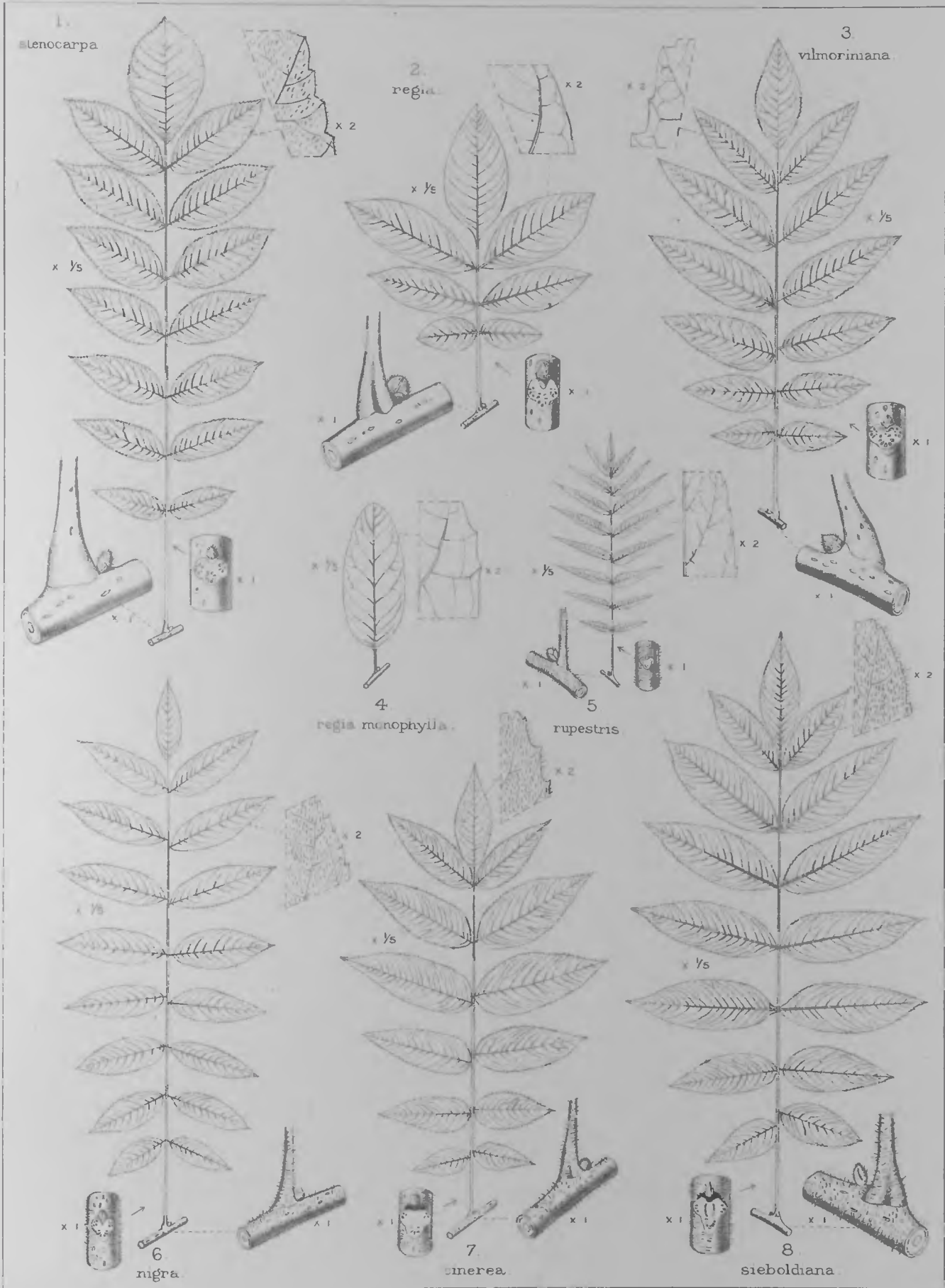
HEMLOCK SPRUCE AT STRATHFIELDSAYE

PLATE 71.



HIMALAYAN HEMLOCK AT BOCONNOC

PLATE 72.



Hunt del. Hutch lith.

PLATE 73.

JUGLANS



WALNUT AT BARRINGTON PARK



PLATE 75.

WALNUT AT GORDON CASTLE



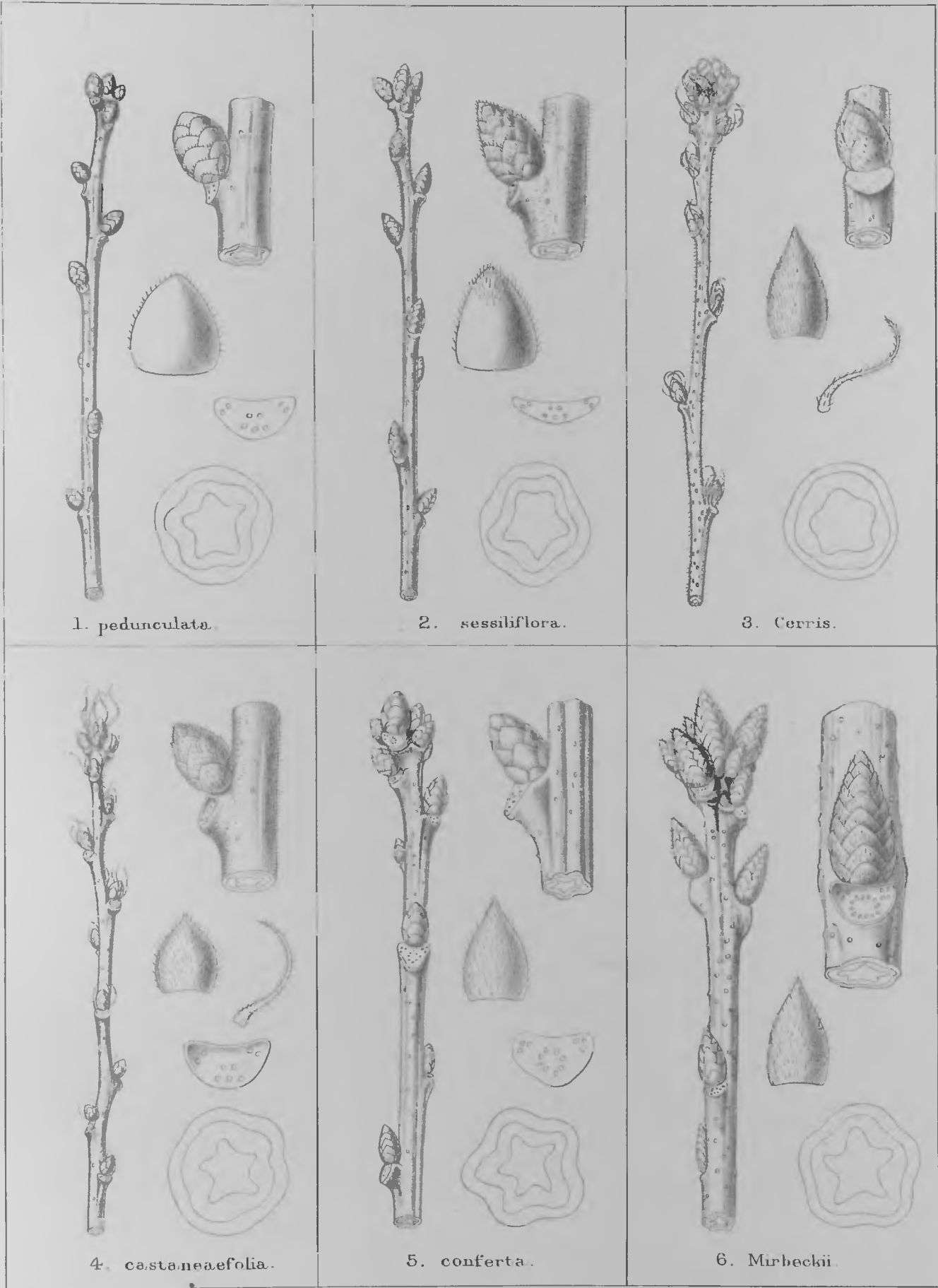
BLACK WALNUT AT TWICKENHAM

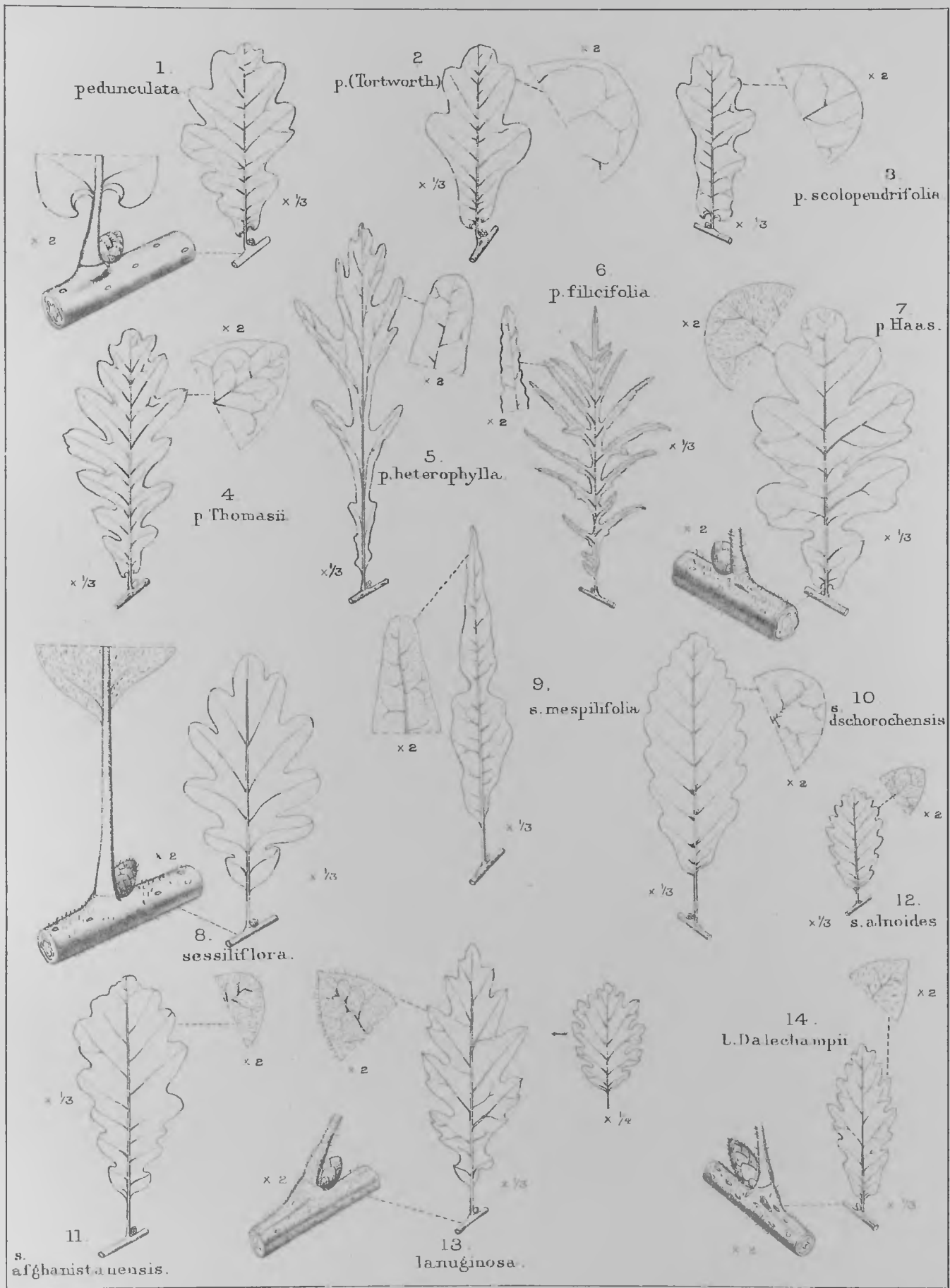
PLATE 76.



PLATE 77.

BLACK WALNUT AT THE MOTE







CYPRESS OAK AT MELBURY

PLATE 80.



PLATE 81.

SELF-SOWN OAKS AT THORNBURY CASTLE



PLATE 82.

CHAMPION OAK AT POWIS CASTLE

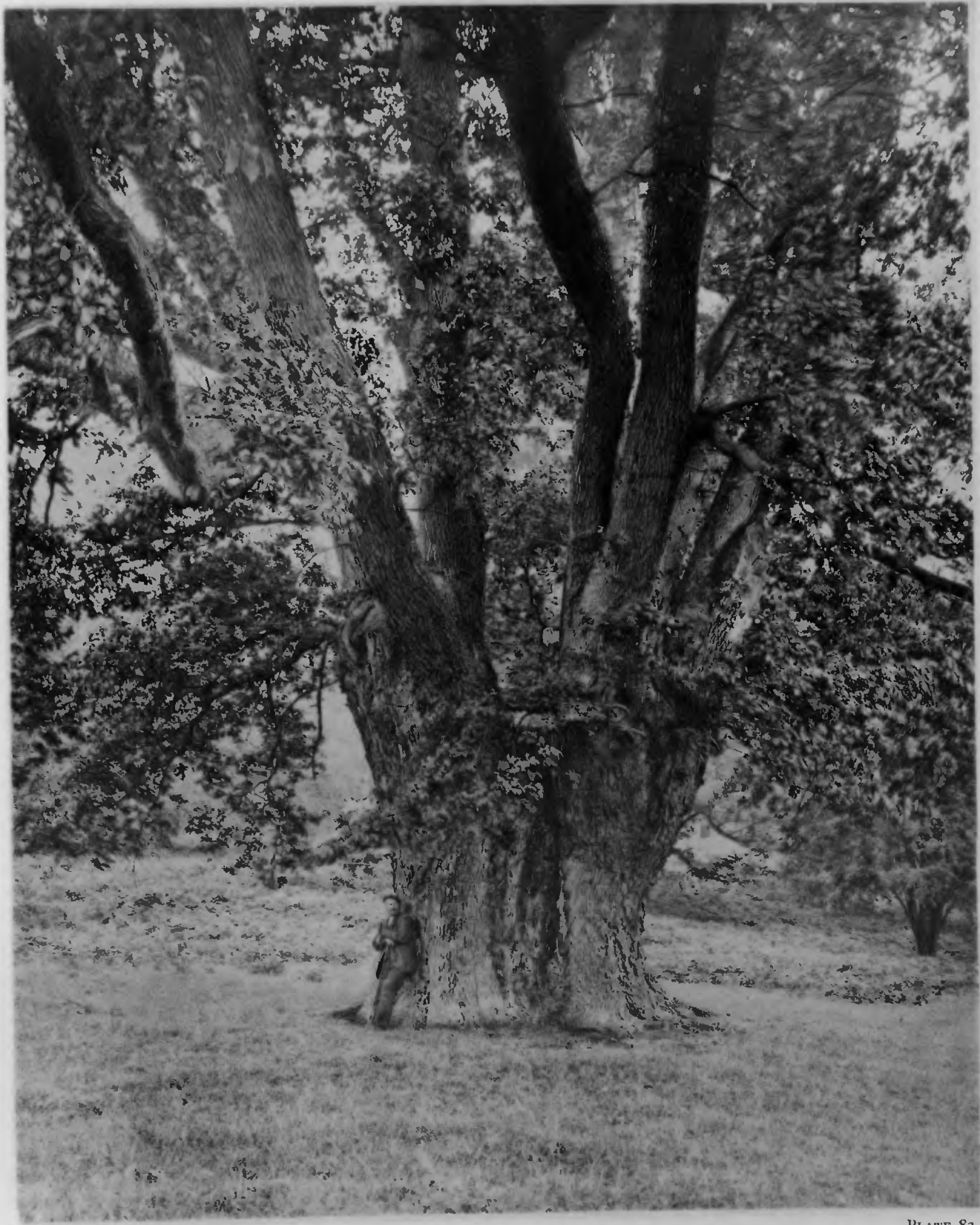
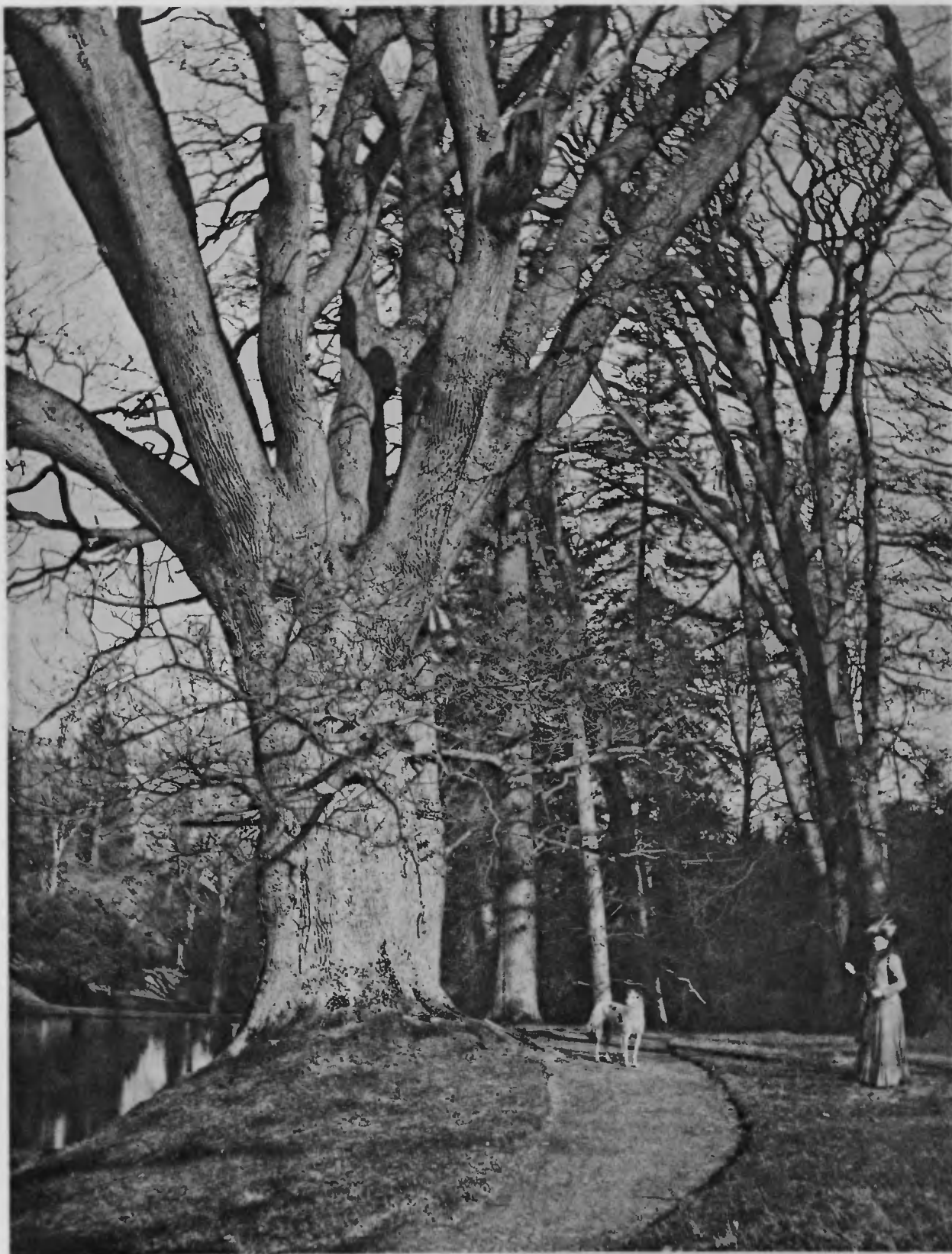


PLATE 83.

OAK AT POWIS CASTLE



LADY POWIS' OAK AT POWIS CASTLE

PLATE 84.



PLATE 85.

TALL OAK AT WHITFIELD



OAK AT KYRE PARK

PLATE 86.



TALL OAKS AT KYRE PARK

PLATE 87.



PLATE 88.

BILLY WILKIN'S OAK AT MELBURY



PLATE 89.

BEGGAR'S OAK IN BAGOT'S PARK



PLATE 90.

OAKS AT BAGOT'S PARK



KING OAK AT BAGOT'S PARK

PLATE 91.



PLATE 92.

SESSILE OAK AT MEREVALE PARK



OAK AT BOURTON-ON-THE-WATER



OAK AT ALTHORP



PLATE 95.

MAJOR OAK IN SHERWOOD FOREST



PLATE 96.

BROWN OAK AT ROCKINGHAM PARK



UMBRELLA OAK AT CASTLE HILL

PLATE 97.



LARCHES IN OAKLEY PARK



PLATE 99.

LARCHES AT SHERBORNE, GLOUCESTERSHIRE



PLATE 100.

LARCHES AT COLESBORNE



PLATE IOI.

CHAMPION LARCH AT TAYMOUTH



PLATE 102.

FORKED LARCH AT TAYMOUTH



PLATE 103.

MOTHER LARCH AT DUNKELD



FORKED LARCH AT GORDON CASTLE



LARCH IN THE ALPS

PLATE 105.

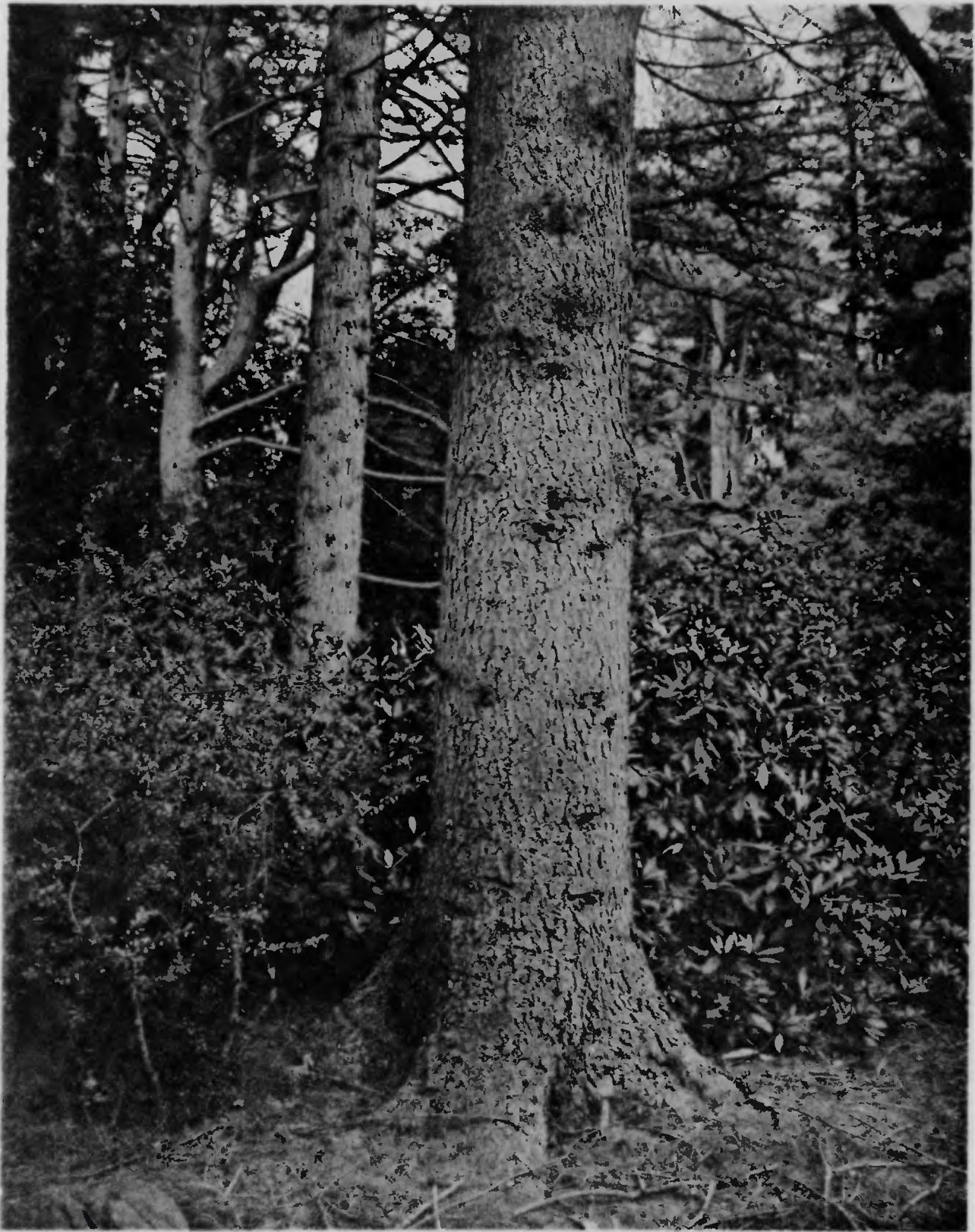


PLATE 106.

DAHURIAN LARCH AT WOBURN



LARCH IN KURILE ISLANDS



PLATE 108.

JAPANESE LARCH AT TORTWORTH



PLATE 109.

SIKKIM LARCH AT STRETE RALEIGH



PLATE 110.

AMERICAN LARCH AT DROPMORE



PLATE III.

WESTERN LARCH IN MONTANA



PLATE 112.

LYALL'S LARCH IN ALBERTA



A



B

PLATE 113.

CORSICAN PINE IN CORSICA

(*Valdoniello, Henry*)



CORSICAN PINE IN CORSICA
(Antré)



PLATE 115.

PINUS LARICIO ON SANDHILLS AT HOLKHAM



PLATE 116.

PINUS LARICIO AT HOLKHAM



PINUS LARICIO AT ARLEY

PLATE 117.



CRIMEAN PINE AT ELVEDEN



PINUS LEUCODERMIS IN BOSNIA



*Plate 120 is reserved for Gymnocladus and will be issued
with a later Volume.*



PLATE 121.

PTEROCARYA CAUCASICA AT MELBURY



PLATE 121.

PTEROCARYA CAUCASICA AT MELBURY



PTEROCARYA CAUCASICA AT CLAREMONT

PLATE 122.



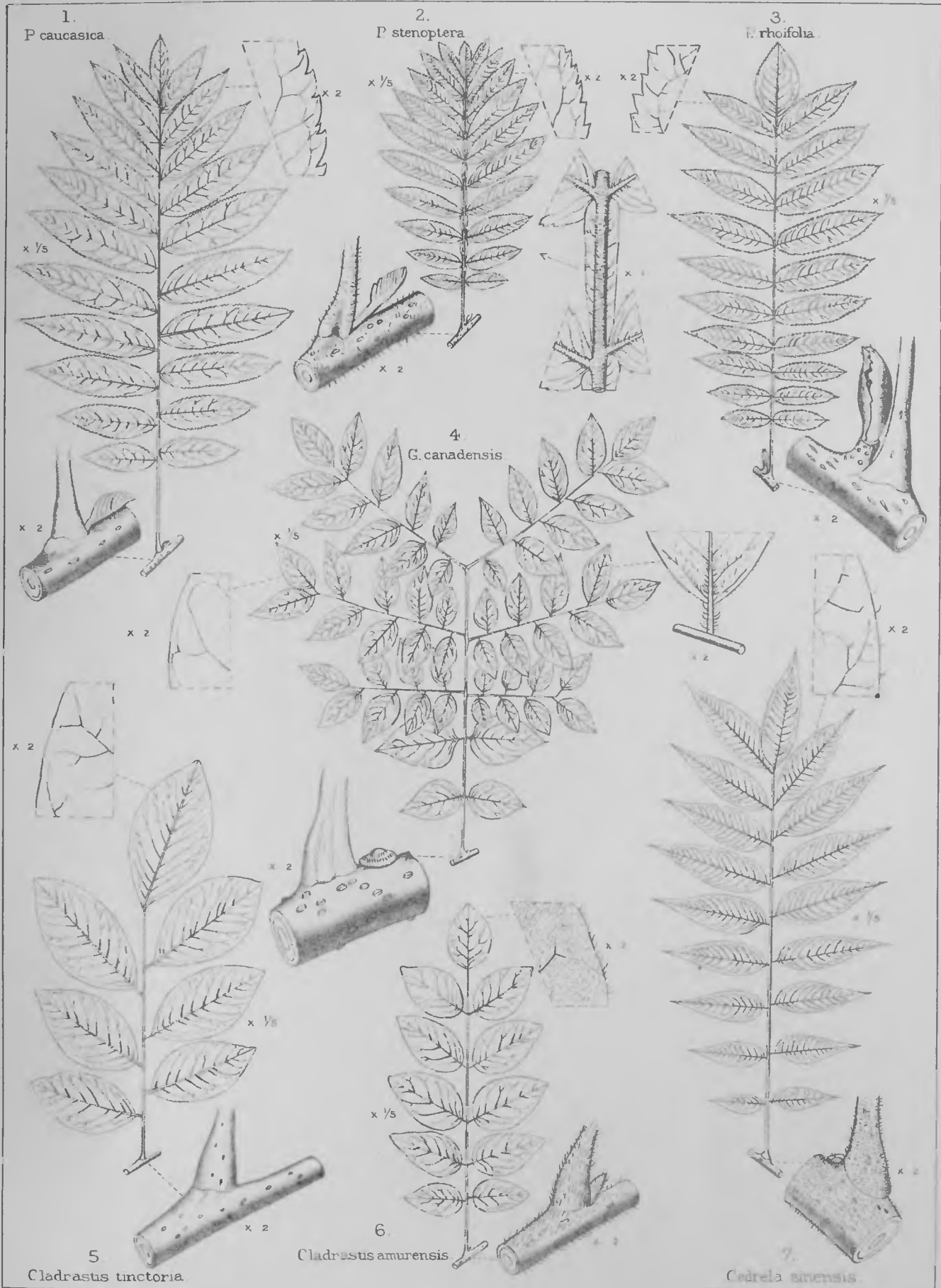
PTEROCARYA CAUCASICA AT CAMBRIDGE

PLATE 123.

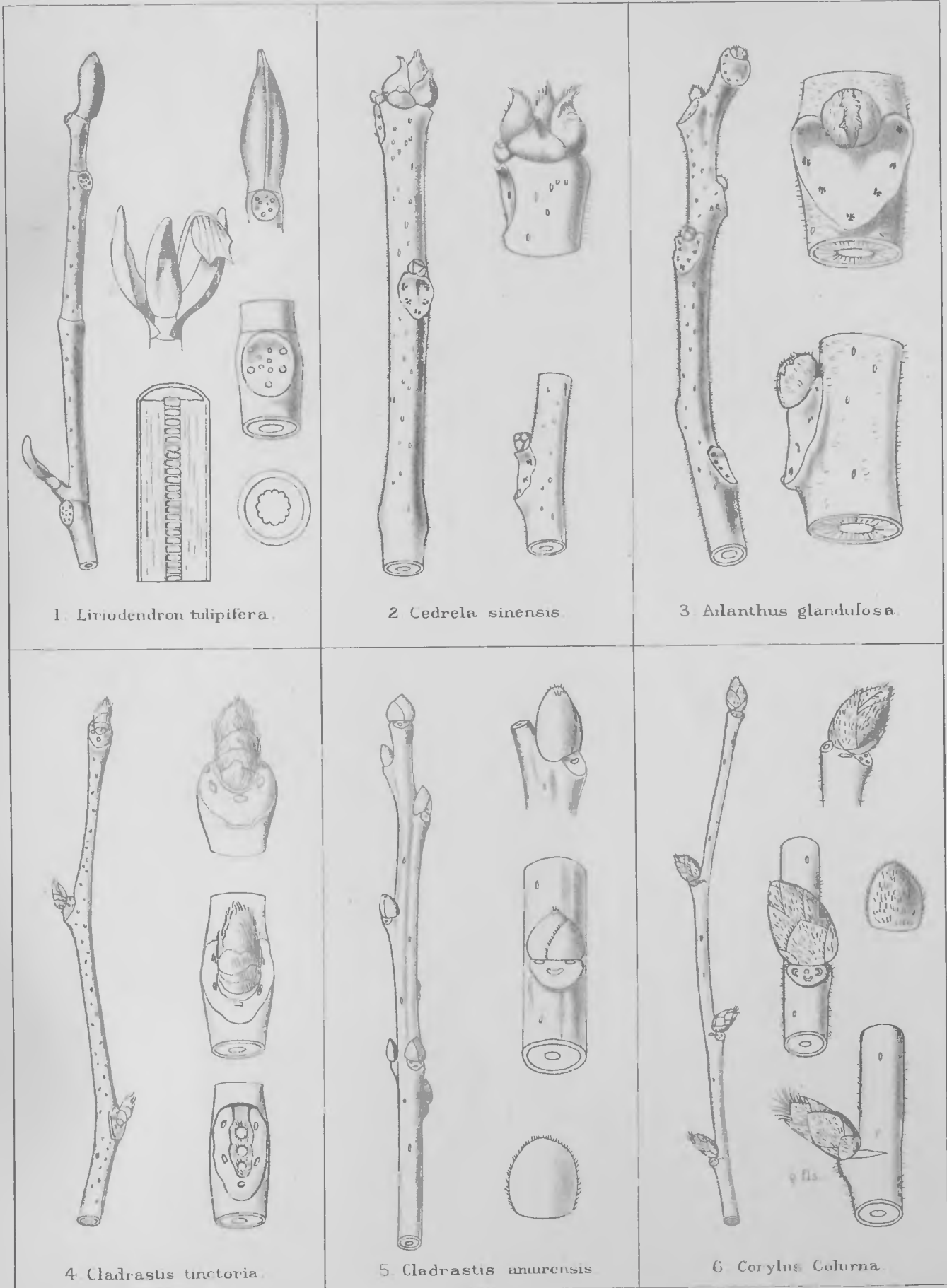


YELLOW-WOOD AT SYON

PLATE 124.



Hou, del. Hoch, lith.



Hutt del Hutch bth.

Pl. 126

LIRIODENDRON, CEDRELA, AILANTHUS, CLADRASTIS AND CORYLUS



PLATE 27.

P TREE AT HORSHAM PARK

Plate 27, which was unavoidably omitted from Volume I., shews the Tulip trees at Leonardslee and Horsham Park mentioned on page 70. We are indebted to Mrs. F. Du Cane Godman for the admirable negatives from which this plate was made.



TULIP TREE AT LEONARDSLEE



TULIP TREE AT LEONARDSLEE



TULIP TREE AT HORSHAM PARK

QK488
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v. 3
pt. 1

VOLUME III



The Trees
of
Great Britain
& Ireland

BY
Henry John Elwes, F.R.S.
AND
Augustine Henry, M.A.

Edinburgh: Privately Printed

F.H.W.

THE TREES OF GREAT BRITAIN AND IRELAND





LEBANON CEDAR AT HIGHCLERE CASTLE

From a Drawing by Charlotte Lady Phillimore.

A detailed botanical illustration of tree branches. The top half shows several catkins (male flower clusters) with red and yellow flowers, some on bare branches and some on branches with small, developing leaves. The bottom half shows a branch with large, green, serrated leaves and a single catkin. The illustration is enclosed in a thin black rectangular border.

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MCMVIII

F.H.W.

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CEDRUS

Cedrus, Lawson, *Agric. Man.* 379 (1836); Loudon, *Arb. et Frut. Brit.* iv. 2402 (1838); Bentham et Hooker, *Gen. Pl.* iii. 439 (1880); Masters, *Journ. Linn. Soc. (Bot.)* xxx. 30 (1893).

Larix, Miller, *Dict.* No. 3 (1724) (*ex parte*).

Pinus, Linnæus, *Sp. Pl.* 1001 (1753) (*ex parte*).

Pinus, section *Cedrus*, Parlatore in DC. *Prod.* xvi. 2, p. 407 (1864).

Abies, Poiret in Lamarck, *Dict.* vi. 510 (1804) (*ex parte*).

TREES belonging to the tribe Abietinæ of the order Coniferæ, with evergreen foliage, borne, for the most part, in tufted flat masses on the ramifications of the branches, which arise irregularly and not in whorls from the stem. Bark dark grey and smooth on young stems and branches; ultimately on old trunks thick and fissuring into irregular longitudinal plates, roughened externally by small scales.

Branchlets of two kinds: long shoots bearing in spiral order solitary leaves, and short shoots or spurs with leaves in pseudo-verticels. Buds minute ovoid, with a few brown scales, which persist after the opening of the bud, either sheathing the base of the long shoots or surrounding the annual rings of the short shoots. Long shoot with a solitary terminal bud, prolonging the growth of the branchlet in the following year; and with a few lateral buds solitary in the axils of some of the leaves and usually developing into short shoots. Short shoot with a terminal bud only, which, in the following year, either lengthens slightly the spur and adds to it a whorl of leaves with or without flowers, or occasionally develops into a long shoot. Long shoots, slightly furrowed, between the slightly raised decurrent bases of the pulvini, the free ends of which project and bear leaves, and on older branchlets, from which the leaves have fallen, remain persistent as slight prominences.

Leaves, deciduous in the third to the sixth year, variable in length, the shortest on the spurs, articulated at the base, acicular, rigid, sharply pointed, more or less triangular in section, stomatic on all sides; fibro-vascular bundle undivided, hypoderm thick, with two resin canals close to the epidermis on the lower surface.

Flowers, monœcious, terminal, solitary on the older leaf-bearing short shoots. Male flowers, erect, catkin-like, cylindrical, about 2 inches long; anthers numerous, spirally crowded, bi-locular, dehiscing longitudinally; connective prolonged into an ovate denticulate crest; pollen grains globose, without wings, borne to the female flowers by the wind. Female flowers appearing as small purplish cones, about $\frac{1}{2}$ inch in length; composed of numerous spirally arranged, closely appressed, irregularly dentate, sub-orbicular scales, each subtended by a short, included, obovate, denticulate bract; ovules, two on each scale, inverted.

Ripe cones, solitary, erect, on short stout peduncles, dull-brown, resinous, ellipsoid or cylindrical; rounded, flattened or depressed at the apex. Bracts obsolete or minute and ragged. Scales numerous, closely imbricated, woody, fan-shaped; upper expanded part thin, transversely oblong, with denticulate rounded or sloping wings, brown-tomentose in greater part beneath, almost glabrous above; claw thickened, obcuneate, with a raised ridge between the depressions for the seeds on the upper surface, the lower surface being slightly hollowed by the pressure of the seeds of the adjoining scale. Seeds, two on each scale, $\frac{1}{4}$ to $\frac{1}{2}$ inch long, with resin-vesicles on both surfaces, brown, irregularly triangular; surmounted by a membranous brownish wing, broadly triangular or hatchet-shaped, about twice as long as the body of the seed. Cotyledons, nine or ten.

The flowers appear in July or August, the pollen being shed profusely in October. During winter the cones remain small, and only begin to grow in the following April, attaining about half or two-thirds their full size in October of the second year. They are fully ripe in October or November of the third year, *i.e.* about twenty-six months after the first appearance of the flowers. In their native forests the dissemination of the seed is caused by the autumnal rains, the cones not disarticulating in dry weather. After being soaked with rain, the scales and seeds separate from the axis of the cone (which remains persistent on the branch) and fall to the ground, the seeds with their light wings being blown, when there is a breeze, to a little distance from the parent tree. In England, irregularities occur in the period when the cones disarticulate, dependent, probably, on the absence of heavy rains in the autumn in certain seasons.

Seedling.—Plants raised from seed gathered on Mount Lebanon in 1904, and sown at Monreith in April 1905, averaged 9 inches high in the following September,¹ and showed the following characters:—Tap-root, about 9 inches long, slender, with a few lateral fibres. Caulicle, 2 inches long, slightly furrowed, glabrous. Cotyledons, ten, sessile, $1\frac{3}{4}$ inch long, curved, tapering to a sharp point, triangular in section, the upper two sides stomatiferous, the lower side green and narrow. Young stem glabrous, bearing in a whorl, just above the cotyledons, the first seven leaves, $\frac{5}{8}$ inch long, linear, flattened, sharp-pointed, stomatiferous on both surfaces, deeply grooved below, slightly convex above, sharply serrate in margin. Above the whorl, leaves, gradually increasing in size to $1\frac{1}{8}$ inch long, arise in spiral order, similarly serrate and stomatiferous, but almost rounded in section; in addition, the stem gives off at irregular intervals five or six small branchlets.

With regard to the different forms of the cedar, which inhabit four distinct and isolated areas, opinions are much at variance as to their rank. They differ more or less in the length of their leaves, and in the size and shape of the cones, cone scales, and seeds, and in the young stage they differ in habit; but in their native forests they all assume, when old, the flattened form which is sometimes erroneously considered to be peculiar to the Lebanon cedar. This is caused by the inflection of the leading shoot, which is followed by a diminution in the rate of vertical growth, the lateral branches at the same time thickening and growing out horizontally. An

¹ This growth is quite exceptional in my experience.—(H. J. E.)

important difference is the height attained in the wild state, the deodar becoming very tall, the Cyprus cedar remaining short, with the Lebanon and Algerian cedars intermediate in size. They differ in their period of vegetation. At Kew the deodar is the first to put forth young leaves in spring; the Lebanon usually follows a fortnight later; and the Algerian generally comes out last, after an interval of a few days. They may be correctly considered geographical races of the same species; but for arboricultural purposes it is most convenient to rank them as distinct species.

CEDRUS LIBANI, LEBANON CEDAR

- Cedrus Libani*, Barrelier, *Plantæ, Icon.* 499 (1714); Loudon, *Arb. et Frut. Brit.* iv. 2402 (1838); Ravenscroft, *Pinet. Brit.* iii. 247 (1884); Kent, Veitch's *Man. Coniferae*, 415 (1900).
Cedrus patula, Koch, *Dendrol.* ii. 268 (1873).
Pinus Cedrus, Linnæus, *Sp. Pl.* 1001 (1753).
Larix Cedrus, Miller, *Gard. Dict.* ed. viii. No. 3 (1768).
Larix patula, Salisbury, *Trans. Linn. Soc.* viii. 314 (1807).
Abies Cedrus, Poiret in Lamarck, *Dict.* vi. 510 (1804).

Leading shoot of young trees erect or slightly bent, not pendulous. Branchlets not pendulous, glabrous or with slight short pubescence. Leaves up to $1\frac{1}{4}$ inch in length, broader than thick. Cones large and broad, ellipsoid, 3 to $4\frac{1}{2}$ inches long, $1\frac{3}{4}$ to $2\frac{1}{2}$ inches wide; scales 2 inches or more in width, with the claw inflected almost at a right angle.

VARIETIES

1. Var. *argentea*, Antoine et Kotschy, *Iter. Cilic.* No. 417. Trees with glaucous foliage, growing wild in the Cilician Taurus, intermingled with the ordinary form. This variety appears in cultivation, but is rarer than the glaucous form of *C. atlantica*.

2. Var. *decidua*, Carrière, *Conif.* 372 (1867). Leaves deciduous. A tree of this kind, slow in growth and bushy in habit, was obtained by Sénéclauze in 1851. Kent mentions one growing at Westgate near Chichester.¹ Webster reports² another, 65 feet high, growing on Lord Derby's property in Kent, and said to be in perfect health, though from its bare appearance in winter it has often been supposed to be dying.

3. Var. *tortuosa*. On the lawn of a private house at Dulwich, belonging to the Dulwich College estate, there is a remarkable cedar, a photograph of which was sent to Kew in 1903. The stem and all the branches are spirally twisted.

The Lebanon cedar is variable in habit, and numerous supposed varieties are mentioned by Beissner, as *nana*,³ a dwarf form; *stricta*, narrowly pyramidal in habit; *pendula*, with pendulous branches and branchlets; and *viridis*, with bright green shining foliage.

¹ But on writing to Captain Norman, who was the authority for this, he tells me that the tree is now dead, and that in his opinion the deciduous habit, which was regular and unfailing, was due to constitutional weakness, caused by uncongenial surroundings, in proof of which he states that another tree at the same place raised from a seed taken from the same cone, was much more robust and showed no abnormal tendency.—(H. J. E.)

² *Hardy Coniferous Trees*, 27 (1896).

³ A specimen of the dwarf cedar, only 4 feet high and of considerable age, is growing in grounds adjoining one of the oldest parks at Hemel Hempstead. The branches are flattened, horizontal, and very close together, giving the plant a dense, stiff appearance.—*Gard. Chron.* xix. 563 (1896).

Supposed hybrids between the Lebanon and Atlantic cedars have been recorded,¹ but on insufficient evidence. (A. H.)

DISTRIBUTION

The best account of the Cedar of Lebanon known to me is the classical paper by Sir Joseph Hooker published in the *Natural History Review*, vol. ii. p. 11 (1862), and as this gives a careful summary of the facts bearing on the specific identity of the forms of cedar, I summarise it as follows:—In the autumn of 1860 Sir J. Hooker went to Syria in company with Captain Washington, Hydrographer of the Navy, and Captain Mansell, R.N., and arrived at Beyrout on 25th September. The party proceeded to the Lebanon, where Captain Mansell made a detailed survey of the basin where the cedars grow, at the head of the Kedisha valley, 15 miles from the sea in a straight line. At that time the other groves were apparently unknown, though Professor Ehrenberg informed Sir Joseph Hooker that he found many trees in forests of oak on the road from Bsharri to Bshinnate. The Kedisha valley at 6000 feet elevation terminates in broad, flat, shallow basins, and is two or three miles across and as much long. It is three or four miles south of the summit of Lebanon, which is about 10,200 feet in height, the chapel in the cedar grove being about 6200 feet. The cedars grow on a portion of the moraine which borders a stream, and nowhere else; they form one grove about 400 yards in diameter, and appear as a black speck in the great area of the corrie and its moraines, which contain no other arboreous vegetation, nor any shrubs but a few small barberry and rose bushes. The number of the trees is about 400, and they are disposed in nine groups, corresponding with as many hummocks of the range of moraines; they are of various dimensions, from 18 inches to upwards of 40 feet in girth; but the most remarkable and significant fact connected with their size, and consequently with the age of the grove, is that there is no tree of less than 18 inches girth, and that no young trees, seedlings, nor even bushes of a second year's growth were found. Calculating from the rings in a branch of one of the older trees, now in the Kew Museum, the younger trees would average 100 years old, the oldest 2500, both estimates no doubt being widely far from the mark. Sir Joseph goes on to say, that the word cedar as used in the Bible applies to other trees, and he doubts whether the cedar of Lebanon is the one which supplied the timber used in building Solomon's temple. He thinks that the cypress or the tall fragrant juniper of the Lebanon (*Juniperus excelsa*) would have been not only much easier to procure, but far more prized on every account.² Between individuals from the Lebanon and the common Asia Minor form there is said to be no appreciable difference by those who have examined both, but there are two distinct forms or varieties in Asia Minor, one having shorter, stiffer, and more silvery foliage than the other; this is the silver cedar, *C. argentea*, of our gardens. Northern Syria and Asia Minor form one botanical province, so that the Lebanon groves,

¹ Beissner, *Nadelholkunde*, 301, 302 (1891).

² But at a later period Sir J. Hooker changed his opinion on this subject, and believed that the wood used by Solomon and by Nebuchadnezzar in buildings was the Lebanon cedar.

though so widely disconnected from the Taurus forest, can be regarded in no other light than as an outlying member of the latter. After speaking of the Algerian cedar and the deodar, Sir Joseph says that it is evident that the distinctions between them are so trivial, and so far within the proved limits of variation in coniferous plants, that it may reasonably be assumed that all originally sprang from one. There are no other distinctions whatever between them of bark, wood, leaves, male cones, anthers, or in their mode of germination, growth, or hardiness (but this has not been confirmed during the severe winters of a later date in England). Though the difference in the shape of the scales and seeds of *Deodara* and *Libani* are very marked, they vary much, many forms of each overlap, and further transitions between the most dissimilar may be established by the intercalation of seeds and scales from *C. atlantica*. Sir Joseph accounts for the difference in the habit of the three forms in a great measure by the climate of the three localities: the most sparse, weeping, long-leaved cedar is from the most humid region, the Himalaya; whilst *atlantica*, the form of most rigid habit, corresponds with the climate of the country under the influence of the great Sahara desert. No course remains, then, but to regard all as species, or all as varieties, or *Deodara* and *atlantica* as varieties of one species, and *Libani* as another. The hitherto adopted and only alternative of regarding *Libani* and *atlantica* as varieties of one species and *Deodara* as another species must be given up.

Ravenscroft, in *Pinetum Britannicum*, gives a very full account of the cedars of Lebanon from various sources, with four good illustrations from photographs taken by F. M. Good of Winchfield, and there are many points in his account worth referring to.

Mr. Ridgway of Fairlawn, who visited them in 1862, says¹ that there is a young tree 50 yards west of the chapel, of exactly the same form and habit as a deodar in his park near Tonbridge. It has the same graceful drooping habit, the same light silvery green, and none of the usual rigid horizontal form of the cedar. He says the remainder of the race of trees vary from 20 to 25 feet in girth; some are as tall and straight as poplars, some not above 20 feet high, and gnarled and stunted. Ravenscroft gives in a table the facts relating to the number of trees found in the accounts of various authors who have written on the Cedars of Lebanon, commencing with Belon in 1550 and ending with Canon Tristram in 1864. Of the older ones there were 28 in Belon's time, which are now reduced to about half that number. There is a gap of some centuries—Ravenscroft says probably more than 1000 years—between the cedars of the second size and the older ones, and again a very long interval of growth between all the young trees, which are now about 400. I do not find any reliable information, taken from an actual count of the number of rings in any of the old Cedars of Lebanon, as to what their possible age may be. Ravenscroft has gone very carefully into the question of the age of the Cedars of Lebanon, which, he says, may be from 4000 to 5000 years old; and he further gives a table based on 200 measurements of cedars of all ages in England, which shows that the average growth in height in England is about 1 foot per annum for trees up to sixty years

¹ *Gard. Chron.* 1862, p. 572.

old, and from 6 to 9 inches in trees of 100 to 200 years. He gives the average breadth of the annual rings per annum in trees of from twenty to fifty years as from $3\frac{1}{2}$ to $9\frac{1}{4}$ lines, and in trees from 60 to 200 years as $3\frac{1}{4}$ lines.

In *Gardeners' Chronicle*, xii. 204 (1879), S. R. Oliver writes:—"And now about the cedars themselves. The guardian told us that there are exactly 385 trees, large and small, but the smallest must be at least from 50 to 80 years old, and no younger trees are springing up—a fact to which it would be well to draw the attention of the public. At this time of year (28th September) innumerable seeds, which are scattered everywhere beneath the trees from the fallen and expanded cones, are germinating, scattered by the wind; these germinating seeds extend far beyond the actual area covered by the remaining trees; and if it were not that they are trodden under foot, or, what is still more destructive, eaten up by the goats, a few decades of years would soon see a fair sprinkling of healthy young cedars enlarging the borders of the grove. In 100 years the grove would be increased into a wood, and five centuries hence the wood would have become a forest. At present, for want of proper protection against the goats and thoughtless tourists, the present grove is dwindling away, and another generation will exclaim against our supineness in thus allowing a relic of the past to die out prematurely. For a small sum of money a stone wall might be built, enclosing the area of the cedar grove sufficiently well against goats. Future travellers ought to be warned by the guardian to confine their steps to certain paths, so as not to injure the young trees; and stringent precautions should be taken against the disfigurement of the trees now existent, by the cutting of names, tearing down of branches for the cones, etc. It would be easy to build such a wall so as not to be an eyesore or disfigurement, by taking advantage of the sinuosities of the numerous small valleys which permeate the vicinity. I am sure that many travellers would contribute small donations should a subscription list be opened for such a purpose.¹ As the property of the cedars belongs to the Patriarch of the Maronites, by name Butross Massaad, who resides by the Dog river, not far from Beyrout, it would be necessary to obtain his co-operation, and I hope, through the aid of the Consul-General for Syria, to have an interview with him on the subject before I leave the neighbourhood. Most of the single trees of antique growth average 20 to 30 feet in girth at about 6 feet from the ground, but the enormous fathers of the forest are in reality a congeries of two, three, or even more trees which have grown so closely together as to coalesce and actually form a single trunk. Among the younger specimens twin and triplet trees are rather the rule than the exception, and this will explain such a girth as Dr. Wartabet measured round the largest tree on the slope north of the Maronite chapel overlooking the ravine, viz. 48 feet. This tree is by no means one of the oldest, but is at its full growth of maturity, and in vigorous health. The hoar, gaunt, and withered trunks of greatest antiquity are around the usual camping ground at the S.E. corner of the group."

Dr. A. E. Day wrote to me as follows on their actual condition more recently, in a letter dated Beirut, Syria, 9th November 1903:—

¹ Rustem Pasha informed Sir W. Thiselton Dyer that he had built a wall to protect the young cedars from grazing, but at a later period this was broken down.

"To the best of my knowledge there are five groves of cedars in Lebanon. The best known one, and that containing the oldest trees, is one in northern Lebanon above Bsharri. [Plate 127, from a photograph by Dr. Van Dyck, shews one of these trees.] The condition of that has, I think, not changed much in thirty years. I am sure that no new trees have grown up in it. A few of the oldest ones have lost branches, or have entirely perished. The grove is a favourite resort in summer for Syrians and for foreigners. A few hours south and west of Bsharri is the village of Hadeth-el-Jubbeh, or Hadeth, as it is often called, though there are a number of Hadeths in Lebanon. Within a half-hour to the south of Hadeth is a fine grove of young trees which, I think I have been informed, was started and has been preserved by a Greek or Maronite bishop. The remaining three groves are near each other, on the western slope of the main ridge of Lebanon, the most northern one being a few miles south of the Beirut-Damascus road as it crosses the ridge. The most northern of the three is above the village of Ain-Zahalta, the next is above Bârûk, and the third is above Maâsir, each being known by the name of the village near it, being also the property of that village. The smallest grove, but that containing the oldest trees, is that of Maâsir. The Bârûk grove is the most extensive of all the five in Lebanon, and contains many young trees in all stages of growth. Most of the trees are upon a very steep slope, but in the upper part of the grove there are various knolls and hollows, affording a few charming spots for camping. I am sorry to say that this fine grove suffers much from being cut. The people of Bârûk obtain from it roof-beams and wood for fuel, and I am informed that they are discussing selling a large part of it to be felled for pitch. I have failed to find a single large tree in the Bârûk grove which has not been cut off, with the result that several branches have taken the place of the principal stem. The ordinary Arabic name of the cedar is 'Arz,' but the natives of the villages near the three southern groves call the tree 'Ubhul.'"

The cedar is also found in the Taurus and Anti-Taurus ranges in Asia Minor, extending from the province of Caria¹ in the west to near the frontier of Armenia in the east. It forms a considerable part of the coniferous forest, which, in a few scattered localities, covers the mountains between 4000 and 7000 feet. It is usually associated with *Abies cilicica*, *Juniperus excelsa*, and *J. foetidissima*; and is occasionally mixed with *Pinus Laricio*. In Lycia, dense woods of cedar were observed by Luschan² in the Baba Dagh and between Zumeru and the Bulanik Dagh. The tree, however, appears to attain its maximum development in the Cilician Taurus, where there are fine forests of great extent in the Bulgar Dagh, which have been visited by Tchihatcheff,³ Kotschy,⁴ and W. Siehe.⁵ The latter states that the climate in which the cedar grows is a severe one, the snow lying several feet deep on the ground for about five months of the year. He describes

¹ Collected in Caria by Pinard, according to Boissier, *Flora Orientalis*, v. 699 (1881). Dr. Stapf informs us that Luschan also saw the cedar in this province.

² Cf. Stapf, *Beiträge Flora Lycien, Carien, u. Mesopotamien*, 2 (1885).

³ *Asie Mineure*, ii. 496 (1860).

⁴ *Reise Cilicischen Taurus*, 58, 370 (1858).

⁵ *Gartenflora*, 1897, pp. 182, 206. Siehe has sent seed from the Cilician Taurus to various places, and I have two vigorous young trees raised from them.

the forest as an open one, the trees standing isolated and attaining about 130 feet in height and 10 feet in girth, and none of a larger size were noticed. Haussknecht found the cedar in the Berytdagh in Cataonia; Heldreich collected it in the Davros Dagh in Pisidia; and two or three other localities, where the tree is apparently neither abundant nor remarkable for size, are mentioned by Boissier.

I saw the cedar in the Ak Dagh, on the road between Makri and Cassaba, in 1874, where the trees were growing in open woods at about 5000 to 6000 feet elevation, and were not anything like as large as those in the Lebanon.

INTRODUCTION

We have no certain evidence as to the earliest introduction of the cedar into England; but Loudon, p. 2412, considers that Evelyn was most probably the introducer of the tree, as he states in the third edition of the *Sylva* (p. 125), published in 1679, that he had received seeds from Mount Libanus.

It has been supposed that Dr. Uvedale got the seeds which were planted by him at Enfield between 1665 and 1670 from Evelyn, who, however, does not mention this in the second edition of the *Sylva*, published in 1670; and until this tree is dead or cut down we shall not know its age for certain.¹

The oldest specimen² of cedar in the British Museum is in a volume of *Herb. Sloane*, ix. fol. 90, the title-page of which bears the following inscription:—"Plants gathered about London about the year 1682 for my own (*i.e.* Sir Hans Sloane's) collection."

Sir Stephen Fox was credited by his descendant, Lord Holland, with having introduced and planted the cedar at Farley, near Salisbury (cf. Loudon, p. 2413), which was cut down in 1813, when it weighed over 13 tons. Quenby Hall, Leicestershire, is also mentioned as having the oldest cedar in England, but this rests on family tradition only, and the tree at Quenby in 1837 was only 47½ feet by 7 feet 9 inches in girth.

In *Country Life*, May 2, 1903, the late Mr. C. J. Cornish gives an account of a cedar at Childrey Rectory, near Wantage, which, "according to unbroken tradition," was planted by Dr. Edward Pocock, who was chaplain to the Turkey Company at Aleppo in 1629, and afterwards chaplain to the Embassy at Constantinople. He returned home in 1641 and was appointed to the living of Childrey in 1642. In 1903 it was still growing vigorously and increasing rapidly in size, and measured 25 feet in girth at five feet from the ground, and covered an area of about 1600 square yards. Though it has suffered much from the loss of branches broken by the weight of snow about twenty years ago it now presents a very handsome appearance as shown by the photograph which is given on p. 567 of *Country Life*, No. 330.

Lord Savile informs me that a cedar, which he remembers as being the tallest that he ever saw, grew at Rufford Abbey. This is believed to have been planted

¹ Boulger, in his biographical sketch of Uvedale in *Journ. Bot.* xxix. 13 (1891), gives some details of the Enfield cedar, but has not been able to verify the statement that it dates from 1670. The Enfield cedar is figured in *Gard. Chron.* xxxii. 31, f. 12 (1902). Cf. also *Gard. Chron.* viii. 505 (1890).

² The statement in *Gard. Chron.* ii. 194 (1887), that there is mention in Belon's works, which were published in 1553 and 1558, that the cedar of Lebanon existed in France before 1558 is erroneous; and it is probable that the tree was not introduced into France till 1734. Cf. Loudon, p. 2414.

by Charles II., who used to visit and stay at Rufford, where his rooms are now known as "the King's rooms." Its stump is now surrounded by iron railings and labelled "Cedrus Libani, planted by King Charles II."

Loudon considered that the cedars at Chelsea¹ mentioned by Sir Hans Sloane in 1685 as then existing (*Ray's Letters*, p. 176), but now dead, and those at Chiswick House, which are still flourishing, were the oldest in England. But I am informed by Mr. Challis, gardener to the Earl of Pembroke at Wilton House, that "in the year 1874 a very large cedar was cut down there, whose stem up to about 18 feet from the ground was nearly uniform in size, and then divided into twelve distinct branches, each nearly equal in size to a good-sized tree, some of them extending horizontally 70 feet from the trunk. The circumference of the bole five feet from the ground was 36 feet, a transverse section measured when down 11 feet 9 inches, and the number of concentric rings, after several careful counts, some of the rings being somewhat indistinct, was 236. A section of this stem was sent to the South Kensington Museum."

If this is correct, and it seems to me that the exact statement of so experienced a gardener as Mr. Challis cannot be questioned, the tree must have been introduced in 1638, before Evelyn's time, and was not only the oldest but also the largest cedar on record in England. I have taken great pains to verify this statement by seeing the section mentioned; but though careful search has been made in the Records of the British Museum (Natural History), as well as at the Victoria and Albert Museum at South Kensington, and in the letter books of the Royal Horticultural Society, this wonderful specimen cannot now be traced or discovered.

CULTIVATION

The seeds of the cedar, whether imported or home grown, should be sown under glass in the spring; for though they will germinate in the open air, their growth is so slow for the first three or four years that much time and loss will be saved by protecting them with a frame. If sown in pots they should be planted out in a frame at a year old, as the roots soon become cramped and pot-bound, and the young plants do not make good roots for some time if they have once been so checked. At two or three years old they may be planted in rich soil about the beginning of May when the buds are starting, and will require some years more in the nursery before finally planting them out.

The Lebanon cedar requires a warm, deep, well-drained soil to bring it to perfection, and does not grow so well in the colder and moister parts of England. When once established it will endure our most severe winters without much injury, though it often suffers from heavy snowstorms, which break the branches. The seedlings vary considerably in habit, in vigour, and in colour, and as they do not bear pruning well when the branches become large, it is best to cut off the lower ones when quite small, so as to encourage an upright growth.

¹ The last of the cedars in the Physic Garden at Chelsea, which had been dead for some years, was removed in 1904. In 1882 it was 60 feet high and 13 feet 9 inches in girth at 3 feet from the ground. *Gard. Chron.* xxxv. pp. 185, 224 (1904). Cf. also *ibid.* xxvi. 336, f. 70 (1886), where a figure of the tree is given.

As most people prefer the spreading forms of cedar for lawns or parks, the Lebanon cedar is probably the best for such places; but when surrounded by other trees it may be drawn up to a great height with few side branches, though I should prefer the Algerian cedar for planting in such situations.

Generally it may be said that the Lebanon cedar is the best for the hotter and drier parts of England, and the deodar for the moister and milder districts. The Algerian cedar seems to be hardier, and according to Sargent this is also the case in the United States; but none of the cedars succeed in New England, though near Philadelphia, Washington, and at Biltmore, North Carolina, there are fine specimens of the Algerian form.

The transplantation of large cedars is rarely desirable, but has been sometimes effected with success. A case is recorded¹ in which a cedar at Southsea 30 feet high, with a spread of 36 feet, was transplanted at a cost of about £100.

Mr. J. W. Odell, gardener at the Grove, Stanmore, in a communication to the Royal Horticultural Society on 14th February 1899, states that during a recent gale a large branch was broken off a cedar there, which showed that a great mass of adventitious roots had started from the seat of a previous injury and grown downwards towards the base of the tree, between the splintered portions of the wood. I observed a precisely similar occurrence in a cedar which was partly blown down at Stoke Hall, Notts, in October 1903. The roots were bright reddish-brown in colour, and the thicker ones, an inch in diameter, were covered with rough pustules. Some of these were sent to the Museum at Kew.

REMARKABLE TREES

Among the existing trees in England it is difficult to say which is the finest. If height and girth combined are taken there is none to equal the splendid tree at Pains Hill, near Cobham, now the property of C. Combe, Esq., of Cobham Park. An account of this place, published in *Country Life* for March 19, 1904, states that these cedars were probably planted between 1750 and 1760 by the Hon. Charles Hamilton. In 1781 Sir Joseph Banks visited Pains Hill with the younger Linnæus, who said that he saw there a greater variety of fir trees than he had seen anywhere else. Curiously enough, Loudon, though he often mentions Pains Hill, gives no measurements, and neither Strutt, Lambert, nor Lawson alludes to the cedars there; but when I saw them in 1904 I measured the largest (Plate 128) to be from 115 to 120 feet high by 26 feet 5 inches in girth. It grows on sandy soil near the lake and divides into several tall, straight stems, which form a spreading crown, and seems to be in perfect health.

The next finest of this type that I have seen is perhaps a tree standing in Goodwood Park, near the kitchen garden, which, when I measured it in 1906, was about 95 feet high, though its flat top makes the exact height difficult to ascertain, and 26½ feet in girth, the branches spreading over an area of 133 paces in circumference (Plate 129). Goodwood² is perhaps more celebrated for its cedars than any other

¹ *Gard. Chron.* xxv. 42 (1899).

² Cf. *Gard. Chron.* xxvii. 124 (1900), where the finest cedar at Goodwood was reported to be 29½ feet in girth in 1900.

place in England, as in 1761 many hundreds were planted by Peter Collinson for the Duke of Richmond. Loudon, on page 2414, quotes a MS. memorandum of Collinson's as follows:—"I paid John Clark, a butcher of Barnes, who was very successful in raising cedars, for 1000 plants of Cedar of Lebanon, 8th June 1761, £79:6s., on behalf of the Duke of Richmond. These 1000 cedars were planted at five years old, in my sixty-seventh year, in March and April 1761; in September 1761 I was at Goodwood and saw these cedars in a thriving state. This day, 20th October 1762, I paid Mr. Clark for another large portion of cedars for the Duke of Richmond. The duke's father was a great planter, but the young duke much exceeds him, for he intends to clothe all the naked hills above him with evergreen woods." Of the cedars at Goodwood, Loudon goes on to say that 139 remained in 1837. According to Kent (*op. cit.* 419, note *), eleven fine cedars were uprooted in Goodwood Park by the fierce gale of 3rd March 1897.

There are some splendid cedars at Wilton of which Lambert¹ writes as follows:—"I am indebted to the Hon. and Rev. W. Herbert (author of the celebrated work on *Amaryllidaceæ*) for the following interesting particulars respecting the cedars at Highclere, the seat of the Earl of Carnarvon: 'The two oldest cedars at Highclere were raised in 1739 from a cone brought from Lebanon by Dr. Pococke² in 1738. They were stunted plants for some time, and removed to their present situation in 1767. The largest of the two measured, in 1829, 9 feet in circumference, having grown only an inch in the last two years, the chalk being unfavourable to its growth. The largest cedar at Highclere, though much younger, measured in 1830, at three feet from the ground, 10 feet 1 inch in circumference; it was reared from a cone, which came from the Wilton cedars in 1772, and was about 48 years old before it bore. It was known to the late Earl of Carnarvon that the cedars at Wilton were kept by his grandmother, the Countess of Pembroke, in pots at her window, till growing too large, they were planted upon the lawn, between the house and the water, a situation very favourable to their growth. Supposing them to have been 48 years old, when the cone was gathered from them in 1772, they must have been raised as early as 1724. It is most probable they were between 1710 and 1720; for the Countess of Pembroke who cultivated them died before her husband, who married again after her death, and died in 1733. The oldest cedars at Highclere are, therefore, now (in 1831) 92 years old; those at Wilton at least 106, probably between 110 and 120. Dr. Pococke found the circumference of the largest cedar with a round or single stem to be 20 feet; but he does not state how near the ground he measured it.'" I saw these trees in 1903 and measured them carefully; the best was then about 108 feet high and 21 in girth, with a spread of 109 feet. This tree has lost a large limb, the hollow caused by which has been carefully filled with cement.

At Strathfieldsaye there are also some splendid cedars, a group of which on strongish clay soil have the same upright, small-branched character as the Windsor trees. The best of these is 110 feet high by 11 feet 9 inches in girth, with a clean

¹ *Genus Pinus*, ii. 91 (1832).

² This is not confirmed by Mr. Challis's statement on p. 459; and probably all the Wilton cedars were not of the same age. Dr. Richard Pococke travelled in the East during 1737 to 1742.

bole of about 40 feet (Plate 130). When mentioned by Loudon it was considered the tallest in England, being then 108 feet high by 9 feet in girth. At Combe Bank, near Sevenoaks, there is a magnificent cedar, which Henry in 1904 measured about 105 feet high with a girth of 20 feet. There are no really large cedars at Syon, Kew, or Woburn. There is a magnificent tree at Blenheim, 28 feet in girth, but of no great height, and having the spreading habit which we usually see in this tree in England (Plate 132).

Probably the tallest cedar in England is one in the pleasure grounds of Petworth Park, which I measured carefully in 1905, and could not make it less than about 125 feet high by 14½ feet in girth. It is remarkable for having a trunk clear of branches for no less than 56 feet, where a small limb comes off, but, with this exception, it is clean up to about 80 feet. Probably this habit is due to its growing in a sheltered position, more or less shut in by other trees, on a deep bed of sandy loam. Owing to its position this tree is very difficult to photograph (Plate 131).

The next finest tree of this type which I have seen is one in the Belvedere Plantation at Windsor. This, according to Menzies, who says that the ground is marked in a map of 1750 as open, cannot be more than 150 years old; and it is at least 115 feet high with a girth of 16 feet. It is without any large branch until it reaches a height of 60 feet or more, and carries nearly the same girth to this elevation; so that a plank 60 feet long and 3 or 4 feet wide at the top end could probably be cut from it. Menzies figures this tree¹ and gives the dimensions in 1864 as only 75 feet by 12 feet 10 inches, which was probably less than its actual size at that time. There are several other fine trees in the same drive, but none equal to this; and a young one close by, which was planted by Mr. Simmonds, Deputy Surveyor of Windsor Forest, about thirty-five years ago, is now about 40 feet high, and has the same straight-growing upright habit which cedars seem to develop best on deep sandy soil.

In Hertfordshire there are many fine cedars, of which the most notable are growing on a lawn at Bayfordbury.² Mr. Clinton Baker tells me that they were raised from seeds of the Enfield Cedar, and planted in 1765. They have been measured at various intervals by his grandfather, father, and himself, as follows:—

	No. 1 at 3 ft.		No. 1 at 5 ft.		No. 3 at 3 ft. ²		No. 3 at 5 ft.		No. 7 at 1 ft.	
	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.
1822 . . .	10	0	10	5	10	10	10	8	14	5
1837 . . .	12	2	...	...	...	...	13	0	17	6
1865 . . .	15	0	16	0	15	11	16	5	22	1
1880 . . .	16	0	17	3	17	3	18	0	...	...
1895 . . .	16	7	...	...	18	9	...	...	26	0
1900 . . .	16	9	18	0	19	5	19	5	27	1
1904 . . .	17	0	18	2	19	5	19	9	27	3

At Langleybury, Herts, a large cedar³ was growing in the grounds of

¹ *History of Windsor Great Park and Windsor Forest*, Plate 14.

² Figured in *Gard. Chron.* xxvi. 521, f. 102, and 553, f. 109 (1886).

³ *Gard. Chron.* xiv. 392 (1880).

E. H. Loyd, Esq., in 1880, which at 4 feet from the ground measured 22 feet 4 inches in girth, with a height of 107 feet. At Chart Park, Deepdene, Surrey, a tree 95 feet high is 19 feet 3 inches in girth, and divides at 12 feet up into ten upright stems.

At Chorleywood Cedars, near Rickmansworth, there are seven very fine cedars, standing on high ground, which form a landmark in the country, and are said to measure about 23 feet in girth. Another at the same place was recently struck by lightning, and cut down.

At Beechwood, near Dunstable, the seat of Sir Edgar Sebright, Bt., there are some very fine old cedars, of which the largest, as I am informed by Miss F. Woolward, measures 100 feet by 28 feet 4 inches, with a spread of branches 46 feet across. Another, 90 feet by 23 feet, has branches from 50 to 60 feet long.

At Chiswick House there are a number of very fine cedars still surviving, though not so many as when the late Mr. Barron, Superintendent of the Royal Horticultural Society's Gardens, measured them in 1882. The two largest trees at that time were 16 feet and 18 feet in girth, and when I saw them in 1904 the two largest were 16 feet 5 inches and 18 feet 5 inches. These are supposed to have been planted about 1720, but are nothing like so fine as many trees at a greater distance from London.

One of the most remarkable cedars in England, on account of its habit, stands in what was probably a dense grove of tall silver firs near the site of the old house at Stratton Strawless, the home of Robert Marsham, who planted it when 1½ feet high, in 1747. When described by Grigor¹ in 1841 its stem was 44 feet high, free from branches, and 12 feet 2 inches in girth at 6 feet. His plate shows that it has changed but little now. When Mr. Birkbeck showed it to me in April 1907 it was about 80 feet high and 16½ feet in girth, and though some branches in the crown had been broken off, it looks remarkably vigorous (Plate 133).

A fine tree of the same type, but not equal to the last mentioned, is in a sheltered part of the grounds at Gosfield Hall, Essex, the property of Mrs. Lowe. It is 80 to 90 feet high, by 14½ feet in girth, with a clean stem up to about 60 feet, and a flat, spreading crown of branches at the top.

A cedar which is growing at Birchanger Place, near Bishop-Stortford, for a photograph of which I am indebted to the owner, T. Harrison, Esq. (Plate 134), is strikingly different in habit, and of its type is one of the most beautiful and perfectly shaped in England. It is about 60 feet high and 17 feet in girth, the branches covering an area at least 100 yards in circumference. Another tree of the same type, but not so symmetrical, grows at Billing Hall, the seat of Valentine Cary Elwes, Esq., near Northampton, and measures about 60 feet by 19 feet 5 inches. The branches, which spread over an area about 100 paces round, are supported by a great number of wooden props.

In the west of England this tree does not attain the same size and beauty as in the drier counties, the largest I have seen in Devonshire being at Bicton, which is about 21½ feet in girth. At Castlehill, in the same county, there is a tree about 80 feet by 14 feet 9 inches; and at Sherborne Castle, in Dorsetshire, there are a

¹ *Eastern Arboretum*, p. 84, plate opposite p. 104 (1841).

number of fine trees, the largest of which I found to be about 105 feet by 16½ feet, dividing at about 15 feet up into five or six tall, straight stems.

In Wales I have seen none remarkable for size except a tree at Maesleugh Castle which is about 100 feet by 16½ feet, with a clean stem about 20 feet high.

In Lincolnshire and Yorkshire, even where the soil is good, the cedar does not attain the same dimensions as in the south of England, but it ripens seed at least as far north as Syston Park, where there are some trees near the house in an exposed position at an elevation of about 500 feet above sea-level, which show remarkable variation in colour. When I saw them on 16th June one was only just opening its buds, and looked quite black in comparison with others whose new leaves were well out and of a very glaucous colour. This colour is reproduced by their seeds, for two young trees raised from them, which were kindly given me by Sir John Thorold, are so glaucous that every one who has seen them in my nursery has mistaken them for *C. atlantica glauca*, while two seedlings of *C. atlantica* from Cooper's Hill are not distinguishable from *C. Libani*.

In Cumberland there are two splendid cedars at Eden Hall, the seat of Sir R. Musgrave, Bart., which, according to a paper¹ by Mr. Clark of Carlisle, were supposed to be 270 years old, and one of them measured 86 feet by 22½ feet, the other 86 feet by 21 feet, with a spread of 101 feet in diameter. At Alnwick Castle, Northumberland, there is a tree in the wood near the Duchess bridge, measuring 69 feet by 7 feet 3 inches.

The finest avenue of cedars I know in England is that at Dropmore, of which I give an illustration taken from a photograph made in 1903 (Plate 135). This avenue is said² to be composed of Lebanon cedars planted probably about 1844, and if really so young as this, is a very remarkable instance of the rapid growth of the cedar in this country. There is, however, some doubt as to whether they are Cedars of Lebanon or Algerian cedars, and though I have made inquiries from Mr. Fortescue I cannot ascertain with certainty their origin.

The best account I know of the Cedar of Lebanon in Scotland is given in the *Transactions of the Horticultural Society*, vi. 429, in 1826, by Mr. J. Smith, then gardener to the Earl of Hopetoun, and as this shows the rate of growth of the cedar to be, even in that latitude, greater than that of any other tree, I quote it as follows:—

“The extensive pleasure grounds at this place were laid out about the year 1740, and in that and the subsequent years a great variety of curious ornamental trees was planted, which are now of considerable size, and in great beauty and perfection: among these are three cedars, which were planted in the year 1748. The two largest are growing in a favourable deep soil, which although not wet inclines to be moist; the third is on a gravelly soil, beside a rill of water. Their situation is well sheltered, and about 100 feet above the level of the sea. In the year 1797 the third tree was the largest, and Dr. Walker,³ who noted its size at that date, ascribes its superiority to the wetness of its situation. He has

¹ *Trans. Eng. Arb. Soc.* 1887, p. 135.

² *Gard. Chron.* xxv. 138, fig. 52 (1899).

³ *Essays on Natural History*, 69 (1808).

stated that it was 5 feet and 1 inch in circumference, but omitted to mention at what height from the ground this measurement was taken. In 1801 the dimensions of these trees, as well as of other kinds planted at the same period, were taken; the observations were repeated in 1820, and I am now enabled to add the present size of those which had been before noticed, as well as some others of different kinds but of the same age, which were not before attended to. The circumference of the trunks is taken in all cases at three feet above the ground, and it will be seen by comparing the different measures how much the cedars have exceeded all the other trees:—

	1801.		1820.		1825.	
	Ft.	In.	Ft.	In.	Ft.	In.
First cedar	10	0	13	1½	14	0
Second cedar	8	6	10	9½	11	4
Third cedar	7	10	9	9½	10	8
Sweet chestnut	10	1	11	7	12	0
Beech	9	4	9	11	10	3
Sycamore	8	11	9	7½	9	11”

I visited Hopetoun, the seat of the Marquess of Linlithgow, in April 1904, and found that two of these cedars still survive in good condition, the larger being about 80 feet high and 23 feet 8 inches in girth, the other about 88 feet by 13 feet.

There is a fine cedar at Biel, East Lothian, the seat of Mrs. N. Hamilton Ogilvy, which is said to have been planted in 1707 by Lord Belhaven, to commemorate the Union of England and Scotland. According to Mr. S. Ross¹ it was, in 1883, 75 feet high by 17½ feet in girth; but I am informed by Mr. T. Muir that it is now 85 feet high by 19 feet 9 inches at 1½ feet from the ground, with a spread of 101 feet.

At Moncreiffe House near Perth, the seat of Sir R. Moncreiffe, there is a well-shaped tree, which Hunter² mentioned as bearing many cones and measuring 66 feet by 11 feet. In 1907, when I saw it, it was about 80 feet by 14½ feet at 3 feet from the ground. At Dupplin Castle, the seat of the Earl of Kinnoull, there are two cedars of which the best shaped measures 86 feet by 16 feet 10 inches, and the other is 18 feet 8 inches in girth at 3 feet. At Murthly there are two good trees, which, though probably not much over seventy years old, measure 74 feet by 9 feet 3 inches and 70 feet by 10 feet 6 inches respectively.

The best I have heard of in the west of Scotland are one at Mount Stuart in Bute, which Mr. Renwick tells me is 64 feet by 8 feet 3 inches, and another at Erskine House, near Renfrew, which is 62 feet by 10 feet at 1½ feet from the ground.

In the N.E. of Scotland it also grows well; there are two very fine trees at Beaufort Castle. According to the measurements given me by Mr. G. Brown the largest of these is 73 feet by 22 feet 8 inches at 3 feet from the ground, dividing at five feet into four large stems, which measure from 9 to 11 feet in girth. The other is the same height and 16 feet in girth. At Brahan Castle there are also some fine cedars.

¹ *Woods and Forests*, Dec. 26, 1883, p. 59.

² *Woods, Forests, and Estates of Perthshire*, p. 135 (1883).

In Ireland the Lebanon cedar has been rarely planted in comparison with its frequency in England; and Henry has not seen any large trees except one at Carton, which in 1903 was 93 feet by 14 feet 9 inches, and is said to have been the first planted in Ireland; and six fine trees¹ at Anneville near Dundrum, Co. Dublin, the largest of which was 14½ feet in girth in 1904.

There is an excellent article on cedars by Dr. Masters in the *Gardeners' Chronicle* for Oct. 17, 1903, giving an illustration of the historic tree in the Jardin des Plantes at Paris, about which many incorrect statements have been published. Carrière² gives 1736 as the date at which it was planted, from seed brought from England by Bernard de Jussieu in 1735. From this seed was also derived the cedar at Montigny (Seine et Oise), and the one at Beaulieu, near Geneva. Carrière states that the cedars at Geneva produce seeds so freely that but for the scythe of the mower it would form forests on the shores of the Lake. In a letter from M. Maurice de Vilmorin I learn that the Montigny cedar³ is now probably the best in France. About 1855 it was 7 metres in girth at two metres from the ground, and it is now 7.90 metres at the same height. There is another tree at Vrigny, the residence of M. Duhamel de Monceau, near Pithiviers, Loiret. His notes of 1874 state that this tree, planted in 1744, had suffered much from the frost of 1870-71, when two-thirds of its branches were frozen. It measured about 8 metres in girth.

I saw a very fine cedar in the grounds of M. Philippe de Vilmorin at Verrières, near Paris, in May 1905, which measured 87 feet by 13 feet; and also visited the tree in the grounds of Madame Chauvet at Beaulieu, near Geneva, which is now considered to be the finest on the Continent, though not equal to several English trees. It is a well-shaped spreading tree about 100 feet high, though difficult to measure exactly, and 16 feet in girth, with a spread of 102 feet.

TIMBER

What is called cedar in commerce is usually the wood of *Cedrela odorata*, a tree found in the West Indies and Central America. The wood of the so-called pencil cedar, *Juniperus virginiana*, is also often known as cedar,⁴ and this can be distinguished at once by its colour and smell from the true cedar. A case was recently tried in London with regard to the quality of the cedar used in panelling a room at Packington Hall, in which it was stated in evidence by a so-called expert that there were three kinds of cedar known in the trade, "English grown, pencil cedar, and Californian cedar," "the latter used for inferior work." This is a not unusual instance of the gross ignorance which prevails in England among users of timbers as to their names and native countries, and this ignorance has led to many costly lawsuits. The Lebanon cedar grows so fast in England under favourable circumstances that the wood is of a much softer character than it is in Syria, but it may be used for

¹ These are said by Loudon, *Arb. et Frut. Brit.* i. 114 (1838), to have been brought direct from the Lebanon by an ancestor of Lord Tremblestown, and to be the oldest in Ireland.

² *Traité Conif.* 78 (1867).

³ An account of it in *Revue Horticole*, 1907, p. 465, gives the dimensions as 105 feet high by 24 feet in girth at one metre from the ground.

⁴ In the Eastern States it is known as red cedar, but this term is applied to *Thuja plicata* in the Pacific States.

many purposes of internal decoration; and the best instance of such use that I know is at Broom House, Fulham, the residence of Miss Sullivan. This lady, having a cedar blown down on her lawn, had it cut into boards, of which there were sufficient to floor and panel the whole of a good-sized drawing-room. When the wood is carefully selected, its pale pink colour and handsome figure make it very ornamental. Its value in commerce is, however, low, because neither the supply nor the demand is regular; and the cost of removing and sawing up large cedar trees is so great, that I was offered a tree containing over 300 cubic feet for nothing if I could get it away; and the Earl of Powis told me that some large trees which were blown down at Walcot were unsaleable, and were eventually used as a cheap material for the kennels of the United Foxhounds. (H. J. E.)

CEDRUS BREVIFOLIA, CYPRUS CEDAR

Cedrus brevifolia.

Cedrus Libani, Barrelier, var. *brevifolia*, Hooker, *Journ. Linn. Soc. (Bot.)*, xvii. 517 (1879); Beissner, *Nadelholzkunde*, 300, fig. 75¹ (1891).

Resembling *C. Libani* in characters of leading shoot and branchlets, but with very short leaves, not exceeding ½ inch in length. Cones smaller than those of *C. atlantica*, which they resemble in other respects.

The cedar was discovered in the mountains of Cyprus in 1879 by Sir Samuel Baker, whose specimens were described in the same year as *Cedrus Libani*, var. *brevifolia*, by Sir J. D. Hooker, who considered this form to agree more closely with the Algerian than the other cedars, resembling it in the small size of the cones and in the general characters of the foliage.

The best account² of this cedar forest is by Sir Robert Biddulph, who wrote as follows in 1884 to the Director of Kew:—

"The cedar forest occupies a ridge on the principal watershed of the southern range, and about 15 miles west of Mount Troodos. The length of the forest is about 3 miles, its breadth very much less. A few outlying cedar trees were visible on neighbouring hills, but on the ridge they were quite thick, and probably many thousands in number. I took the height above the sea by an aneroid barometer, and found it to be 4300 feet. The trees are very handsome and in good condition, but comparatively young. The smallest seemed to be from ten to fifteen years old; the largest, I am told by the principal forest officer, are probably not over sixty or seventy years. The worst feature is that there were no seedlings or young trees under ten years; and indeed this is the same with regard to the pine forests. It would seem as if the great influx of goats has been comparatively recent. I made a tour through the heart of the forest last August. I started from a point on the west coast, and from thence ascended to the main watershed, and kept along the top till I reached Mount Troodos, taking three days to do it. The country through which we passed on the first day was perfectly uninhabited, and a mass of hills and forest, chiefly *Pinus hale-*

¹ Beissner's figure represents a ripe cone, collected on Mt. Troodos by Herr v. St. Paul.

² Published in *Nature*, xxix. 597 (1884). Cf. also *Proc. R. Geog. Soc.* xi. 709 (1889).

pensis and the Ilex. The trees were in very great number, but there was a scarcity of young trees, and most of the old ones had been tapped for resin. On the second day we passed through the cedar forest, and the same sort of country as before, the *Pinus Laricio* beginning at an altitude of 4000 feet. We got as far as the monastery of Kykou that day, and the next day I continued along the watershed to the camp at Troodos. Our road as far as Kykou was a mere track on the side of the hill, in some parts rather dangerous, and we had to lead our ponies on foot, in many parts very steep. The difficulty on the road is the want of water at that elevation. We halted the first night at a beautiful spring, but we had to carry with us food for man and beast for the whole party, muleteers, etc. The scenery was wild and romantic. This spot is the centre of the *moufflon* ground; three of them were at the spring when we approached it. It gave me a clearer idea of the forests of Cyprus than I ever had before."

Madon, who wrote for the Government in 1881 a report¹ on the forests of Cyprus, states that none of the trees were then apparently over eighty years old; but that all were in a vigorous state of vegetation, with numerous young trees of every age covering the soil. In addition to the main forest, three outlying clumps were seen by Madon,—one on the other side of the Ogotina valley, a group of forty-four very young trees at the Kykou monastery, and a third group much lower down. He considered that the cedars formerly covered the whole of the mountain heights from Machera to Livrami, being limited below by the zone of the olive tree. The timber can be recognised in the houses at Campo and in the carvings of the Kykou monastery, showing that the tree was formerly felled for building purposes. Madon noticed what has been confirmed by other observers, that the foliage varied in tint, most of the trees being glaucous.

Hartmann, who has recently visited Cyprus, reports² that the trees are remarkable for their broad, umbrella-like crowns, and average about 40 feet in height, 6 feet in girth, and 100 years in age. (A. H.)

I am informed by Mr. C. D. Cobham, Acting Chief-Secretary to Government, in a recent letter, that the Cyprian cedars now occupy an area of about 500 acres in the centre of the Papho Forest, of which the summit, Tripylos, is 4640 feet above the sea. The cedars are mixed with pines and Ilex. There are also a few young trees at Kykou Monastery, a few in the vineyards at Chakistra, and one good specimen tree at Pedoullas. This last was purchased by the Government to preserve it from being cut for building material. There are a number of seedlings in the cedar forest, but these do not seem to have been affected by the exclusion of goats, as animals avoid the cedar when they can find other food. The largest tree in the forest is in Argakis Irkas Teratsa, near the Kykou goatfold. It stands about 60 feet high, and measures 11 feet 6 inches in girth at five feet from the ground. A photograph of this tree is so precisely like a Lebanon cedar standing on my own lawn, which I see as I write, that I need not reproduce it. I may add that some cones sent from Cyprus in February 1905 were smaller than the cones from Syria

¹ *Parly. Paper: Encl. 2 in Cyprus, No. 366, of 1881, p. 28.*

² *Mitt. Deut. Dendr. Ges. 1905, p. 181.*

or those grown in England. Though at the time I did not think they were mature, yet the seeds contained in them have germinated and produced young plants, which in July were just putting forth their second whorl of leaves, but by the following May had increased very little in size, being much smaller than those of the same age from Swiss and English seed.

Plants were raised at Kew from seed received in 1881; and two, now growing in the cedar collection at Kew, have attained only 6 feet in height, and are remarkable for their singularly short leaves and stunted bushy appearance. A number of them were killed by the winter, having been planted out when too young, which seems to show that this variety is more tender than the Lebanon tree. (H. J. E.)

CEDRUS ATLANTICA, ATLAS OR ALGERIAN CEDAR

Cedrus atlantica, Manetti,¹ *Cat. Plant. Hort. prope Modiciam, Suppl. Secundum*, 9 (1845); Ravenscroft, *Pinet. Brit.* iii. 217 (1884); Kent, Veitch's *Man. Coniferae*, 409 (1900); Masters, *Gard. Chron.* x. 425, f. 53 (1891).

Cedrus africana, Knight, *Syn. Conif.* 42 (1850).

Cedrus Libani, Mathieu, *Flore Forestière*, 564 (1897).

Pinus atlantica, Endlicher, *Syn. Conif.* 137 (1847).

Pinus Cedrus, Linnæus, var. *atlantica*, Parlatores, DC. *Prod.* xvi. 2, p. 108 (1864).

Abies atlantica, Lindley and Gordon, *Journ. Hort. Soc.* v. 214 (1850).

Young trees stiffer in habit than the Lebanon cedar, and with an erect leader. Branchlets not pendulous, covered with short dense pubescence. Leaves up to an inch (occasionally in cultivated specimens $1\frac{1}{4}$ inch) long, usually as thick as or thicker than broad. Cones shorter and more cylindrical than in *C. Libani*; scales $1\frac{1}{2}$ inches in width, claw inflected.

VARIETIES

Var. *glaucæ*.—In the cedar forests of Algeria a certain proportion of the trees have glaucous foliage, the leaves being marked above with conspicuous white stomatic bands; but there is no other difference, and no foundation exists for the opinion, first mooted by Jamin,² that the glaucous variety constitutes a distinct species.³ The glaucous tint is an essentially unstable character,⁴ trees occurring in the wild state in which glaucous leaves appear only on some of the branches. This variety often arises in cultivation.

Beissner⁵ mentions several varieties, which have been obtained in cultivation, as *pyramidalis*, *columnaris*, and *fastigiata*,⁶ characterised by peculiarities of habit; and a variegated form in which the foliage of the young shoots is yellowish,⁷ but so far

¹ Manetti gives the name only without any description, in the second supplement to his catalogue (1845), and not in the first supplement (1844) as usually stated. Endlicher first described the Atlas cedar from plants 6 inches high, sent in 1847 by Manetti from the Royal Gardens at Monza (Modicia) near Milan.

² Deccaisne, *Rev. Hort.* ii. 41 (1853). Cf. *Gard. Chron.* 1853, p. 132.

³ *Cedrus argentea*, Renon, *Ann. Forest.* iii. 2 (1854).

⁴ Cf. Fliche in Mathieu, *Flore Forestière*, 564, note 2 (1897).

⁵ *Nadelholzkunde*, 304 (1891).

⁶ Var. *fastigiata*, a pyramidal form, with branches ascending like those of the Lombardy Poplar, originated as a seedling in Lalande's nursery at Nantes. Cf. *Gard. Chron.* vii. 197 (1890).

⁷ Var. *aurea*, young foliage of a rich golden colour, which changes to the normal green of the species in the second year. This variety is mentioned by Kent, *loc. cit.*

as we have seen these are not distinguishable as they get older. At Glasnevin there is a remarkable tree about forty years old, of which the stem is erect for about 25 feet, and beyond this bends over almost horizontally, extending laterally outwards for almost 12 feet; and Elwes saw one of very slender and pendulous habit at Angers in France.

DISTRIBUTION

This cedar occurs in Algeria and Morocco. In the latter country its distribution is still scarcely known, though it was in Morocco that the Atlas cedar was first discovered. Philip Barker Webb visited¹ Tangiers and Tetuan in the spring of 1827, and from a native received branches of cedar which had been collected in the impenetrable mountains of the province of El Rif, where there were said to be vast forests. Webb's specimens are preserved in the museum at Florence, where I saw them in December 1906. His discovery was published in an article² by De Candolle in 1837. Dr. Trabut³ states that the tree occurs in the mountains behind Tetuan; and it is supposed⁴ to exist to the south-east of Fez, where the traveller Rohlfs states that he saw larch growing.

In Algeria the cedar⁵ forms a considerable number of isolated forests, none of them of great extent, at altitudes between 4000 and 6900 feet. The tree appears to be indifferent to soil, as it grows both on limestone and on sandstone formations. No meteorological observations have been regularly taken in the cedar forests; but in general, where the tree flourishes, snow lies for several months during winter, the temperature descending to 5° Fahr., and frost prevailing until May. In summer the weather is dry with moderate temperatures.

In the following detailed account I have supplemented my own observations by consulting both the special pamphlet⁶ concerning the cedar, published by order of Governor-General Cambon, and M. Lefebvre's excellent book⁷ on the forests of Algeria.

The chief forests are those in the vicinity of Ouarsenis, Téniet-el-Hâad, and Blida, and in the Djurdjura range in the province of Algiers; and those on Mt. Babor, in the Mâadid mountains south of Sétif, and in the Aurès and Belezma mountains near Batna.

The forest⁸ of Ouarsenis, the most westerly in Algeria, lies in the mountains south of Orléansville. Here the cedar, mostly in mixture with *Quercus Ilex*, only covers an area of 250 acres. The forest near Blida, which is often visited by tourists, as it lies near the railway not far from Algiers, is 1700 acres in extent, and consists of cedars either growing pure or in mixture with the evergreen oak; and it is, generally speaking, in a poor condition. In the Djurdjura range, extending in an interrupted band on both slopes for nearly 40 miles, are the remains of an ancient forest, most of the trees either growing singly or in small groups on rocks and precipices,

¹ Gay, *Bull. Soc. Bot. France*, iii. 39 (1856).

³ *Les Zones Botaniques de l'Algérie*, 7 (1888).

⁵ A fine picture of a forest in Algeria is given in *Garden and Forest*, viii. 335, f. 47 (1895).

⁶ *Les Forêts de Cèdre* (Alger-Mustapha, 1894).

² *Bibliothèque Universelle de Genève*, 1837, pp. 439, 440.

⁴ Lefebvre, *Les Forêts de Cèdre*, 1 (1894).

⁷ *Les Forêts de l'Algérie*, pp. 406-421 (Alger-Mustapha, 1900).

⁸ Hutchison, *Trans. R. Scot. Arb. Soc.* xiii. 211, states, but does not give his authority, that cedars were cut here, the diameter of which was so great, that it was necessary to join two saw-blades, each 6½ feet long, in order to fell the trees.

between 4900 and 6500 feet; but on the Häizer peak M. Britsch saw a few trees on the north slope as high as 7100 feet.

The forest on Mt. Babor is of no great extent, but is an interesting one, consisting of a mixture of cedar, *Quercus Mirbeckii*, and *Abies numidica*, and will be described in our account of the last-named species. The brigadier in charge of this forest informed me that he had measured there a cedar 62 feet in girth. In the mountains of Mâadid there are four distinct forests, generally speaking in bad condition, and yielding scarcely any timber, though in one of them, called Ouled Khellouf, there are said to be some very large trees.

The forests which are the most important from every point of view are those in the west near Téniet-el-Hâad, and those in the east in the vicinity of Batna, visited by me last January.

The cedar occurs around Batna, both on the Aurès range and its spur Belezma. The forest of Sgag is 23 miles distant from Batna and covers 1200 acres. Between Batna and Biskra, about 20 miles north of the latter place, the forest of Djebel Lazereg is 1350 acres in area, and is noted for producing a peculiar kind of cedar timber, pink in colour and with a juniper-like odour. A very fine forest of considerable extent, 28,000 acres, lies around Mt. Chélia, the highest point in Algeria, 7500 feet altitude, 43 miles to the south-east of Batna; but it was practically inaccessible in January. In one part of it, the forest of Beni-Oudjana, 44,666 trees have been marked for felling, estimated to contain 3,615,000 cubic feet of timber, which will be offered for sale by the Government in the course of the present year.

I visited the forest of Belezma, which is only 12 miles to the north-west of Batna. The whole wooded area here under government control is 140,000 acres in extent; but of this the cedar occupies only 22,000 acres, ascending the mountain to its summit, 6900 feet, and descending on northern slopes to 3600 feet, and on southern slopes to 4300 feet. The forest was badly treated in former years, whole tracts of the finest trees having been clean cut away and the timber used in building the town of Batna. The drought which prevailed from 1875 to 1881 caused serious damage to the remaining trees, and many died, most of which, except those that have been lately felled, are still standing. Felling is done regularly every year, only dead trees being removed. The sapwood of these has rotted away, but the heartwood remains quite sound and unaltered. This timber is mainly used for railway sleepers, though some has been utilised in house-building and for making wood pavement and furniture. None of it appears ever to have been exported; and it is a great pity to see such excellent wood utilised only for rough purposes. The price obtained for it is as it stands very low, 1d. to 2d. per cubic foot; yet it is fairly accessible, as the haulage to Batna is very cheap, but the rate by railway from there to Philippeville, the nearest seaport, is 15s. per ton.

It snowed very heavily during my stay at the forester's house near the top of the mountain; but so far as I could see, the cedar only grows here in a dense condition in the young stage, there being in the ravines fine stands of cedars 30 feet high, which are slightly mixed, like the rest of the forest, with *Quercus Ilex*, *Juniperus thurifera*, and *Juniperus phœnicea*. These young trees are narrowly

pyramidal in form, with erect stiff leaders; but in slightly older trees the leader begins to incline over on one side, and the branches to thicken and elongate, and this process being continued, eventually the tree assumes when old the habit of Lebanon cedars, as we see them in English parks. In other parts of the forest the older trees are more or less scattered with the same admixture of junipers and evergreen oak, the undergrowth being Phillyrea and broom. The cedar appeared to be slow in growth, the annual shoots of young vigorous trees not exceeding three or four inches in length. From observations made in one section of this forest the tree shows at different ages the following dimensions:—

AGE.	Diameter.		Height of Market-able Timber.	Total Height.
	Feet.	Inches.		
125 years	2	7½	46	98
160 "	2	11½	52½	105
200 "	3	3	59	115
255 "	4	3	59	125
305 "	4	11	59	125

An official document, which I saw at Batna, gave the total number of sound trees over 40 inches in girth as 265,500, estimated to contain between ten and eleven million cubic feet of timber, the total timber in the forest, young and old trees, cubing 16,000,000 feet. In addition, there is still standing 900,000 cubic feet of dead timber. In a few spots, as in the Chellala-Bordjen section, there are rather dense stands of old trees, which run to 7000 cubic feet per acre; but there are large tracts in parts of the forest which have scarcely 150 cubic feet to the acre.

The tree produces seed abundantly every two or three years; and regeneration is good in favourable situations, as in northerly ravines. The cones¹ disarticulate in November, after the autumnal rains, but if the weather is exceptionally dry, do not open. Seedlings appear under dense cover, but in such situations grow slowly, and do much better in the partially open places between large trees. The wide-spreading branches which the tree ultimately produces show, I think, that in old age it requires a great deal of light, and tends to grow in a more or less isolated condition; but until middle age the trees bear crowding without injury. In the bare parts of the mountain, where the trees were cut away many years ago, artificial planting has been tried on a small scale, and has succeeded on northern slopes when two-year-old seedlings have been planted in autumn. Plants put out in the spring on the southern slopes have died of drought, which is the great enemy to both artificial and natural regeneration.

The forest of Téniet-el-Hâad is about a day's journey from Algiers—four hours by rail and thence seven hours by the coach to the town, which is distant from the cedars about an hour's walk. The mountain-range runs in a N.W.-S.E. direction, the cedars ascending to the summit of the crest, 5900 feet, and descending on the north side to 4250 feet, and on the south side to 4900 feet, there being a zone of

¹ Only the central part of the cone contains good seed. In January the basal scales of many cones were still remaining around the central axis, the other scales having fallen much earlier.

Quercus Ilex below, with which the cedar slightly mingles. The cedar forest occupies 2300 acres, four-fifths of this being on the north slope and one-fifth on the south slope, and consists of a mixture in varying proportions of cedar and *Quercus Mirbeckii*, the latter a beautiful tall tree with semi-evergreen foliage, often attaining 12 feet in girth. This mixed forest is nowhere very dense, except where there are young stands, and grows upon sandstone—the undergrowth being chiefly *Rosa* and *Rubus*, with *Juniperus* in the lower zone. The tallest cedar does not, I believe, exceed over 120 feet; and the largest, which I measured and photographed (Plate 136, B), are *La Soltane*, 98 feet high by 24 feet in girth, and *Le Massaoud* (Plate 136, A), 108 feet by 23 feet. Trees of peculiar shape are common; one, 108 feet by 19 feet, dividing into two stems at eight feet up; and another, *Le Cèdre Parasol*, which stands on a rocky promontory, being a low tree with a peculiar broad-shaped umbrella-like crown. Around the forester's house, Le Rond Point, at 4600 feet, there is a plateau of some extent, with many fine old trees having the habit of the Lebanon cedar as we see it in England.¹ No felling is done at present in this forest, which is rapidly improving in value owing to the entirely successful natural regeneration, cedars being present in all stages of growth.

The wood of the cedar, though without resin-canals, contains a quantity of resin, which gives it a peculiar, penetrating, and distinctive odour.² At Batna, *libanol*, a kind of resin, is obtained by distillation of the sawdust of old trees. This product is very valuable in the treatment of inflammation of the mucous membranes, and is said to be curative in influenza. Cedar wood contains a large amount of white sapwood, 25 to 50 annual rings, with a brown or brownish-yellow heartwood. The heartwood is homogeneous and fine in the grain, and takes an admirable polish. It lasts indefinitely, trees which were cut down fifty years ago in the forest at Batna remaining still on the ground quite sound, and when not exposed to the air is imperishable. Pieces of cedar wood have been found in tombs which are supposed to belong to the Punic period, and portions of ancient mosques built of cedar are in perfect condition. Placed in water, the heartwood becomes very hard; and vats made of it, which have been buried in sand for thirty years, are not only well preserved, but cannot be cut by an axe. The wood of dead trees can be used at once, but that of living trees requires to be seasoned carefully for six or twelve months. Though the timber is used in building, it is rather heavy for that purpose, and has no great elasticity or resistance to flexion under a heavy weight. It is, however, well suited for the finest kinds of cabinet-making. (A. H.)

CULTIVATION

The seed ripens in most seasons in England at least, as well as that of the Lebanon cedar, and will sometimes come up naturally near the parent trees, as at Cooper's Hill near Windsor, from whence I transplanted two self-sown seedlings to my own garden.

¹ An excellent illustration in *Garden and Forest*, viii. 335 (1895), shows the flat-topped habit of mature trees in their native forest.

² The odour disappears after exposure to the air for a few years, and is not noticeable in the cedar furniture which is so common in the houses at Batna and Téniet-el-Hâad. Cf. Lefebvre, *Les Forêts de l'Algérie*, 350 (1900).

When staying at Heythrop Park, Oxfordshire, in March 1901, I went out on a morning when the frost was so hard that the hounds could not hunt till noon, and found seeds which had germinated on the ground beneath a glaucous cedar. The radicles were protruding from the seeds, in some cones which had not fallen; I took them home and planted them, and have now several healthy young trees about a foot high.

I also sowed a quantity of imported seed in the open field, where they germinated well, but the plants were all destroyed by mice, frost, and drought in the first season, though seedlings raised in the nursery stood the winter without protection. As the seed can be procured in quantity at a cheap rate from Messrs. Vilmorin of Paris, I should recommend its being sown in a frame and protected for two or three years, after which it will require two to three years more in the nursery before planting out.

The tree seems to like lime in the soil, and will, in my opinion, prove a valuable timber tree if planted in open woods, in warm, dry soils, sufficiently close together to prevent its branches from developing too much, and possibly if mixed with beech it might thrive better than alone.

As regards the relative rate of growth of the Atlas and Lebanon cedars we have the evidence of M. André Leroy, the well-known nurseryman of Angers, who, in the *Belgique Horticole*, 1867, p. 59, gives the following measurements:—

LEBANON CEDAR			ATLAS CEDAR		
AGE.	Height.		AGE.	Height.	
	Metres.	Centimetres.		Metres.	Centimetres.
1 year .	0	6-8	1 year .	0	10-15
2 years .	0	12-15	2 years .	0	20-30
3 „ .	0	18-25	3 „ .	0	40-50
4 „ .	0	36	4 „ .	1	0
5 „ .	0	50	5 „ .	1	75
6 „ .	0	75	6 „ .	2	50
7 „ .	1	0	7 „ .	3 and upwards.	

After seven years of age, he states that the annual growth was often more than one metre, and mentions a tree only twelve years old, from seed, which was one metre in circumference (I presume at the ground). He also says that it is easier to transplant, and endures exposure and bad soil better than the Lebanon cedar, and believes that it will prove a valuable tree for planting on barren wastes where nothing else will thrive.

These remarks, no doubt, will apply better to the soil of Central France than to England, but I have the highest possible opinion of the hardiness of the tree, and have found it endure the damp, cold, and early and late frosts of the Cotswold hills in a way that few other conifers will do. So far as my experience goes, however, it is not a tree which can be transplanted without some care in a small state, and when it has had its roots cramped in small pots, as is often done by nurserymen for con-

venience of sale, is rather apt to die. I am not aware that it has ever yet been tried in quantity under forest conditions; but, so far as I have seen, it is not subject to insect or fungoid diseases which attack and kill the deodar.

Many of the grafted trees of the glaucous variety, which are usually sold by nurserymen, are one-sided and unsightly objects, for a good many years after planting at any rate; and though it is claimed by some that grafting, if properly done, does not permanently disfigure the tree, yet I would always prefer seedlings. Even if not quite so glaucous in colour as the best of the others, a certain number of this tint will generally appear among them.

The date at which the Algerian cedar was first introduced to this country is somewhat uncertain; but it must have been subsequent to 1844, and if any older ones exist they cannot be recognised with certainty. Several trees appearing older than this have been supposed to be African, on account of their habit and cones, but there is nothing on record to prove it.

According to Ravenscroft, the oldest of which we have an exact record were raised at Eastnor Castle in 1845, from cones gathered by Lord Somers himself at Téniet-el-Hâad. In December 1860 the tallest of these was 18½ feet; in December 1866, 31 feet. When I measured it in 1906, it was 77 feet by 8 feet 1 inch.

REMARKABLE TREES

The tallest tree that I have measured in England is at Linton Park, Kent, and is a glaucous tree, which, from its shape, seems to be grafted, though there is no evidence of this. It was 80 feet high in 1902.

The largest recorded at the Conifer Conference in 1891 was at Mulgrave Castle, Yorkshire,¹ the seat of the Marquess of Normanby. It was then 66 feet by 5 feet 10 inches. Mr. Corbett informs me that it is now 72 feet by 8 feet 4 inches.

On Ashampstead Common, Berks, there is a handsome and well-grown tree which has grown up in a semi-wild condition among other trees, and which was 63 feet by 6½ feet when I last saw it in 1907 (Plate 137).

At Ashridge there are several fine glaucous trees, raised from seeds, which were brought by Earl Brownlow, in 1862, from Téniet-el-Hâad; the best of them already measures 58 feet by 6 feet. At Merton Hall, Norfolk, there is a very well-shaped tree measuring 60 feet by 6 feet.

At Bicton there is a fine tree measuring 68 feet by 7 feet 6 inches. At Coldrinick, in Cornwall, there is a well-shaped tree which, in 1905, was 64 feet by 5½ feet. At Heanton Satchville, North Devon, I saw a healthy young tree in a shrubbery, which was clear of branches to 20 feet up, and though 48 feet high, was only 2 feet 7 inches in girth, showing the ability of this cedar to thrive without much space, even in a climate so much damper and cooler than that of Algeria.

At Tortworth there is a cedar about 50 feet high with very short leaves, and remarkably fastigiate habit, which seems to belong to the variety named *fastigiata*.

In Scotland I have not seen any so large as in England; but the tree grows

¹ A tree at Grimston, near Tadcaster, Yorkshire, reported in 1900 to be 70 feet high and 13 feet in girth at three feet from the ground, which was said to be sixty-five years old, is probably a Lebanon cedar. Cf. *Gard. Chron.* xxviii. 210 (1900). †

well at Murthly and other places. At Smeaton-Hepburn, a tree,¹ planted in 1847, was, in 1902, 69 feet high and 6½ feet in girth. At Fordell, in Fifeshire, the property of Lord Buckinghamshire, I am informed by Mr. Sibbald that a number of cedars were planted by Mr. Fowler, then head gardener, 42 years ago on a damp sandy soil and well sheltered by other trees. The average height of the Algerian cedars in 1906 was 48 feet, with an average girth of 4 feet 4 inches, and of the deodars 33 feet by 3½ feet. The majority of them are in good health, though the Algerian have made by far the best trees, and as the soil and climate of Fifeshire do not seem to be so favourable to the growth of trees generally as those of Perthshire, Morayshire, or parts of Ross-shire, this seems to prove that the tree may be planted in Scotland with good hopes of success.

The finest Atlas cedar in Ireland is at Fota, and is of the glaucous variety. It was planted, according to Lord Barrymore, in 1850, and measured in 1904 83 feet high by 7 feet 7 inches in girth (Plate 138). At Carton, the seat of the Duke of Leinster, a tree, which is, from its habit, apparently an Atlas cedar, was, in 1903, 80 feet high by 9 feet in girth. At Powerscourt a glaucous specimen was in the same year 50 feet high by 5 feet in girth.

In the south of France and North Italy this tree grows better and faster than in England. Perhaps the best that I have seen are in the public garden at Aix en Savoie, where there is a grove of splendid trees 90 to 95 feet high, though only planted in 1862. They average 6 to 7 feet in girth, and there are many self-sown seedlings near them. On the shores of the Lago Maggiore the tree succeeds perfectly, several fine trees in the grounds of the Villa Barbot near Intra being 90 feet or over, and one 7½ feet in girth. It seemed to me likely to become a most valuable forest tree in this region.

(H. J. E.)

CEDRUS DEODARA, DEODAR

Cedrus Deodara, Lawson, *Agric. Man.* 381 (1836); Loudon, *Arb. et Frut. Brit.* iv. 2428 (1838); Brandis, *Forest Flora*, 516 (1874), and *Indian Trees*, 691 (1906); Ravenscroft, *Pinet. Brit.* iii. 225 (1884); Masters, *Gard. Chron.* x. 423, f. 52 (1891); Kent, *Veitch's Man. Coniferae*, 411 (1900).

Cedrus Libani, Barrelier, var. *Deodara*, Hooker, *Himal. Journ.* i. 257 (1854), *Nat. Hist. Rev.* ii. 11, tt. 1-3 (1862), and *Fl. Brit. Ind.* v. 653 (1888); Collett, *Flora Simlensis*, 486 (1902); Gamble, *Ind. Timbers*, 710 (1902).

Cedrus indica, Chambray, *Arb. Res. Couif.* 341 (1845).

Pinus Deodara, Roxburgh, *Hort. Beng.* 69 (1814).

Abies Deodara, Lindley, *Penny Cycl.* 9 (1833).

Young trees with pendulous leader. Branchlets always pendulous, grey and densely pubescent. Leaves up to 2 inches long, as thick as broad. Cones large and broad, ellipsoid, 4 to 5 inches long by 3 to 4 inches in diameter, rounded at the apex; scales 2 to 2½ inches wide, with claw not inflected, usually less tomentose than in the other cedars.

¹ Sir A. Buchan-Hepburn in *Proc. Berwick Nat. Club*, xviii. 210 (1904).

VARIETIES

A considerable number of varieties have arisen in cultivation, ten being mentioned by Beissner.¹

1. Var. *albo-spica*. Growing shoots during spring and early summer of a milky-white colour. Trees of this kind at Dropmore² are pyramidal in habit, and make splendid growth. At Grayswood,³ Haslemere, a bushy form with this peculiar foliage has been noted.

2. Var. *robusta*. Branchlets stout; leaves longer and thicker than in the ordinary form.

3. Var. *crassifolia*. Branches short and stout; branchlets not pendulous; leaves short and thick.

4. Var. *verticillata*. Branchlets whorled.

5. Var. *fastigiata*. Fastigate in habit.

6. Varieties with variegated foliage and with bright yellow leaves have also been noted. The glaucous tint has appeared in cultivation, and is met with in the wild state. A very glaucous tree at Castlewellan has been named var. *nivea*.⁴ Trees with thin, shining, deep green foliage have been distinguished as var. *viridis*.

(A. H.)

DISTRIBUTION

The deodar is found in the Western Himalaya; and extends eastwards to the Dauli river in Kumaon, occurring at 4000 to 10,000 feet, most common at 6000 to 8000 feet. It extends westwards through Kashmir to the Peiwar forests in the Kuram valley of Afghanistan.

According to Gamble, from whom I take the most of the following account, it is a gregarious tree, but rarely forms pure forests, though exceptions are met with, generally in the form of sacred groves; usually it is associated with *Picea Morinda* and *Pinus excelsa*, and three species of oak in their various zones. Sometimes the silver fir (*Abies Pindrow*) accompanies it, but more rarely; the cypress (*Cupressus torulosa*) in its favourite localities joins it; the yew is often found under it; and at low elevations it mixes with *Pinus longifolia*.

Among other trees commonly found with it may be mentioned *Betula alnoides*, *Populus ciliata*, *Æsculus indica*, elm, hazel, hornbeam, maples, bird-cherry, holly (*Ilex diphyrena*), *Pieris ovalifolia*, and rhododendron; while among the shrubs commonly found in deodar forests may specially be noted species of *Berberis*, *Indigofera*, *Desmodium*, *Cotoneaster*, *Euonymus*, *Salix*, especially *Salix elegans*, *Viburnum*, *Lonicera*, *Parrotia*, and rose, while *Clematis montana*, *Vitis semicordata*, and ivy, are frequently met with climbing over and festooning its branches.

In the outer ranges the deodar forests chiefly clothe the northern and western slopes of the ridges, while in the interior hills, to which the rainfall of the south-west monsoon still reaches, they are found on all aspects, but less pure. Beyond the region of the south-west monsoon the deodar is still found, but gets

¹ *Nadelholzkunde*, 307, 308.

³ *Gard. Chron.* xxxvii. 59, 105 (1905).

² *Gard. Chron.* xxxvii. 44, 76 (1905).

⁴ *Ibid.* xxxv. 399, fig. 146 (1899).

gradually scarcer, and in such places its companions may be *Pinus Gerardiana* and *Quercus Ilex*.

The deodar can attain a very great size.¹ Thomson² mentions one near Nachar, on the Sutlej, that was 35½ feet in girth. Dr. Stewart measured one at Kúarsi in the valley of the Ravi that was 44 feet at 2 feet, and 36 feet at 6 feet from the ground; another about 900 years old was 34½ feet in girth. Minniken records a tree at Punang, in Bashahr, that was 150 feet high and had a girth of over 36 feet, the clean bole being 45 feet long. Dr. Schlich measured a tree in the Sutlej valley 250 feet high with a girth of 20 feet.

In the Dumrali block in the Tehri-Garhwal leased forests a fallen tree was unearthed 90 feet long and over 7 feet in diameter, which had been dead for at least 100 years, and was, when it fell, probably 550 years old. When cut up it gave 460 metre-gauge sleepers. I am indebted to Mr. J. H. Lacey for the illustration (Plate 139) representing a group of deodars in the Himalayas.

A great section in the corridor of the forest school at Dehra Dún is 23 feet in girth, with 665 annual rings. The number of annual rings to the inch varies much according to the elevation and rainfall, but averages about 8 to 12, though in the Kuram valley Bagshawe found an average of about 21.

As an ornamental tree there are few in the world that can compare with the deodar. From the Lebanon cedar and the Atlas cedar it differs somewhat in appearance, but even to an expert, in the collections of Europe, it is not always easy to recognise to which of the three species a given specimen belongs. Roughly, however, the deodar is distinguished by means of its drooping branches and its longer needles. Two well-marked varieties are recognisable in the forests, the one with dark green, the other with silvery foliage. The latter variety, well known in European collections, is found wild in ravines at a comparatively low level. Gamble saw it in Jaunsar, in the upper Dharagadh, in ravines at from 4000 to 6000 feet, and believes that the variety comes true from seed.

Deodar trees are often lopped for litter, and if the leading shoot is not damaged, the tree grows on well enough; when the leading shoot is cut or damaged, the tree shows a great tendency to form others; and frequently several erect shoots, with the appearance of young trees, may be seen growing up straight from its branches. The deodar may be almost said to produce coppice shoots, for, as Brandis remarks, if only a small branch be left to a stump, it will send out shoots and grow well, eventually, perhaps, forming a new tree.

In close forests deodars flower and seed rather sparsely; for good seed bearers we have to look to the old trees on dry ridges, where they can get a large amount of sunlight. When the seeds are ripe the cones break up and the scales fall; the winged seeds are then carried by the wind for a short distance. It may be interesting to record the result of the examination of an average cone by Mr. B. B. Osmaston in October 1900. He found in the top part 25 scales, with 50 bad seeds;

¹ Webber, in *Forests of Upper India*, 331 (1902), says: "I have seen deodars 40 feet in girth and 250 feet high, the age of which must be 1000 years or more"; and Pakenham Edgworth informed Bunbury that he had measured deodars 46 feet in girth. Cf. Lyell, *Life of Sir C. J. F. Bunbury*, ii. 238 (1906).

² *Western Himalaya and Tibet*, 64 (1852).

in the middle 100 scales, with 90 good and 110 bad seeds; in the lower part 94 scales, with 188 bad seeds—the whole cone, therefore, giving 219 scales, with 438 seeds, of which 90 were good.

CULTIVATION

The best account we have of the introduction of the deodar is given by Ravenscroft, who states that the Hon. Leslie Melville sent seeds¹ in 1831 which were sown at Melville in Fifeshire, at Dropmore, and elsewhere.

Lord H. Bentinck sent some to Welbeck in 1832, but it was not until 1841 that the Right Honourable T. F. Kennedy, then at the head of the Woods and Forests, took steps to procure seed in large quantities from the Himalayas. His proceedings are described at great length in the *Thirty-first Report of the Commissioners of Woods*, pp. 168-172, and pp. 440-454 (1853), and further in the *Thirty-fourth Report* (1856), pp. 87, 88, and pp. 120-122. From this it appears that 60,000 seedlings were distributed in the spring of 1856 amongst the New, Dean, and Delamere forests, and a further 40,000 were sent out in the following autumn.

I am indebted to Mr. E. Stafford Howard, C.B., for information as to the results of these experiments as given in letters from the Hon. Gerald Lascelles and the late Mr. P. Baylis. The former says:—"I have made search for any records of the planting of the deodars, but can find nothing worthy of quotation. It is a fact that it was very largely planted here, as we can see for ourselves,—more, however, as an avenue or ornamental tree than, strictly speaking, for timber. Large quantities were raised in the nursery at Rhinefield, which at that time was managed by one Nelson, who in a small book speaks of the very large experience he has had in raising and transplanting deodars. The tree is, however, a failure by reason of the way in which it suddenly dies off, unaccountably, when it is about forty or fifty years old. There are some notable successes, such as the grove at Boldrewood² and others, but I must have cut hundreds which had died off suddenly."

Mr. Baylis wrote on 8th May 1905: "I cannot give much definite information on the subject, though Crown Keeper Smith remembers some deodars being planted about 1857 along the sides of the rides in the High Meadow estate; but large numbers of these have perished, and there are no very fine trees among those that are left. A ride along the top of the Churchill enclosure was also planted about the same time with similar trees; but many of these also have died, and I cannot say that any of them have thriven well, though one tree has occasionally borne cones. I think that the climate here is too cold and damp for them to thrive, and that they cannot stand the damp cold of our winters in the Forest, though on the slopes of the Malvern hills they flourish fairly well."

This liability of the deodar to die after attaining considerable size has been often noticed, and, so far as I have observed, is most common on soils which are poor in lime.

¹ A tree raised from these seeds was planted near the Director's Office at Kew, and had attained a height of 32 feet in 1864. It became diseased and was removed in 1888. Cf. *Kew Hand List of Conifera*, xiv. (1903).

² The best deodar at Boldrewood is now 64 feet high.

The Earl of Ducie informs me that in 1854, and for several years afterwards, he planted many deodars at Tortworth, both on the old red sandstone and on the mountain limestone. Many of these have perished after thirty to forty years' growth, without any apparent reason, except that in one case where only six out of about ninety remain, it is probable that they were infected with disease by the dead roots of beech trees which previously occupied the ground. Very few deodars at this place seem likely to attain a great age, and contrast unfavourably with the Cedar of Lebanon. But at Miserden Park, in the same county, on a dry oolite limestone, at an elevation of at least 600 feet, a line of deodars about sixty years old have remained healthy, though their growth here is much slower than at Tortworth.

At Poltimore, near Exeter, there is a fine avenue of deodars which were planted in 1851-52, and have grown to an average height of 70 to 80 feet in 1906, most of them being extremely vigorous, but there are several blanks in this avenue.

The cause of these deaths is explained by Mr. R. L. Anderson in a note published in the *Quarterly Journal of Forestry*, i. 216, who states that the fungus now known as *Armillaria mellea*, Vahl., was present on the roots of one of these deodars; and as the best means of checking its spread to other healthy trees, recommends trenching the ground round the affected tree, digging up and burning its roots, and scattering gas lime over the ground where they have been.

At Castle Menzies, in Perthshire, of a number of deodars, which were planted by the late Sir R. Menzies about 1852 to commemorate the birth of his son, on soil which was too wet to suit them, though *Tsuga albertiana* and *Picea sitchensis* have succeeded very well close by, several are dead, and all are more or less stunted, though one of these trees measuring $7\frac{1}{2}$ feet in girth was successfully transplanted in February 1907, and had not lost a leaf when I saw it in the following July.

I have not myself gathered any ripe seed of the deodar in England, but there is a tree growing in Kew Gardens between the main gate and the Director's office which measures 37 feet by 4 feet 8 inches, and was raised from seed produced in 1861 or 1862 by a tree at Killerton, and sent by the late Sir Thomas Acland to Kew in February 1868. Mr. Smith, the then Curator of Kew, was so much impressed by the good quality of the soil from the top of Killerton Hill in which this tree was raised, that two truck loads of it were sent to Kew.

The earliest record¹ of the deodar producing fruit in England is of a tree at Bury Hill, near Dorking, which produced cones in 1852, when it was 28 feet high. Cones have also been borne on trees at Dropmore,² Sunninghill,² Bishopsteignton² near Teignmouth, Enys² in Cornwall, and Fota² in Ireland. Seedlings have been raised from home-grown seed at Rozel Bay² in Jersey and at Bicton.³

A deodar in Kew Gardens produced cones in 1887, according to a note in *Gardeners' Chronicle*, ii. 248 (1887), where it is stated that the production of cones on this species in this country has hitherto been a rare occurrence. At The Coppice, Henley, the seat of Sir Walter Phillimore, Bart., and at Shiplake House, the

¹ *Gard. Chron.* 1852, p. 582, and x. 279 (1891).

² *Ibid.* x. 423, 435, 436, 492, 679 (1891).

³ *Ibid.* 1869, p. 1279.

residence of Miss Phillimore, there are deodars coning profusely at present, probably on account of the hot summer of 1906. At White Knights Park, Reading, there is a seedling now about 8 feet in height, and supposed to be 16 years old, which germinated on a vine border, the seed having come from a tree which measures 75 feet in height and 10 feet in girth.

In India the cones are often much damaged by the larvæ of a Pyralid moth which eats out the seeds, and the saplings are attacked by the well-known fungus *Trametes radiciperda*, which spreads underground through the roots from tree to tree. The leaves are also attacked by Uredinous fungi, especially by *Æcidium cedri*, Barclay, which forms small yellow spots and causes them to fall.

As regards the comparative hardiness to severe winter frosts of the three cedars we have valuable evidence¹ collected by Mr. Palmer in 1860-61. Reports were received from no less than 211 places in England, Scotland, and Ireland. "The winter of 1860-61 was the most severe that has happened since its introduction. It was a winter such as had scarcely any parallel for severity in the memory of man, and unless some general change of climate should take place, it may be looked upon as exceedingly improbable that any cold of greater intensity should again visit us. The effect of that winter upon the deodar may therefore be taken as a safe guide in judging of its suitability for our climate; what the effect was we are, as already mentioned, enabled, through the kindness of Mr. Palmer, to state with accuracy.

Mr. Palmer's record of observations shows that the deodar is by no means so hardy a tree as the larch, and also that it is the least hardy of any of the cedars. There is no instance of any of the larches reported to him having been injured by the cold of 1860; while out of the deodars growing at 211 places in Great Britain and Ireland, plants were killed at 55, and were uninjured only at 80, having been more or less injured at the remaining 76, a percentage of frailty much greater than we should have anticipated. The Cedar of Lebanon and the *Cedrus atlantica* proved more hardy, and about equal between themselves. The following summary will show the actual results of Mr. Palmer's report on all three:—

	Total Places reported on.	Not injured.	Injured.	Much injured.	Killed.	Proportion of Killed and Much injured.
Cedrus Deodara .	211	80	50	26	55	1 in $2\frac{1}{2}$
Cedrus Libani .	81	51	19	6	5	1 in $7\frac{1}{2}$
Cedrus atlantica .	74	48	19	2	5	1 in $10\frac{1}{2}$

It may be interesting to notice in what proportion the three different parts of the kingdom suffered. It was as follows:—

	Total Places reported on.	Not injured.	Injured.	Much injured.	Killed.	Proportion of Killed and Much injured.
Scotland .	64	19	26	14	5	1 in $3\frac{1}{2}$
England .	142	61	24	13	50	1 in $2\frac{1}{2}$
Ireland .	4	3	1			"

¹ Published in Ravenscroft, *Pinet. Brit.* iii. 242 (1884).

REMARKABLE TREES

The two finest deodars, as regards size and symmetry, that I have seen in Great Britain are at Bicton, where cones were produced, according to *Pinet. Brit.*, as long ago as 1858. One of these on the lawn measured in 1902 was 80 feet by 11 feet 8 inches (Plate 140). The other is near the ornamental water in a more sheltered situation, and was then 90 feet by 9 feet 1 inch.

Another of about the same height at Beauport has an erect top, and looks as if it might become much taller. The tallest reported at the Conifer Conference was at Studley Royal, and was then 70 feet by 7½ feet; but when I visited that place I saw no very large tree of the kind.

At Dropmore there is a handsome tree which in 1905 was 77 feet by 8 feet 10 inches, and had many of the woody knots embedded in the bark that are sometimes seen in the cedars. It is said to have been planted¹ in 1834.

At Westonbirt, a tree, planted by the late Mr. Holford, about 85 feet by 8 feet 9 inches, is one of the largest and best shaped that I have seen. A deodar of peculiar habit at Linton Park, Kent, reported to be 79 feet high, is figured in *Gardeners' Chronicle*, December 12, 1903, fig. 159.

At Barton there is a fine tree branched to the ground, which in 1904 was 76 feet by 9½ feet. At Highclere there is a handsome tree about 75 feet by 8 feet 4 inches, which was planted by the then King of Spain in 1844. At Williamstrip, on rather heavy soil, there is a healthy tree of 72 feet by 8 feet.

At Ombersley Court, near Worcester, there is a very fine tree 84 feet by 8 feet 4 inches, which has the erect habit of *atlantica*; but the drooping branchlets show it to be a deodar.

At the Frythe, near Welwyn, Herts, a large deodar was cut down some years ago; and from the side of the stump there is now (1906) a young tree springing up, quite vigorous and healthy, and about 25 feet high. At Chart Park, Surrey, there is a tree 89 feet by 8 feet 11 inches; and adjoining this place, in the Tunnel Park, Deepdene, there is another fine tree 77 feet by 9 feet, both measured by Henry in 1905. At Fulmodestone, Norfolk, a tree planted in 1861 was in 1905 66 feet by 7 feet 4 inches in girth. At Shiplake House, near Henley, a tree, planted in 1852, was 73 feet by 7 feet 9 inches in 1905, and is bearing numerous cones in the present year. A deodar, growing on Haddington Hill, near Wendover, at 800 feet elevation, is 63 feet by 5 feet 10 inches.

There are many trees of from 60 to 70 feet in other parts of England, but we have seen none which call for special notice.

In Scotland the deodar is only hardy in the warmer parts of the country, and does not seem to have attained anything like the same dimensions as in England or Ireland. At Poltalloch, notwithstanding the wet and windy climate, it grows fairly well and has attained over 50 feet. At Rossdhu, on Loch Lomond, it is even taller.

In Perthshire there are good specimens at Abercairney, Castle Menzies, and Dunkeld, which seem to have been planted after the great frost of 1860-61, which

¹ *Gard. Chron.* xxv. 138 (1899).

destroyed so many of this tree in the north. The tree at Abercairney is remarkably weeping in habit, and measured, in 1904, 51 feet high by 4 feet 8 inches in girth. The best that we know in this county is perhaps one at Murthly, which is older and bore cones in 1892. It grows well at Gordon Castle, where there is a tree about 50 feet high, and as far north as Dunrobin in Sutherlandshire. At Conan House, Ross-shire, there is a healthy tree 47 feet by 9 feet 9 inches. At Leny, near Callander, there is a very old-looking but rather stunted deodar, which may have been introduced by the distinguished Indian naturalist Buchanan Hamilton, grandfather of the present owner, but when I saw it in 1906 it was only about 45 feet by 7 feet.

At Smeaton-Hepburn, a tree¹ planted in 1841, when it was 2½ feet high, measured in 1902, 55 feet in height and 6 feet 7 inches in girth.

The finest deodar in Ireland is growing at Fota, Co. Cork, and measured, in 1903, 84 feet high by 7 feet 2 inches in girth. At Coollattin, Wicklow, there are two trees, one of which measured, in 1906, 53 feet by 6 feet 10 inches. At Hamwood, Co. Meath, a tree, supposed to have been planted in 1844, was 74 feet by 7½ feet in 1905. At Mount Shannon, Limerick, there is a tree 66 feet by 8 feet 5 in. in 1905. At Emo Park, Portarlinton, a tree measured, in 1907, 61 feet by 7 feet 4 inches, and was thriving; but in the dry climate of Queen's County, the deodar as a rule is not a satisfactory tree.

TIMBER

The timber is the most important of any in North-Western India, and supplies a large quantity of railway sleepers, bridge, and building timber. Gamble says that it is rather brittle to work, and does not take paint or varnish well. It has also a very strong odour which, although pleasant in the open air, is not so in a room. It is extremely durable, probably with cypress (*Cupressus torulosa*) the most durable of Himalayan woods. Stewart mentions the pillars of the Shah Hamadin Mosque at Srinagar in Kashmir, which date from 1426 A.D., and were quite sound when he wrote. Its grain is so straight that the logs can be split into boards, which are afterwards trimmed with an adze; and shingles for roofing, according to Webber,² stand the changes of climate for centuries without any sign of decay.

The weight of well-seasoned dry wood of average growth is about 35 pounds per cubic foot, branch wood being very much heavier and more full of resin.

Oil is extracted from it by distillation, which is a dark brown, strong, and unpleasant smelling fluid, said to be a good antiseptic, and serves to coat the inflated skins known as "mussucks" used for crossing the Himalayan rivers. (H. J. E.)

¹ Sir Archibald Buchan-Hepburn in *Proc. Berwick Nat. Club*, xviii. 210 (1904).

² *Forests of Upper India*, 41 (1902).

LIBOCEDRUS

Libocedrus, Endlicher, *Syn. Conif.* 42 (1847); Bentham et Hooker, *Gen. Pl.* iii. 426 (1880); Masters, *Journ. Linn. Soc. (Bot.)*, xxx. 19 (1892), and *Gard. Chron.* xxx. 467 (1900).
Heyderia, Koch, *Dendrologie*, ii. 2, p. 179 (1873).
Calocedrus, Kurz, *Journ. Bot.* xi. 196 (1873).
Thuya, Baillon, *Hist. Pl.* xii. 34 (1892).

EVERGREEN trees with aromatic odour, belonging to the tribe Cupressineæ of the order Coniferæ, closely resembling *Thuya* in habit and other characters, the branches as in that genus ending in frondose "branch-systems," which are flattened in one plane and three- to four-pinnately divided, with their axes bearing scale-like leaves in four ranks. On the main axes the leaves are often remote by the lengthening of the nodes; on the lateral axes they are closely imbricated, and vary in the different species in size and form, as detailed in the three sections below. In seedling plants the leaves are always linear-lanceolate and spreading.

Flowers: monœcious with those of the two sexes on different branchlets, or rarely diœcious, solitary, terminal. Male flowers oblong, subsessile, with six to twenty stamens decussately opposite on a slender axis; filaments short, dilated into broadly ovate or orbicular scale-like peltate connectives, which bear usually four sub-globose anther-cells, two-valved and opening on the back. Female flowers oblong; subtended at the base by several pairs of leaf-like scales, which persist slightly enlarged under the fruit; composed of four or six decussately opposite acuminate bracts; lowest pair small, unfertile; next pair above fertile, bearing at the base two erect ovules on a minute accrescent ovular scale; uppermost pair when present unfertile.

Cones small, pendulous or erect, ripening and letting out the seed in the first year, persistent empty on the branchlets in the second year. Scales decussate, four or six; the lowermost pair short, thin, often reflexed; the next pair long, thickened, woody, widely spreading at maturity, marked externally close to the apex by the shortly acuminate or long-beaked tip of the bract; third pair, when present, connate into an erect median partition. Seeds, two or one by abortion on each of the two fertile scales, with two lateral wings, one broad, oblique, nearly as long as the scale; the other short, narrow, or rudimentary; cotyledons two.

Eight species of *Libocedrus* have been described, remarkable for their distribution over widely separated areas in the two hemispheres. Three sections may be distinguished:—

Libocedrus

I. Ultimate branchlets on mature trees tetragonal, bearing leaves all alike and uniform in size.

1. *Libocedrus tetragona*, Endlicher. Chile, Patagonia.
Leaves spreading.
2. *Libocedrus Bidwilli*, Hooker. New Zealand.
Leaves closely appressed.

II. Ultimate branchlets flattened, with leaves of two kinds; lateral boat-shaped, median flat and appressed.

A. Median and lateral leaves equal in length.

3. *Libocedrus decurrens*, Torrey. Oregon, California, W. Nevada.
Leaves green on both surfaces.
4. *Libocedrus macrolepis*, Bentham et Hooker. China, Formosa.
Leaves glaucous on the lower surface, with white stomatic bands.

B. Lateral leaves much longer than the median leaves.

5. *Libocedrus chilensis*, Endlicher. Chile.
Median leaves minute, rounded at the apex, with a conspicuous gland.
6. *Libocedrus Doniana*, Endlicher. New Zealand.
Median leaves ovate, acute, mucronate, scarcely glandular.

The two following species, imperfectly known and not introduced, will only be mentioned here. They belong to the last section:—

7. *Libocedrus papuana*, F. v. Mueller.¹ New Guinea.
8. *Libocedrus austro-caledonica*, Brongniart et Gris.² New Caledonia.

LIBOCEDRUS TETRAGONA

Libocedrus tetragona, Endlicher, *Syn. Conif.* 44 (1847); Lindley and Paxton, *Flower Garden*, i. 47, f. 32 (1850); Kent, Veitch's *Man. Coniferae*, 256 (1900).
Libocedrus cupressoides, Sargent, *Silva N. Amer.* x. 134 (1896).
Thuya tetragona, Hooker, *London Journ. Bot.* iii. 148, t. 4 (1844).
Pinus cupressoides, Molina, *Saggio Sulla Storia Naturale del Chile*, 168 (1782).

A tree³ attaining in South America, though rarely, a height of 160 feet. Branchlets tetragonal. Leaves equal in size and uniform in shape in the four ranks; those on the ultimate branchlets about $\frac{1}{2}$ inch long, adnate only at the base, the remaining part free and spreading; ovate, acute, or rounded at the apex, keeled on the back, concave and glaucescent above; those on primary axes larger, adnate for the most of their length, the apices only being free and spreading.

Cones on long branchlets, less than $\frac{1}{2}$ inch long, brown. Scales four, minutely

¹ *Trans. Roy. Soc. Victoria*, i. 32 (1889).

² *Bull. Soc. Bot. France*, xviii. 140 (1871).

³ This tree has been confused by travellers with *Fitzroya patagonica*, which has very similar foliage when old. In the former, the leaves gradually taper to a rounded or acute apex; in the latter they are broadest in their upper third, close to the rounded apex. The cones are entirely different.

pubescent on the margin, each bearing above the middle on the back a lanceolate, subulate, erect, incurved spine; the two smaller scales lanceolate; the two larger scales oblong, each bearing a solitary seed; the larger wing oblique, obovate, obtuse, twice as long as the seed, the shorter wing narrow. (A. H.)

This tree inhabits the western slopes of the Andes of Chile from latitude 35° southwards, and was collected by me in February, 1902, on the west end of Lake Nahuel-Huapi at two to three thousand feet. It was growing both on swampy ground, where it attained a considerable size, and on the steep hill-sides above Puerto Blest. The natives of the district call it Alerce,¹ which is the usual name in South Chile for *Fitzroya patagonica*, and use it for making long straight thin shingles, which seem to be extremely durable. Owing to the inaccessible nature of the country and the scarcity of inhabitants, little or no timber has as yet been cut in the dense forests which clothe the shores of this large and picturesque lake. Judging from the climate, which is severe in winter, this beautiful tree should be hardy in the west and south-west of Great Britain and Ireland. According to Dusen and Macloskie,² it is common in Western Patagonia, extending through Fuegia to Cape Horn, rising up to the snow-line in the mountains, and met with of all sizes, from 2 to 160 feet high. As a rule it never forms forests, but grows either in small thin groves or sparingly mixed with *Nothofagus betuloides* and *Drimys Winteri*.

It was introduced by W. Lobb³ in 1849, but is excessively rare in cultivation, the only specimen we have seen being a small tree 15 feet high, in 1906, at Kilmacurragh, Co. Wicklow. This tree is narrowly pyramidal in habit, with bark scaling off in long papery ribbons. (H. J. E.)

LIBOCEDRUS CHILENSIS

Libocedrus chilensis, Endlicher, *Syn. Conif.* 44 (1847); Lindley, *Journ. Hort. Soc.* v. 35 (1850); Lindley and Paxton, *Flower Garden*, i. 48, f. 33 (1850); Kent, *Veitch's Man. Coniferae*, 252 (1900).

Thuja chilensis, Don, in Lambert, *Pinus*, ii. 19 (1824); Hooker, *London Journ. Bot.* ii. 199, t. 4 (1843).
Thuja andina, Poeppig et Endlicher, *Nov. Gen. et Spec.* iii. 17, t. 220 (1845).

A tree, attaining in Chile 50 feet in height, usually with a short trunk branching into a compact pyramidal head, or becoming at high altitudes a dense shrub. Branchlets compressed, slender; leaves scale-like in four imbricated ranks, those of the lateral ranks much longer than the others, boat-shaped, free at the apex, and spreading for one-third their length, keeled, acute, marked above and below with a white stomatic band; median leaves, minute, appressed, rounded at the apex, the dorsal with a prominent gland.

¹ Sir W. T. Thiselton-Dyer suggests that this is no doubt a Spanish corruption of the Arabic *El Arz*, a name which seems to include any coniferous tree, e.g. *Cedrus Libani* and *Pinus halepensis*. According to Pearce, the tree producing the valuable alerce timber is *Fitzroya patagonica*. Cf. *Hortus Veitchii*, 46 (1906).

² Scott, *Princetown Univ. Exped. Patagonia*, viii. 6, 18, 142 (1903).

³ *Gard. Chron.* 1849, p. 563.

Cones¹ on short branchlets, $\frac{1}{2}$ inch long; scales four, each with a minute projecting point below the apex, bright brown, two larger fertile and two smaller unfertile. Seeds one or two on each of the larger scales, oblique, with a narrow short wing on one side below, and an oblique broad oval wing on the other side above, the two wings being upper and lower, rather than lateral in position. (A. H.)

A tree, said by Bridges—who was the first to send home seeds to Low of Clapton in 1847—to attain occasionally 80 feet in height. It grows on the lower slopes of the Andes of Southern Chile, from lat. 34° southward to Valdivia; and was collected by me in the valley of the Rio Limay below Lake Nahuel-Huapi at 3500 to 4500 feet. Here it grows scattered on grassy hillsides or in open groves, and is a graceful tree of 50 to 60 feet in height. A photograph of our camp in this valley, taken by Mr. Calvert, gives a good idea of its appearance (Plate 141).

Though from the climate of the region in which it grows, this tree ought to be hardy in the warmer parts of England, and though in Mr. Palmer's tables a small number of trees seem to have survived the frost of 1860-61, as at Bishopstowe, Nettlecombe, Southampton, and even at Keir in Perthshire, yet by far the greater number of the plants introduced in 1847 were killed; and it is now very rare in cultivation; but seems, though slow in growth, to thrive at several places. By far the largest specimen I have seen is at Whiteway near Chudleigh, Devon, the property of Lord Morley, which in 1907, according to the measurements of the gardener, Mr. Nanscawen, was 46 feet 8 inches by 5 $\frac{1}{2}$ feet. We have also seen specimens in England at Blackmoor, Hants, the seat of Lord Selborne; and in Ireland at Castlewellan, the largest tree there being 20 feet high in 1903; at Powerscourt, where in 1906 there was a tree 28 feet high by 3 feet 3 inches, with the bark scaling off in long, narrow, papery slips, the habit being much wider than that of *L. decurrens*, with ascending branches; and at Kilmacurragh, Wicklow, where there is a tree 25 feet in height. (H. J. E.)

LIBOCEDRUS DONIANA

Libocedrus Doniana, Endlicher, *Syn. Conif.* 43 (1847); Kirk, *Forest Flora New Zealand*, 157, tt. 82, 82A (1889); Kent, *Veitch's Man. Coniferae*, 254 (1900); Cheeseman, *New Zealand Flora*, 646 (1906).

Libocedrus plumosa, Sargent, *Silva N. Amer.* x. 134 (1896).

Dacrydium plumosum, D. Don, in Lambert, *Pinus*, ed. 2, Appendix 143 (1828).

Thuja Doniana, Hooker, *London Journ. Bot.* i. 571, t. 18 (1842).

A tree, attaining in New Zealand 100 feet in height and 15 feet in girth, with reddish, stringy bark scaling off in ribbons. Branchlets flattened, with leaves similar in shape and arrangement to those of *L. chilensis*; lateral leaves adnate in the lower half, free and spreading in the upper half, acute, mucronate, green and shining above, glaucescent with a white band below; median leaves appressed, ovate, acute, mucronate, scarcely glandular.

Cones about $\frac{1}{2}$ inch long; scales four, each with a lanceolate acuminate, erect,

¹ Cones ripened on young trees at Les Barres in France in 1900. Pardé, *Arb. Nat. des Barres*, 31 (1906).

incurved spine above the middle on the back; two lower scales half the size of the others, acute; two upper scales rounded at the apex, each bearing one seed, which has two lateral wings, one short and narrow, the other broad and entire or sub-dentate.

This tree occurs in the North Island of New Zealand, in forests from Mongonui southward to Hawke's Bay and Taranaki, at elevations from sea-level to 2000 feet, usually rare and local. Kawaka is the native name, and it is also known as the New Zealand *Arbor Vitæ*, the dark red wood, beautifully grained and durable, being used in cabinet-making.

It is occasionally seen in conservatories; the only tree growing in the open, that we know of, being one at Powerscourt, which was 20 feet high and 18 inches in girth in 1903.

(A. H.)

LIBOCEDRUS BIDWILLI

Libocedrus Bidwilli, J. D. Hooker, *Flora New Zealand*, i. 257 (1867); Kirk, *Forest Flora New Zealand*, 159, tt. 82A, 83 (1889); Cheeseman, *New Zealand Flora*, 647 (1906).

A tree similar to *L. Doniana*, but smaller, attaining a maximum of 80 feet in height and 12 feet in girth; but often bushy at high altitudes and on peat-bogs.

Branchlets on young trees like those of *L. Doniana*, but more slender; on old trees tetragonal, $\frac{1}{20}$ th to $\frac{1}{10}$ th inch in diameter, clothed with densely imbricated, minute, scale-like leaves, uniform in size and shape in the four ranks, closely appressed, boat-shaped, ovate, acute, green in colour. Cones like those of *L. Doniana*, but smaller, $\frac{1}{4}$ to $\frac{1}{3}$ inch long.

This tree occurs both on the North and South Islands of New Zealand, from Te Aroha mountain and Mount Egmont southward to the Foveaux Strait, not uncommon in hilly and mountain forests at 800 to 4000 feet elevation. It is known as cedar or Pahautea, and has soft, red, and rather brittle wood. This species has not apparently been introduced, though judging from its occurrence higher in the mountains and more southerly in latitude than *L. Doniana*, it ought to be hardy in the milder parts of the British Isles.

(A. H.)

LIBOCEDRUS MACROLEPIS

Libocedrus macrolepis, Bentham et Hooker, *Gen. Pl.* iii. 426 (1880); Kent, Veitch's *Man. Conifera*, 255 (1900); Masters, *Gard. Chron.* xxx. 467 (1901); Henry, *Garden*, lxii. 183, with figure of tree (1902).

Calocedrus macrolepis, Kurz, *Journ. Bot.* xi. 196, t. 133 (1873).

A tree, attaining in China 100 feet in height, broadly pyramidal in habit, with whitish, scaly bark. This species resembles *L. decurrens* in foliage—the frondose branch-systems being, however, more flattened, and the leaves thinner in texture and larger at the corresponding stages of growth than in that species—the best mark of distinction being the glaucous tint of the leaves beneath. Staminate flowers oblong,

tetragonal; stamens sixteen to twenty. Cones on very slender branchlets (which are modified in being tetragonal, with minute appressed leaves uniform in the four ranks), about $\frac{3}{4}$ inch long, purplish or dark brown, roughened externally by longitudinal ridges; scales six, resembling those of *L. decurrens*, but smaller and with blunter minute processes. Seed, one on each of the two middle scales; two-winged, with the larger wing broader in the middle and more obtuse than in the Californian species.

This species occurs in the forests of Southern Yunnan in China, at 4000 to 5000 feet, but is rarely met with wild, and only in ravines near water-courses. It was discovered by Anderson near Hotha in 1888; and was subsequently seen by me wild, near Talang, and frequently planted in temples. It is known to the Chinese in Yunnan as Poh or Peh; and the wood is much esteemed, especially that of logs often found buried, the result of inundations in past times. Specimens of this species, so far as one can judge by the foliage alone, have been sent to Kew from North Formosa by Bourne.

The Chinese Libocedrus was introduced by Mr. E. H. Wilson, who collected seeds when he was paying me a visit at Szemao in the autumn of 1899. Young plants,¹ raised at the Coombe Wood Nursery, have beautiful, glaucous, large, flat foliage, the apices of the leaves being tipped with very fine, long, cartilaginous points. They may also be seen in the temperate house at Kew. The tree would probably be hardy in Cornwall and the south-west of Ireland, and being highly ornamental, is worth a trial in warm, sheltered spots.

(A. H.)

LIBOCEDRUS DECURRENS, INCENSE CEDAR

Libocedrus decurrens, Torrey, *Smithsonian Contrib.* vi. 7, t. 3 (1854); Sargent, *Silva N. Amer.* x. 135, t. 534 (1896), and *Trees N. Amer.* 73 (1905); Kent, Veitch's *Man. Conifera*, 253 (1900); Mayr, *Fremdländ. Wald- u. Parkbäume*, 315 (1906).

Thuja Craigana, Murray, *Botan. Exped. Oregon*, 2, t. 5 (1853).

Thuja gigantea, Carrière, *Rev. Hort.* 1854, p. 224 (in part) (not Nuttall).

Heyderia decurrens, Koch, *Dendrologie*, ii. 2, p. 179 (1873).

A tree, attaining in America 180 feet in height and 21 feet in girth, with a straight stem tapering from a broad base. Bark nearly an inch thick, light cinnamon-red, irregularly fissuring into ridges covered with appressed flat scales.

Leaves shining green, each set of four equal in length, adnate for most of their length to the branchlets, but free at the tips, which end in fine cartilaginous points; about $\frac{1}{8}$ inch long on the conspicuously flattened secondary and tertiary axes, increasing to $\frac{1}{2}$ inch on the main axes, which are only slightly flattened: those of the lateral ranks boat-shaped, gradually narrowing to an acuminate apex, keeled and glandular on the back, covering in part the median leaves, which are obscurely glandular and flattened, with broadly triangular cuspidate apices.

¹ A seedling is figured in *Ann. of Bot.* xvi. 557, fig. 30 (1902), concerning which Sir W. Thiselton Dyer says:—"The primitive leaves are not very different from the cotyledons, with which they are serially continuous; but after a time there is a complete change in the form and disposition of the foliar organs."

Flowers appearing in January at the end of short lateral branchlets of the previous year; staminate, $\frac{1}{4}$ inch long; pistillate, with ovate, acute, greenish-yellow scales, subtended at the base by two to six pairs of slightly altered leaves, which persist yellowish, sharp-pointed and membranous at the base of the fruit.

Cones about an inch long, pendulous, reddish-brown, on short branchlets with ordinary leaves. Scales six; lower pair short with a reflexed process; middle pair long, lanceolate, gradually narrowing to a rounded apex, below which is a minute deltoid spreading or reflexed process, and concave on the inner surface at the base, with depressions for the seeds; upper pair connate into a thick, woody, median partition, slightly longer than the fertile scales, crowned by three minute spines. Seeds four, two collateral on each of the middle scales; body, $\frac{1}{3}$ to $\frac{1}{2}$ inch, lanceolate, pale brown, containing liquid resin, marked with a white hilum on each surface at the base; wings two lateral, one short and narrow, the other oblique, produced above the seed, nearly as long as the scale, rounded at the narrow apex, and about one-third as broad as long in the middle widest part.

Seedling.—Seedlings sown at Colesborne in spring were about 3 inches high in August, and had a slender tap-root, about 5 inches long. Caulicle, $1\frac{1}{4}$ inch long, terete, brownish, glabrous. Cotyledons, two, $1\frac{5}{8}$ inch long, linear, nearly uniform in width, rounded at the apex, green beneath, marked above with numerous inconspicuous stomatic lines. Primary leaves variable in number, first pair opposite, succeeded by three or four whorls in sets of four each, or only one or two whorls are produced; linear, $\frac{3}{4}$ inch long, tapering to an acuminate apex, glaucous on both surfaces with indistinct stomatic lines. Above the primary leaves the stem gives off branches, and produces scale-like small leaves, arranged in four ranks, and intermediate in character between the primary leaves and the adult foliage. (A. H.)

DISTRIBUTION

Libocedrus decurrens was discovered by Fremont in 1846 on the upper waters of the Sacramento river. It was introduced in 1853 by Jeffrey, who collected for the Oregon Botanical Association of Edinburgh; and his specimens were named by Murray *Thuja Craigana* in honour of Sir W. Gibson Craig, one of the members of the association. Carrière confused the tree with *Thuja gigantea*; and for some time there was great confusion in the nomenclature of the two species. *Libocedrus decurrens* is the name now universally adopted.

According to Sargent, the distribution extends from the north fork of the Santiam river in Oregon, lat. $44^{\circ} 50'$, southward along the western slopes of the Cascade Mountains, and through the Sierra Nevada in California, occasionally crossing the range into Western Nevada; also along the Californian coast ranges from Mendocino county to the San Bernardino, San Jacinto, and Cuyamaca Mountains, reaching its most southerly point on Mount San Pedro Martin, half-way down the peninsula of Lower California. Sargent states that it is rather rare in Oregon, ascending to 5000 feet, and in the Californian coast ranges, where it rises to 5000 to 7000 feet; being most abundant and of largest size in the sierras of Central California at 3000 to 5000 feet, thriving best on warm, dry hillsides, plateaux, and

the floors of open valleys, usually growing singly or in small groves, often mixed with *Pinus ponderosa* and black oak.

Henry saw it in Oregon on the eastern spurs of the coast range near Kerby; and found it common on the road from there south-west across the Siskiyou range into Northern California, where it grew near Gasquet's Inn, about twenty miles inland from Crescent City on the coast. In these localities it occurred scattered on dry, sunny hills, in situations similar to that of *Pinus ponderosa*, at 2000 to 3000 feet altitude, and was not seen in shaded, moist ravines. The trees here are broadly pyramidal in habit, not assuming the columnar form of English cultivated trees, and of no great size, the largest measured being 123 feet by 11 feet 1 inch.

Plummer, in his report on the Cascade Forest Reserve, where a good illustration is given, on p. 102, of a grove of this tree, says:—"The incense cedar is almost always hollow-trunked or dry-rotted at the heart, even though the tree may have every outward appearance of perfect health. The wood has been very little used for any purpose but fuel or fencing, and is not cut when better is obtainable. It is said by Rothwell and Rix to ascend the mountains as high as 5750 feet."

Sudworth in his report on the Stanislaus and Lake Tahoe forest reserves¹ says that it is here an abundant tree at between 3500 and 5500 feet, but extends from 2000 to 7000 feet. Mature trees are from 80 to 100 feet high, and 4 to 7 feet in diameter, attaining these dimensions in from 100 to 200 years. Large trees, as shown by a photograph (plate cxiii. of Sudworth), are almost always rotten at heart. Reproduction by seed is good and abundant almost everywhere, especially in the drier situations.

The largest trees I have seen were on the lower slope of Mount Shasta at about 4000 feet, where I measured a tree 130 feet by 12 feet 7 inches which had been left standing when the surrounding forest was cut. Here it grew in company with Douglas fir, *Abies concolor*, and *A. magnifica*, on dry soil, and though the fruit on 1st September was fully formed the seeds were not ripe. The average size of the trees here was 90 to 100 by 8 or 9 feet. Prof. Sheldon says that it attains 100 to 150 feet high by 3 to 7 feet diameter, but such dimensions are not common.

CULTIVATION

When raised from seed it is somewhat slow in growth at first, but in good nursery soil soon makes a well-rooted plant, which is proof against the worst spring and winter frosts, and seems hardy on heavy soil and in damp situations, where *Thuja plicata* is sometimes injured when young. It produces very little seed in this country, and these do not always mature, and in consequence is usually propagated by cuttings.

Though it seems doubtful at present whether this tree can be looked on as a timber tree in England, yet on account of its rather stiff and formal habit it is well suited for the formation of small avenues, and when planted close together, as at Ashridge Park, forms a dense shelter without any clipping.

¹ Washington, 1900.

REMARKABLE TREES

The finest tree that I know in England is the one figured (Plate 142) which grows in the grounds at Frogmore. This was planted, as I am told by Mr. M'Kellar, by H.S.H. the Princess of Hohenlohe on 16th March 1857, and must be about 54 years old. It has been stated on a photograph taken for the late Hon. Charles Ellis to be 82 feet high, but when I measured it in 1904 I could not make it more than 65 feet, and being forked at about five feet from the ground its girth was about 9 feet.

Another very fine tree grows close to the house at Bicton, which in 1900 was 60 feet by 7 feet 7 inches; and at Killerton there is a tree 55 feet by 5 feet 5 inches. At Orton Hall, near Peterborough, the tree succeeds very well on rather heavy soil, which does not suit many conifers, and here a tree 60 feet by 6 feet 9 inches has borne fruit, from which Mr. Harding, gardener to the Marquess of Huntly, has raised seedlings, some of which are now 9 feet high; smaller ones which he sent me are growing at Colesborne. At Hardwicke, near Bury St. Edmunds, one of the healthiest young trees I have seen, which was only planted in 1873, is already 48 feet by 4 feet 5 inches. At Crowsley Park, Oxfordshire, a tree planted about 1850 was, in 1907, 53 feet high by 8 feet 1 inch in girth, dividing into two stems at 10 feet from the ground, but forming a very narrow column. At the Wilderness, White Knights, Reading, an extremely narrow tree is 60 feet high by 4½ feet in girth. At Nuneham Park, Oxford, there is a fine tree in the pinetum, which is 58 feet by 7 feet. At Bayfordbury, Herts, the best specimen is 52 feet by 5 feet 9 inches.

In Herefordshire the best specimen I know of is at Eastnor Castle, which forks at about 6 feet, and measured in 1906 53 feet by 7 feet 6 inches. There is a nice avenue of it in the grounds at Ashridge Park, and also a circle consisting of 32 trees at only 1 yard apart, which were planted by Earl Brownlow thirty-five years ago, and are now about 35 feet high.

Other remarkable trees which we have seen are at Fulmodestone, Norfolk, 58 feet by 5 feet 11 inches in 1905; at Highnam, Gloucester, 50 feet by 5 feet 3 inches in 1905; at Beauport, Sussex, 53 feet by 6 feet 2 inches at 2 feet up, dividing into two stems, a conical tree, with extremely dense foliage, in 1904; at Dropmore, a large tree not measured. At Coldrinick, Cornwall, there is a tree which Mr. Bartlett informs us, was, in 1905, 51 feet by 6½ feet. Mr. R. Woodward, jun., measured in 1906 a tree at Wexham Park, Stoke Pogis, 56 feet by 3 feet. At Salhouse, Norfolk, Sir Hugh Beavor measured, in 1904, a tree 57 feet by 6 feet 8 inches. A fine specimen at Tittenhurst, Sunninghill, is figured in *Gardeners' Chronicle*, xxxvi. 284, fig. 127 (1904).

In Scotland the tree is not so common, though specimens 40 to 50 feet high are growing in various places; the tallest reported at the Conifer Conference of 1891 was at Torloisk in Mull, and then measured 37 feet in height.

At Smeaton-Hepburn, East Lothian, a tree planted in 1843 was measured by Henry in 1905 as 53 feet by 5 feet 4 inches. A tree at Keir, Perthshire, seen

by Henry, was 42 feet by 4 feet 10 inches in 1905. At Brahan Castle, Ross-shire, Col. Stewart Mackenzie of Seaforth informed us in 1904 that he had a tree 4 feet 10 inches in girth, height not stated.

In Ireland, *Libocedrus decurrens* is rare in cultivation. At Stradbally Hall, Queen's County, a fine tree measures 53 feet high by 5½ feet in girth. There is a tree at Fota 45 feet high, dividing into two stems at 2 feet from the ground. At Churchill, Armagh, a fine healthy specimen, growing in sand, was 45 feet by 4 feet 10 inches in 1905. At Adare a tree measured, in 1903, 47 feet high by 7 feet 9 inches in girth.

In North Italy this tree grows larger than in England and ripens seed freely, which it rarely does here. At Pallanza, in Rovelli's nursery, I measured a splendid tree over 90 feet high by 9 feet 3 inches in girth. Another on the Isola Madre was 90 feet by 9 feet 10 inches, from which I gathered seed in October 1906, which have produced a good crop of seedlings.

It also ripens seed and grows well in the climate of Paris, and also at Les Barres, and has produced self-sown seedlings at Thiollets (Allier).¹ The largest I have seen in France is at Verrières, near Paris, a handsome and well-shaped tree, which measured, in 1905, 50 feet by 5 feet 5 inches, and is figured on plate vii. of *Hortus Vilmorinianus* (1906). (H. J. E.)

¹ Pardé, *Arb. Nat. des Barres*, 32 (1906).

CUNNINGHAMIA

Cunninghamia, R. Brown, in Richard, *Conif.* 80, t. 18 (1826); Bentham et Hooker, *Gen. Pl.* iii. 435 (1880); Masters, *Journ. Linn. Soc. (Bot.)* xxvii. 304, fig. 18 (1889), and xxx. 25 (1892).
Belis,¹ Salisbury, *Trans. Linn. Soc.* viii. 315 (1807).
Jacularia, Rafinesque, in Loudon, *Gard. Mag.* viii. 247 (1832).
Raxopitys, Nelson (Senilis), *Pinaceæ*, 97 (1866).

A GENUS, belonging to the Coniferæ, with only one known living species,² and doubtfully represented in the fossil state.³

Cunninghamia is considered by Bentham and Hooker, and by Masters, to be a member of the family Araucariæ; but it is placed by Eichler⁴ in Taxodineæ. Seward and Ford, who have lately published an exhaustive monograph⁴ of *Araucaria* and its allied genus *Agathis*, agree with Eichler that it has no close relationship with those genera. It appears, however, to be a connecting link between the Araucariæ and the Taxodineæ; and mainly differs from *Araucaria*, some species of which it closely resembles, in foliage, in having three ovules on the bract, and not one only, as in that genus.

The generic characters are given in the following detailed account of the species:—

CUNNINGHAMIA SINENSIS

Cunninghamia sinensis, R. Brown, *loc. cit.* (1826); Lambert, *Genus Pinus*, ed. 2, t. 53 (1832); Loudon, *Arb. et Frut. Brit.* iv. 2445 (1838); Murray, *Pines and Firs of Japan*, 116, figs. 216-224 (1863); Kent, *Veitch's Man. Conifera*, 292 (1900); Shirasawa, *Icon. Ess. Forest. Japon.* text 23, t. 9, ff. 1-24 (1900).
Cunninghamia lanceolata, W. J. Hooker, *Bot. Mag.* t. 2743 (1827).
Pinus lanceolata, Lambert, *Genus Pinus*, ed. 1, t. 34 (1803).
Belis jaculifolia, Salisbury, *loc. cit.* 316 (1807).
Belis lanceolata, Sweet, *Hort. Brit.* 475 (1830).

¹ This name, though the earliest, is not adopted on account of its close resemblance to the genus *Bellis*, used for the daisies.

² While the above was passing through the press, there has been received at Kew a specimen of a new species of *Cunninghamia*, lately discovered in the mountains of Formosa at 7000 feet altitude. This species, which will shortly be published by Mr. Hayata, differs from *C. sinensis* in having shorter leaves, acute and not acuminate at the apex. Mr. Hemsley is inclined to think that a specimen, preserved in the Herbarium, which was collected on Mt. Omei, in Western China, by Faber, is possibly a third distinct species.

³ Engler u. Prantl, *Natur. Pflanzenfamil.* ii. 85 (1889). *Cunninghamites*, an allied fossil genus, has been found in the Keuper and Chalk deposits in Saxony, Bohemia, Westphalia, Southern France, and Greenland. Cf. Schimper u. Schenck, *Palæontologie*, 283 (1890).

⁴ *The Araucariæ: Phil. Trans. Roy. Soc.*, vol. cviii. p. 308 (1906).

Cunninghamia

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An evergreen tree, attaining in China 150 feet in height and 18 feet in girth of stem, with brownish bark scaling off in irregular longitudinal plates, and exposing a reddish cortex beneath. Branches at first in pseudo-whorls, afterwards given off irregularly. Young branchlets sub-opposite or in pseudo-whorls, covered with green epidermis; older shoots brownish except for the green leaf-bases. Leaves persistent alive five to seven years, afterwards remaining dry and dead for many years on the branches and even upon the stem; densely and spirally arranged on the branchlets, but twisted on their bases so as to be thrown into two lateral spreading ranks; narrowed at the base and decurrent on the shoot to the insertion of the next leaf; rigid, more or less curved, narrowly lanceolate, acuminate, 1 to 2 inches long; upper surface dark green, concave with slightly raised margins; lower surface convex, with a green midrib and two white stomatic bands, the stomata in several regular lines; sharply and finely serrate; with one resin-canal beneath the single unbranched fibrovascular bundle.

Staminate flowers, five to ten in an umbel at the apex of a branchlet; the umbel surrounded at its base by numerous triangular imbricated serrulate bracts; each flower a spike-like cylindrical column of spirally crowded stamens; each stamen consisting of a slender stalk with an ovate serrulate connective, from which hang three longitudinally-dehiscing anther-cells. Female flowers, single or three or four together at the apex of a branchlet; erect ovoid cones, composed of numerous spirally imbricated lanceolate mucronate bracts in a continuous series with the leaves; lower bracts sterile, resembling leaves but with thickened bases; ovular scale on the upper fertile bracts visible only as a slight projection; ovules three on the base of each bract, reversed.

Fruit, an ovoid-globose brownish cone, about 1½ inch long, composed of thin woody scales, which are the bracts of the flowers increased in size and hardened, but otherwise little altered; loosely imbricated, serrate in margin, broadly ovate or reniform, with a cusped apex often reflected outwards. Seed-scale visible only as a transverse narrow membranous fimbriated projection on the inner surface of the woody bract, below its centre and above the seeds. Seeds three on each bract, about ¼ inch long, brown, oblong compressed, surrounded by a membranous narrow wing. Cotyledons two. The cones persist for a year or more on the branchlets after the escape of the seed; and are occasionally proliferous, the elongated shoot above the cone producing leaves and growing to be several inches in length.¹

Seedling.—Seedlings sown at Colesborne in spring were about 3 inches high in August, and had a short flexuose tap-root, provided with a few lateral fibres. Caulicle brownish, terete, glabrous, 1 inch long. Cotyledons two, about ½ inch long, coriaceous, entire, linear, with a median groove beneath. Young stem glabrous, ridged by the decurrent bases of the leaves. Leaves numerous, spirally arranged on the stem, ½ to 1½ inch long, soft in texture, linear, curved, broad at the base, whence they taper gradually to a fine bristle-pointed apex, serrulate in margin, green above, marked beneath with two narrow white stomatic bauds.

In *Cunninghamia*, as in *Araucaria*, root-suckers are often produced, which grow

¹ Cf. *Woods and Forests*, 1884, p. 593, and *Garden*, xxix. 173 (1886).

into young trees, close to the parent stem. Coppice shoots are also produced freely from the stools in China, when the trees are felled.

Cunninghamia¹ was discovered in 1701 by J. Cunningham in the island of Chusan; and his specimens, preserved in the British Museum, were early described by Plukenet.² The first accurately scientific description, however, is due to Lambert, and was based on specimens brought home by Sir G. Staunton, who accompanied Lord Macartney's embassy to China in 1793.

The tree has been known to the Chinese from the most ancient times, being mentioned in their earliest classical writings. It is called *sha*, a name, however, which is often applied also to *Cryptomeria* and other conifers yielding valuable timber. It was introduced³ by William Kerr from Canton into Kew Gardens in 1804; but no trees of that date now exist there. Probably most of the existing trees in England were raised from seed collected by Fortune about 1844.

Cunninghamia is widely spread throughout the central, western, and southern provinces of China, extending southwards from Szechwan, Hupeh, Kiangsi, and Kiangsu to Yunnan and Kwangtung. It is usually a tree of mountain valleys, requiring a hot summer and considerable humidity to thrive; and ranges in altitude from sea-level to 5000 feet, occurring in Central China below the zone, which, in the high mountains, is covered by silver fir and spruce. There appear to be large forests of it in the interior of Hunan and Fokien, judging from the vast quantities of its timber which are exported from there. In Fortune's time it was abundant on the islands of Chusan and Pootoo, but was rare in Hongkong, where the only wild trees of this species grew as isolated specimens in the Happy Valley. Fortune,⁴ in 1849, passed through fine forests of *Cunninghamia* in the mountains of Northern Fokien, many of the trees being 80 feet in height, and perfectly straight; and he noticed variations in the tint of the foliage. He met with dense woods in the Snowy Valley and other parts of Chekiang, but the trees were usually young, and not remarkable for size.

Mr. E. H. Wilson informs me that there are magnificent forests of *Cunninghamia* in Western Szechwan. One which he specially noted in the Upper Ya Valley extended for fifty miles between 2000 and 5000 feet altitude, the best trees ranging from 100 to 150 feet in height, and from 15 to 18 feet in girth; and when growing in close stands, with straight stems clean to 40 feet or more, the branches above being short, slender, and horizontal. In the open the trees have much longer pendulous branches. The foliage is occasionally glaucous. Where trees had been cut down, new growth was being everywhere produced by shoots from the stools. Mr. Wilson mentions the common use of the timber in China for house-building purposes generally, and for the masts and planking of native craft. The bark is also used in the mountains for roofing houses. In the Chien Chang Valley in

¹ In a note in King's *Survey of the Coasts of Australia*, ii. 564 (1826), R. Brown states that he requested Richard to change the name *Belis*, given by Salisbury, into *Cunninghamia*, in honour of both J. Cunningham, the discoverer of the tree, and of the collector Allan Cunningham.

² *Amaltheum Botanicum*, i. t. 351, f. 2. (1705).

³ Aiton, *Hortus Kewensis*, v. 320 (1813).

⁴ *Wanderings in China*, 379 (1847); *Tea Countries*, ii. 178, 212 (1853); *Residence among the Chinese*, 189, 277 (1857).

Szechwan, owing, according to tradition, to earthquakes some two centuries ago, landslips occurred which have buried whole forests in certain places beneath the soil. The dead timber is now being dug out, and is in an excellent state of preservation, being redder and more fragrant than the ordinary timber. It is known to the Chinese as fragrant *Cunninghamia*, *hsiang-sha*, and sells for extraordinary prices, selected thick planks for coffins often being worth £12 to £60 a piece.

The wood, according to Mayr,¹ is extraordinarily light, with a broad sap-wood and a dark yellow heart-wood. It is used extensively in the coast ports of China for making tea-chests.

Cunninghamia appears to be confined as a wild tree to China; but it is occasionally planted² in Japan, the Loochoo Islands, and Formosa. M. Hickel has lately received seeds from Tongking, but these may have been gathered from cultivated trees.

(A. H.)

REMARKABLE TREES

The growth of this tree in England depends mainly on the amount of heat in summer, which in most places is evidently insufficient; and though it endures severe winter frosts without much injury on well-drained soil, it suffers much from wind and frost in spring. It rarely ripens seed in this country, the only case I know of being a tree at Penrhyn Castle which is now dead, but from whose seed some young trees were raised. The best of these, when I saw them in 1906, was about 10 feet high.

The tallest trees of this species that we know are at Killerton, where, in 1904, there were two which measured 62 and 60 feet in height by 4 feet in girth. One of these has since been cut down, its branches having become ragged, and a section sent to the Kew Museum shows the age to be at least 63 years. Another, at Bicton, was, in 1906, 56 feet by 4 feet 10 inches, also rather ragged in its branches. There is a tree at Highnam, in Gloucestershire, about 25 feet high.

At Heanton Satchville, the seat of Lord Clinton, in North Devon, there is a slender but healthy-looking tree 50 feet by 3 feet, and another one which has thrown up a shoot from the stool. At Escot in South Devon, the seat of Sir John Kennaway, Miss Woolward measured one in 1905, 45 feet high. At Pencarrow in Cornwall Mr. Bartlett showed me a tree, planted by Sir W. Molesworth in 1850, which was in 1905 40 feet by 4 feet 8 inches, and one of the healthiest that I have seen; and there is a smaller tree, 30 feet by 4 feet, at Coldrinick, in the same county.

Coming farther east there is a splendid tree at Bagshot Park, the seat of H.R.H. the Duke of Connaught, which, when I saw it in May 1907, was no less than 47 feet high by 7 feet in girth, and 48 yards in the circumference of its branches. Being on very well drained soil, and well sheltered by other trees, it has suffered

¹ *Fremdländ. Wald- u. Parkbäume*, 285 (1906).

² Cf. Hayata, in *Tokyo Bot. Mag.* xix. 50 (1905).

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little from frost and wind, and is the handsomest and best-shaped tree¹ I have seen (Plate 143).

At Beechlands, near Lewes, the seat of Captain Rose, I am told by Mr. Chisholm that there is a *Cunninghamia* 50 feet high by 5 feet 1 inch in girth, forked near the top. It bears many cones, which, however, do not produce fertile seeds.

At Grayswood, Haslemere, a tree planted in 1882 is 30 feet high by 2 feet 7 inches in girth, but has not a very thriving appearance. Another at Redleaf, near Penshurst, Kent, the seat of Mrs. E. Hills, though forked near the ground, has one good trunk 47 feet by 5 feet 4 inches, and healthy foliage. At Langley Park, near Norwich, the seat of Sir Reginald Beauchamp, there is a tree 35 feet by 3 feet, which though healthy looking has grown but little for many years. At Tittenhurst,² near Sunninghill, there is a fine healthy tree over 20 feet in height. At Bayfordbury, Herts, *Cunninghamia*, though planted several times, has never succeeded, being much injured by spring frosts, and only one specimen, a few feet high, survives.

The most northern point at which I have seen the tree growing in England is in the sheltered Duchess' garden at Belvoir Castle. This, I was told by Mr. Divers, was planted in 1844, and in 1907 measured 39 feet by 3 feet 2 inches; but Mr. Fenner informs me that there is one 32 feet high at Holker Hall, Lancashire.

In Scotland, as might be expected, there are no trees of any great size. At Brodick Castle, in the Isle of Arran, a tree, which was planted about the year 1858, had only attained, according to the Rev. Dr. Landsborough,³ 10 feet high in 1895, and never throve. There was formerly a tree at Smeaton-Hepburn, East Lothian, which died about five or six years ago after a drought.

In Ireland, *Cunninghamia* is a very rare tree. There is one in Mr. Walpole's garden at Mount Usher in Co. Wicklow, which was in 1903 31 feet high by 2 feet 2 inches in girth. It was supposed to be then about 28 years old. In Mr. Acton's arboretum at Kilmacurragh, in the same county, there is a thriving specimen, which Henry measured in 1903 as 25 feet high by 1½ feet in girth.

Around Paris⁴ the tree always looks suffering, the leaves turning yellowish and assuming a burnt aspect; but it grows well at Les Barres,⁵ and fructifies annually. In North Italy the climate evidently suits the tree much better, as I saw, in the grounds of the Villa Ceriana near Intra, a tree 76 feet by 7 feet 4 inches, producing cones freely in 1906, from which I have raised healthy seedlings. At Locarno,⁶ on the northern end of Lake Maggiore, a tree planted fifteen years is 23 feet in height.

(H. J. E.)

¹ John Smith, in *Records of Kew Gardens*, 290 (1880), states that a *Cunninghamia*, possibly the same tree as the one mentioned above, bore cones at Bagshot in 1838.

² *Gard. Chron.* xxxvi, 284 (1904).

³ *Trans. Bot. Soc. Edin.* 1896, xx, 527.

⁴ Moullefert, *Traité des Arbres*, ii, 1336 (1898).

⁵ Pardé, *Arb. Nat. des Barres*, 57 (1906).

⁶ Christ, *Flore de la Suisse*, 77 (1907).

LIQUIDAMBAR

Liquidambar, Linnæus, *Gen. Pl.* 463 (1742); Bentham et Hooker, *Gen. Pl.* i. 669 (1865); Engler u. Prantl, *Pflanzenfam.* iii. pt. 2, 123 (1891).

DECIDUOUS trees belonging to the order Hamamelideæ. Leaves alternate on long shoots, crowded and almost fascicled on short shoots, long-stalked, simple, palmately lobed, glandular-serrate. Stipules two, attached to the petiole near its base, lanceolate or subulate, caducous or persisting throughout the summer.

Flowers monœcious, or in rare cases polygamous, in heads subtended at the base by caducous bracts. Staminal heads, globose or elongated, several in a raceme on an erect axis, which is subterminal; each head composed of numerous stamens, interspersed with minute scales, without corolla or calyx; filaments slender; anthers basi-fixed, oblong-obcordate, dehiscing longitudinally. Pistillate heads solitary, on long pendulous stalks, arising in the axils of the uppermost leaves, composed of numerous confluent flowers, the ovaries embedded in the axis of the inflorescence; calyces minute, united together and with the ovaries, and bearing on their summits each four or more stamens, with usually aborted anthers; corolla absent; ovary two-celled, each cell with numerous ovules; styles two, recurved, stigmatic above on their inner surface.

Fruit: a woody spherical head, composed of numerous capsules, consolidated together. Capsule with two valves, opening above to let out the seeds, each valve terminating in a beak (the hardened woody persistent style); calyx persistent, either minutely tuberculate or produced above into long spines. Perfect seeds, angled, winged above, one or two in a capsule, the remaining ovules having aborted. Most of the capsules, however, contain only numerous minute unfertile seeds without wings.

The leaves of *Liquidambar* resemble strongly those of certain maples; but in the latter they are always opposite, and not alternate or fascicled as in the former. Moreover, stipules or their scars are present on the petiole near its base in *Liquidambar*, and are absent entirely in *Acer*.

Three species of *Liquidambar* are well known, and occur in cultivation. Besides these there are apparently two species,¹ wild in China, which are imperfectly known and not introduced.

¹ These are:—

1. *Liquidambar Rosthornii*, Diels, *Flora von Central China*, 380 (1901), a small tree occurring in Szechwan; flowers and fruit unknown. It resembles in foliage *L. orientalis*.

2. *Liquidambar* sp., Hemsley, *Journ. Linn. Soc. (Bot.)* xxiii. 292 (1887). Specimens, consisting of detached leaves and fruits, were sent to Kew from Hankow by Consul Alabaster. Judging from the imperfect material, this is a distinct species. Mr. E. H. Wilson has recently observed a species of *Liquidambar*, growing on the plain near Kiukiang, in Kiangsi, which is probably the same. Cf. *Gard. Chron.* xlii. 344 (1907).

The species in cultivation are :—

1. *Liquidambar styraciflua*, Linnæus. North America.

Shoots glabrous. Leaves large, usually five-lobed, only occasionally lobulate in margin; under surface glabrous, except for dense tufts of pubescence in the axils of the main nerves at the base, and occasional minute tufts at the junctions of the lateral and main nerves.

2. *Liquidambar orientalis*, Miller. Asia Minor.

Shoots glabrous. Leaves small, five-lobed, margin with large lobules; under surface quite glabrous.

3. *Liquidambar formosana*, Hance. China, Formosa, Tonking.

Shoots pilose. Leaves large, usually three-lobed; under surface pilose, without conspicuous axil-tufts.

LIQUIDAMBAR STYRACIFLUA, SWEET GUM

Liquidambar styraciflua, Linnæus, *Sp. Pl.* 999 (1753); Loudon, *Arb. et Frut. Brit.* iv. 2049 (1838); Oliver, in Hooker, *Icon. Plant.* xi. 13 (1867); Sargent, *Silva N. Amer.* v. 10. t. 199 (1893), and *Trees N. Amer.* 340 (1905).

Liquidambar macrophylla, Oersted, *Am. Cent.* xvi. t. 10 (1863).

A tree, attaining in America 160 feet in height and 17 feet in girth. Bark deeply and longitudinally fissured, with broad ridges covered by thick corky scales.

Young shoots green, glabrous. Leaves (Plate 199, Fig. 7) large, averaging 6 inches broad and 5 inches long, variable in form, cordate or almost truncate at the base, five-nerved, palmately and deeply cut into five oblong-triangular acuminate lobes, the terminal lobe largest, the basal lobes smallest, rarely lobulate; serrations shallow, non-ciliate; upper surface dark green, shining, glabrous; lower surface light green, shining, glabrous except for dense tufts of pubescence in the axils of the nerves at the base and occasional minute tufts at the junctions of the lateral and main nerves. Petiole glabrous, slightly grooved on its upper side, dilated at the base, near which are two scars indicating where the lanceolate stipules have fallen off in early summer.

Fruiting heads, about 1½ inch in diameter, hanging on the tree during winter after the fall of the seeds in autumn, calyx margins with irregular small tubercles; capsules with two stout style appendages, forming woody spines, one terminating each valve. Perfect seeds few, with short terminal wing; imperfect seeds numerous, minute, angled, without wings.

The branchlets¹ of many trees of this species are remarkable for their corky wings, which begin to develop in the second season and increase in width and thickness for many years. These wings occur on lateral branches, on the upper side only, in three or four parallel ranks; but on vertical branches they are borne irregularly on all sides. Trelease² observed in the case of *Liquidambar* trees

¹ See Miss Gregory in *Botanical Gazette*, xiii. 282 (1888).

² *Garden and Forest*, 1890, p. 195.

growing in Tower Grove Park, St. Louis, that about half the trees either showed no sign of the corky wings or in some cases only a slight trace of them. In Kew Gardens the same difference is noticeable in trees of the same age growing close together, some being without corky-winged branchlets, while others have them much developed.

The leaves usually turn a most brilliant colour in autumn, the tint being red purple, or yellow.

IDENTIFICATION

In summer the maple-like but alternately-placed leaves are unmistakable. In winter (Plate 200, Fig. 2) the following characters are available: Twigs moderately stout, slightly angled, greenish, glabrous; lenticels scattered, prominent. Leaf-scars alternate, obliquely set on projecting pulvini, arcuate or semicircular, marked by three bundle-dots. Terminal bud about ½ inch long; lateral buds smaller, varying in size, and directed outwards from the twig at an angle of about 45°; all ovoid, acute at the apex, and composed of six to seven imbricated scales, which are green with brown margins, vaulted on the back, shining, glabrous, ciliate, and often minutely cuspidate at the apex.

Short shoots are numerous in this species, and, unlike the long shoots, are pubescent. All the shoots show at the base ring-like marks, indicating where the accrescent scales of the terminal bud of the preceding year have fallen off in spring.

VARIETIES

Though Oersted considered the Mexican and Guatemalan trees to constitute distinct forms, no varieties have been clearly made out. The species occurs over a wide extent of territory and in diverse climates; and certain differences are observable in the shape, size, and pubescence of leaves in wild specimens; but these scarcely warrant the division of the species into geographical forms. In dry regions in Mexico the under surface of the leaf is covered with dense pubescence. Leaves with only three lobes occur on adult trees in Mexico and Guatemala; but as three-lobed leaves are frequently borne on young shoots of the common form, this peculiarity scarcely merits the rank of a variety. (A. H.)

DISTRIBUTION

The *Liquidambar* or Sweet Gum,¹ as it is usually called in the United States, has a very wide range of distribution. Its most northerly station is, according to Sargent,² near Newhaven, Connecticut, where it only grows near the coast as a small tree, 40 to 60 feet high. Farther south it extends westwards as far as S.E. Missouri and Arkansas, and in the south to Florida and Texas, reappearing on the mountains of Mexico and Guatemala. In the maritime region of the South Atlantic States and in the Lower Mississippi basin it is one of the most abundant

¹ Also known as Red Gum.

² *Garden and Forest*, ii. p. 232.

forest trees, but only attains its full size and perfection in deep rich swamps and river bottoms. I have seen it of immense size in the Lower Wabash Valley in Southern Illinois, where Ridgway measured a tree no less than 164 feet high by 17 feet in girth with a clear stem 80 feet long, and another 137 feet high by 11½ feet in girth, which was 94 feet to the first branch. Plate 144 A, taken from a photograph for which I am indebted to the U.S. Bureau of Forestry, represents the tree (Example M) mentioned in *Proc. U.S. Nat. Mus.* v. 67, by Ridgway, which was 12½ feet in girth at the base, 78 feet to the first limb, and contained 7888 feet board measure. It grew two miles from Mount Carmel on land now cleared. Such trees, however, are now hardly to be found except in very inaccessible places. On the coast region of North Carolina, Ashe and Pinchot give its dimensions as 100 feet high and 5 or 6 feet in diameter.

The largest that I saw in the Eastern States was a tree in the Clifton Park, near Baltimore, which was 71 feet by 5 feet 9 inches. In New England, near Boston, Sargent says that it suffers from frost in severe winters, and I saw none in cultivation so large as those in England. I found it in a very different and more beautiful form in the mountains near Jalapa, Mexico, at about 4000 feet elevation, where in the month of March in open forests its leaves were conspicuous by their scarlet colour, but the trees were not of extraordinary dimensions. In America it grows mixed with *Nyssa*, *Liriodendron*, maples, and oaks. Ashe says that it fruits annually or every other year, but that much of the seed is abortive, and that it springs up commonly on damp hillsides and bottom lands, and also shoots from the stool after the trees have been felled.

HISTORY AND CULTIVATION

According to Loudon, this tree was first mentioned by Francis Hernandez, a Spanish naturalist, who published a work on the natural history of Mexico in 1651 at Rome. In 1681 it was sent home by Banister to Bishop Compton, who planted it in the Palace Gardens at Fulham. It had become common in cultivation in Michaux's time, but he says that even in France it had never produced seed. In Northern Italy it grows well, and I found a good-sized tree on the Isola Madre in Lake Maggiore, which bore seed, from which I have raised plants.

Though this tree will grow to considerable size in the warmest parts of England, and on account of its beautiful autumnal tints is highly ornamental, yet it requires a much greater degree of heat and moisture than our climate affords to bring it to perfection, and has been somewhat neglected by nurserymen on account of its tenderness when young. I have raised it from imported seeds, which do not keep well when extracted from the fruits, but the seedlings grow so slowly that the more common way of raising it is from layers. It does not transplant well, and requires a good deal of moisture in the soil and a warm, sheltered situation. Its branches are easily broken by the wind, and though it does not come early into leaf, is often injured by late frosts.

REMARKABLE TREES

The largest trees mentioned by Loudon were at Strathfieldsaye (64 feet) and at Syon (59 feet), the latter tree being reported in 1849 to measure 84 feet by 4 feet. We cannot identify either of them now; but at Syon there is a tree, leaning considerably to one side, which was about 75 feet by 6 feet in 1904. The tallest which I have seen is at Godinton, the property of G. Ashley Dodd, Esq., near Ashford, Kent, which in 1907 was 82 feet by 6 feet, a piece estimated at 12 feet long having been broken off the top; and the next to it is one at Petworth, which Sir Hugh Beevor measured in 1894, 84 feet by 5 feet 7 inches; another tree at the same place, 7 feet 6 inches in girth, has been damaged at the top by wind.

Miss Woolward tells me of a fine tree at Escot, Devonshire, the seat of Sir John Kennaway, which was referred to by Bunbury as the largest known to him, and in 1905 measured 75 feet by 7 feet 8 inches. At Cobham Hall, Kent, there is one which I measured as 80 feet by 5 feet 9 inches; and at Broom House, Fulham, there are two trees on the lawn of about the same height and over 6 feet in girth.

At Barton,¹ Suffolk, there are four trees, which were planted in 1825-26, the two largest measuring, in 1904, 71 feet by 5 feet 6 inches and 52 feet by 3 feet 2 inches. At Arno's Grove, Middlesex, a tree drawn up in a plantation, measured by Henry in 1904, was 83 feet by 3 feet 10 inches. A large tree which we have not seen was reported² to be growing on the lake side at Chevening Park, near Sevenoaks, Kent. At Arley Castle there is a tree 65 feet by 4 feet 3 inches.

In Scotland we have no records worth mentioning, though the species exists in the south-west.

In Ireland there is a good tree at Fota, which in 1903 measured 57 feet high by 8 feet in girth.

TIMBER

Though neglected until recent years this tree is now very largely cut for timber in the Mississippi valley, and has been introduced to Europe under the name of satin walnut. Owing to its low price it has been tried, under the name of red gum, for street paving with very bad results, though, according to Stone,³ it is very resilient, and if creosoted may be a useful wood for this purpose.

A careful investigation of the mechanical properties of this wood was made by A. K. Chittenden of the U.S.A. Bureau of Forestry in 1905,⁴ from which I take the following:—"Red Gum is perhaps the commonest timber tree in the hardwood bottoms and drier swamps of the Southern States, growing best on alluvial soil of great fertility, which is liable to heavy floods in winter and spring, and often covered with water from January till May. In the best situations it reaches a height of 150 feet and a diameter of 5 feet. It reproduces well only where there is sufficient light, as the seedlings will not bear shade. It also sprouts readily from the stump up to about fifty years of age, but such shoots rarely form large trees. The demand for

¹ Bunbury, *Arboretum Notes*, 28.

² *Garden*, xxxviii. 208 (1890).

³ *Timbers of Commerce*, 113 (1904).

⁴ *U.S. Dept. of Agriculture, Bureau of Forestry, Bulletin*, No. 58 (1905).

the timber has increased rapidly during the last few years, owing to the increasing scarcity of better timber, and about 75 per cent. of the best grades, 'Nos. 1 and 2 clear heart,' are exported to Europe for furniture and inside fittings. It is said to make very good flooring, and is now largely used for railway waggon box boards, the price in the U.S.A. being about 27 dollars per 1000 feet for firsts and seconds, as compared with 41 dollars for cypress. From 1900 to 1902 much of the wood was cut into 3-inch by 9-inch planks, to be used for cutting paving blocks in London, but in 1902 the market for this gave way, and the mills are now trying to introduce this wood as a paving-block material in the United States, where several large cities were in 1905 considering the use of this wood. The qualities necessary for a good paving block are durability, close grain, and the power of resisting abrasion. These qualities are found in red gum."

A very unfortunate experiment was made in Whitehall in the autumn of 1901, when the Corporation of Westminster accepted the tender of an American contractor to pave this street with "red gum." The surveyor seems to have supposed that red gum in America was the same as red gum in Australia, where the name is applied to several species of eucalyptus, which have a good reputation for street paving. Be this as it may, the paving wore out so soon that a large proportion was taken up again in July 1902, and a long and costly lawsuit followed. The contractor alleged (1) that the defects arose from the bad foundations of the road; (2) from excessive watering; (3) from stones having been forced into the pavement; and the case was not finally settled till October 1905.

Mr. Weale tells me that an inferior quality of this wood containing much sapwood is also known in the trade as "hazel pine." "Satin walnut" is worth wholesale from 2s. to 2s. 3d. per cube foot, and "hazel pine" only 1s. 3d. to 1s. 6d. In colour the former is a light fawn, often marked with a rich dark stripe; but is so deficient in strength and durability, and even when well seasoned is so liable to warp and twist, that it is only used for the cheapest classes of furniture.

Michaux says that though much inferior to black walnut and cherry, it was used a good deal in his time in America for picture-frames, bedsteads, coffins, and furniture. Red gum is now much used for veneer in the United States. It furnishes 17 per cent of all the veneer produced, the quantity in 1905 being over 187 million square feet.¹ I brought from St. Louis a slab of this timber cut from a tree of 30 inches diameter, of which the sapwood was about 6 inches thick and much paler in colour. Though cut 4 inches thick this plank cracked badly in drying; and it will evidently be a very difficult wood to dry without warping. It has a very close, fine grain, and takes a good polish.

(H. J. E.)

¹ U.S. Dept. Agric. Forest Service Circular, No. 51 (1906).

LIQUIDAMBAR ORIENTALIS

Liquidambar orientalis, Miller, *Gard. Dict.* No. 2 (1768); Oliver, in Hooker, *Icon. Plant.* xi. 13, t. 1019 (1867); Hanbury, *Science Papers*, 139, with figure (1876); Bentley and Trimen, *Medicinal Plants*, ii. No. 107, t. 107 (1880).

Liquidambar imberbe, Aiton, *Hort. Kew.* iii. 365 (1789); Loudon, *Arb. et Frut. Brit.* iv. 2053 (1838).

A tree attaining in Asia Minor 40 to 60 feet in height. Bark longitudinally fissured, with corky irregularly quadrangular scales on the ridges, the orange-coloured inner bark visible in the fissures. Young shoots glabrous. Leaves (Plate 199, Fig. 6) small, averaging 3 inches wide by 2½ inches long, palmately cut about half-way into five oblong triangular acute lobes, the upper three lobes usually with one to four lobules; base truncate or widely cordate; margin with shallow glandular serrations; upper and lower surfaces quite glabrous in cultivated trees, but with axil tufts of pubescence at the base of the under surface in wild specimens. Petiole glabrous, swollen at the base, and bearing near its insertion two minute triangular stipules.

Flowers and fruit similar to those of *Liquidambar styraciflua*, but smaller. Fruiting head about 1 inch in diameter; capsules with more slender beaks than in the preceding species; calyx slightly tuberculate and not spiny.

In winter the twigs resemble those of the American species, but are more slender, with smaller leaf-scars and buds, which are reddish and have six glabrous ciliate scales; short shoots glabrous.

This species does not apparently develop corky ridges on the branches.

DISTRIBUTION

Liquidambar orientalis is known to occur wild only in the south-western part of Asia Minor lying opposite to the island of Rhodes, and in Cilicia, near Alexandretta. It forms woods of considerable extent in the district of Sighala, near Melasso, and in the vicinity of Budrum, Mughla, Djova, Ughla, Marmoriza, and Isgengak. According to Maltass, who obtained specimens for Hanbury, there is a fine forest of this species between the village of Caponisi and the town of Mughla, many trees attaining 40 feet in height, while in other forests, according to native report, they were as high as 60 feet.¹

Liquid storax, a balsamic resin, obtained from the inner bark of the tree by boiling it in water, is exported in considerable quantity from Smyrna and other Levantine ports, the bulk of this product going to China and India, where it is known in commerce as rose maloes.² Liquid storax is used to a small extent by druggists in this country, and is one of the ingredients of "Friar's Balsam."

¹ Elwes passed through this district in 1874 on the way from Makri to Ephesus, but saw no trees of any size. This is a very hot country in summer, myrtle, oleander, and arbutus being the common shrubs.

² Rose maloes is a corruption of rassamala, the Javanese and Malay name for *Altingia excelsa*, Noronha, a tree allied to *Liquidambar*, which yields by incisions in the bark a sweet-scented resin. Cf. Bretschneider, *Bot. Sincum*, iii. 464 (1895).

CULTIVATION

The Oriental Liquidambar was introduced into France about the middle of the eighteenth century by the French Consul at Smyrna, and speedily passed into England, where it was cultivated in 1759 by Miller.

It grows very slowly in this country, where it is very rarely seen in cultivation. There is a tree in Kew Gardens, about 15 feet high, the age of which is unknown. According to Nicholson it was 10 feet high in 1884. It has a twisted, crooked trunk, dividing about 6 feet up into two main stems. The branches are numerous and drooping, the habit of this tree being in marked contrast to that of a tall *Liquidambar styraciflua* close beside it, and probably results from the young branchlets being continually killed by the frost.

A larger and very old tree at White Knights, near Reading, in the grounds of Mr. J. Heelas, was in 1904 about 25 feet high by 3 feet 4 inches in girth, and was decayed at the top, with many dead branches and a hole in the butt close to the ground.

This tree is commonly cultivated in the Mediterranean region; and Mr. Hickel, Inspector in the French Forest Service, informs us that there is a very large specimen, rivalling in size the American species, in the square near the railway station at Montpellier. In the park at Baleine¹ (Allier) there is a tree 75 feet high by 7 feet in girth.

Elwes measured a tree in the Jardin des Plantes, Paris, which was 40 feet high; but was told that it did not ripen seed; and in the Botanic Garden at Padua he saw a tree about 50 feet high by 4 feet in girth, which in May had abundant fruit of the preceding year upon it, but could find no seeds in them. (A. H.)

LIQUIDAMBAR FORMOSANA

Liquidambar formosana, Hance, *Ann. Sc. Nat. 5^{me} série*, v. 215 (1866), and *Journ. Bot.* 1870, p. 274; Oliver, in Hooker, *Icon. Plant.* xi. 14, t. 1020 (1867); Hemsley, *Journ. Linn. Soc. (Bot.)* xxiii. 291.

Liquidambar acerifolia, Maximowicz, *Mél. Biol.* vi. 21 (1866) and viii. 419 (1871).

Liquidambar Maximowiczii, Miquel, *Ann. Mus. Bot. Lugd. Bat.* iii. 200 (1867).

A tree² attaining, in China, 80 feet in length and 15 feet in girth. Young shoots with scattered long hairs. Leaves (Plate 199, Fig. 8) widely cordate at the base, usually with three broad oblong-triangular acute or acuminate lobes, the outer lobes occasionally giving off two short additional lobes; margin, occasionally lobulate, sharply serrate, ciliate; palmately three-nerved with two strong lateral nerves; upper surface dull with scattered long hairs; lower surface light green

¹ Pardé, *Arbor. Nat. des Barres*, 205, note 1 (1906).

² The peculiarities of the buds, leaves, and stipules have been fully described by Lubbock, in *Journ. Linn. Soc. (Bot.)* xxx. 495 (1894).

with dense long pubescence. Petiole pilose, with two subulate, persistent, pubescent, glandular stipules.

Fruiting heads spiny, 1½ inch in diameter, each capsule surrounded by several long spines arising from the calyx, and resembling the two indurated styles which terminate the valves. Perfect seeds few, or absent in many capsules, with narrow short wings.

This species is widely distributed over the central and southern provinces of China, and occurs also in Tonking, Hainan,¹ and Formosa. In Hupeh, where it has not been seen over 1000 feet altitude, the tree is valuable, as its timber is used for making the Hankow tea-chests. The Chinese call it Fêng tree.²

It is doubtful if it will prove hardy, and is extremely rare in cultivation in Europe, the only plant known to us being one in Kew gardens, which is trained against a wall, and is interesting for its beautiful foliage, which lasts till late in November. It was introduced by seeds sent by Consul Alabaster from Hankow in 1884. (A. H.)

¹ Swinhoe, *Journ. Bot.* i. 257, says it is the commonest tree in the mountain forests of Hainan. Hance, *loc. cit.*, says that at Canton old stumps buried beneath the soil sucker freely.

² It yields a resin, *Fêng-hsiang*; and a caterpillar, which feeds on its leaves, produces a coarse kind of silk, used for fishing-lines.

NYSSA

- Nyssa*, Linnæus, *Gen. Pl.* 308 (1737); Bentham et Hooker, *Gen. Pl.* i. 952 (1867); Harms in Engler u. Prantl, *Pflanzenfam.* iii. 8, 257 (1898).
Tupelo, Adanson, *Fam. Pl.* ii. 80 (1763).
Ceratostachys, Blume, *Bijdr. Fl. Ned. Ind.* 644 (1825).
Agathisanthes, Blume, *loc. cit.* 645.
Daphniphylopsis, Kurz, *Journ. Asiat. Soc.* 1875, ii. 201.

DECIDUOUS trees or shrubs belonging to the order Cornaceæ. Leaves alternate simple, stalked, with margin entire or remotely one- to four-toothed, without stipules. Branchlets with discoid pith.

Flowers small, diœcious or polygamous, borne at the summit of axillary peduncles, the staminate flowers numerous in heads, umbels, or short racemes, the pistillate and perfect flowers solitary or aggregated in two- to eight-flowered heads, umbels, or short racemes. Staminate flowers: calyx short, flat or cup-shaped, five- to seven-toothed or entire; petals five to seven or ten to fourteen; stamens five to ten, inserted on the margin of an entire or lobed disc; filaments slender, anthers oblong. Pistillate flowers: calyx campanulate or urceolate, five-toothed or entire; petals four to five, seldom three or six to eight; stamens absent or equal in number to the petals and alternating with them, bearing fruitful or barren anthers; ovary coalesced with the receptacle, crowned above by a disc, one- rarely two-celled, one ovule in each cell; style one, recurved, stigmatic along one side near the apex. Fruit a drupe, oblong or ovoid, urceolate at the apex; flesh thin, oily; stone bony, thick-walled, terete or compressed, ridged or winged, one- or rarely two-celled, containing one seed, which has a membranous testa and copious albumen. Cotyledons flat and leafy.

The alternate stalked simple leaves, entire and ciliate in margin; and the branchlets with true terminal buds, without stipules or their scars, showing on section the peculiar discoid pith, are characteristic of *Nyssa*.

Seven species of *Nyssa* have been described:—*Nyssa sessiliflora*, Hooker, a tree attaining 60 feet in the Himalayas and Java; has not been introduced and would probably not be hardy in England. *Nyssa sinensis*, Oliver, has recently been introduced from Central China. The remaining five species are natives of Eastern North America. *Nyssa acuminata*, Small, a species imperfectly known, is a small shrub growing in pineland swamps in Georgia. *Nyssa Ogeche*, Marshall, a tree of moderate size, occurring in river swamps in South Carolina, Georgia, and Florida, is unknown in cultivation outside of its native home, and would probably not grow in England.

Nyssa biflora, Walter, a small tree, growing in ponds, from North Carolina to

Louisiana, is probably only a variety of *Nyssa sylvatica*, Marshall; and no trees referable without doubt to it are known to us in England. *Nyssa sylvatica*, Marshall, and *Nyssa aquatica*, Marshall, occur rarely in cultivation in England.

NYSSA SYLVATICA, TUPELO, PEPPERIDGE, BLACK GUM

- Nyssa sylvatica*, Marshall, *Arbust. Am.* 97 (1785); Sargent, *Silva N. Amer.* v. 75, t. 217 (1893), and *Trees N. Amer.* 707 (1905).
Nyssa multiflora, Wangenheim, *Nordam. Holz.* 46, t. 16, f. 39 (1787).
Nyssa villosa, Michaux, *Fl. Bor. Am.* ii. 258 (1803); Loudon, *Arb. et Frut. Brit.* iii. 1317 (1838).

A tree, occasionally attaining in America 100 feet in height and 15 feet in girth. Bark thick and deeply fissured longitudinally. Young shoots glabrous or with short, erect pubescence. Leaves (Plate 199, Fig. 2, leaf from a tree in Arnold Arboretum, U.S.; and Fig. 9, leaf from a tree at Kew) extremely variable in shape and size, obovate, oval or elliptical; base tapering or rounded, apex acuminate or acute, margin entire or repand and ciliate; upper surface glabrous, dark green, usually shining; lower surface glabrous or with slight pubescence on the midrib and principal veins. Petiole channelled or winged, glabrous or pubescent, $\frac{1}{4}$ to 1 inch long. Flowers on pubescent peduncles, appearing after the leaves; staminate flowers numerous, stalked and in crowded clusters; pistillate flowers sessile, two to fourteen in a head. Fruit ovoid, bluish-black, $\frac{1}{3}$ to $\frac{2}{3}$ inch long; stone terete or more or less flattened, with ten to twelve indistinct ribs.

Seedling.—The caulicle, glabrous, terete, and about 2 inches long, ends in a long flexuose whitish tap-root, which gives off numerous lateral fibres. The cotyledons are ovate-lanceolate, rounded at both base and apex, about $1\frac{1}{2}$ inch long by $\frac{5}{8}$ inch broad, on petioles $\frac{1}{8}$ inch long, slightly coriaceous, entire in margin, pale beneath, glabrous, pinnately veined. The stem, reddish and pubescent, gives off alternately the true leaves, which are oval, with a cuneate base and acuminate apex, entire or one- to two-toothed and ciliate in margin, pale and glabrous on the under surface with the exception of some pubescence at the base of the midrib, and with a pubescent petiole. The preceding description was drawn up in the summer of 1905, from a seedling at Colesborne, raised from seed gathered by Elwes at Boston at the end of the preceding September.

IDENTIFICATION

Nyssa sylvatica, with leaves quite glabrous or pubescent only on the midrib and principal veins beneath, is readily distinguishable from *Nyssa aquatica*, with leaves grey and pubescent all over the under surface, and with one or two teeth often on the margin. *Nyssa sinensis*, which resembles in foliage *Nyssa sylvatica*, is distinguished by the appressed pubescence of the shoots.

In winter *Nyssa sylvatica* (Plate 200, Fig. 5) shows the following characters:—

Twigs slender, glabrous, or with slight pubescence near the tip only; stipule-scars absent. Leaf-scars small, crescentic, set somewhat obliquely on slightly prominent pulvini, surrounded by a narrow raised rim, marked with three bundle dots. Buds conical, pubescent, and acute; scales five or six, imbricated, pubescent, ciliate, reddish or greenish; terminal bud larger than the lateral buds which arise at an angle of about 45° . Pith solid, but interrupted by transverse woody partitions, showing on longitudinal section a ladder-like appearance.

The inner scales of the bud are accrescent; and the base of the shoot is marked by ring-like scars, indicating where these scales have fallen off in the preceding spring.

VARIETIES

This species is extremely variable in leaf, both in wild specimens and cultivated trees. This is well shown in the Strathfieldsaye tree, the leaves of which vary from a long elliptical acuminate to a short broad obovate obtuse outline; some are quite glabrous, whilst others are pubescent on the midrib and principal veins beneath. Usually the leaves are very shining above and coriaceous; but in a tree growing at Kew in a wood, they are dull above and thin in texture. In some specimens there are numerous glands on the under surface of the leaf; whilst in others, as in a specimen growing in the Arnold Arboretum collected by Elwes, no glands are visible. The fruit is also variable, being either terete or flattened. The tree occurs in America in very diverse stations, both on wet soils and on dry mountain slopes; and this may explain the remarkable extent of its variation.

Var. *biflora*, Sargent, *Silva N. Amer.* v. 76, t. 218 (1893).

Nyssa biflora, Walter, *Fl. Carol.* 253 (1788); Loudon, *Arb. et Frut.* iii. 1317 (1838); Sargent, *Trees N. Amer.* 709 (1905).

Leaves smaller than in the type, very narrow, glabrous and glandular beneath, quite entire in margin. Fruit with an oval, flattened stone, narrowed at both ends and prominently ribbed. This variety is a small tree, rarely more than 30 feet high, growing in ponds on the pine barrens near the coast from N. Carolina to Louisiana. It usually has a trunk with a swollen base, and appears to be a form of the species which has adapted itself to life in water.

The cultivated trees mentioned by Loudon as being *Nyssa biflora* were all probably *Nyssa sylvatica* of the typical form. (A. H.)

DISTRIBUTION

Nyssa sylvatica is found in North America from Southern Ontario, where it grows to a good size near Niagara, and in New England, where I saw it in the neighbourhood of Boston 60 or 70 feet high, westwards to Central Michigan and South-Eastern Missouri, and southwards to Florida and Texas. It attains its largest size, according to Sargent, in the southern Appalachian Mountains, growing as high as 100 feet with a maximum girth of about 15 feet.¹ It is found generally in wet soil on

¹ But Ridgway measured a black gum in Wabash Valley, 125 feet high by 13 feet in girth, and 64 feet to the first limb.

the borders of swamps; but in the south grows also on high wooded mountain slopes. It is very variable in form, sometimes branching close to the ground; but oftener has a stout straight trunk, covered with light brown deeply furrowed bark, which is often curiously divided into hexagonal scales. Plate 144 B shows the trunk of a tree in America. The upper branches are twiggy and usually crooked. The glossy green leaves are rarely disfigured by fungi or insects, and turn to deep red in autumn. An excellent illustration of a group of trees growing near a pond in Massachusetts is given in *Garden and Forest*, iii. 491, which resemble in habit the Siberian or Japanese larch; and this is the form which the trees often assume in low swampy ground in New England. Another figure in the same journal, vii. 275, fig. 46, shows the habit of a tree growing in drier ground in Pennsylvania.

CULTIVATION

Nyssa sylvatica was in cultivation at Whitton, near Hounslow, in 1750. It is, when well grown, a very distinct and beautiful tree, the brilliant scarlet assumed by its leaves in autumn rendering it a very desirable ornament for the park or pleasure ground.

Sargent says that one reason why this tree is not more generally planted is that its long roots with few rootlets make it difficult to transplant, and that it must be either planted out when quite young or frequently transplanted in the nursery. Those which I have raised from seed grew slowly the first year, but seemed to ripen their young wood better than many American trees. When pricked out singly into pots in the following spring they all died.

We have seen very few specimens in this country, the only one of great size being the tree¹ at Strathfieldsaye, which measured in 1897 74 feet high by 5 feet 5 inches in girth. It grows on rather heavy soil. This tree was reported by Loudon to be about 30 feet high in 1838, and is probably over 100 years old (Plate 145). It produced seed in 1906 which appeared to be mature.

There is a tree at Munden, near Watford, the seat of the Hon. A. Holland Hibbert, which has a short bole of $4\frac{1}{2}$ feet long with a girth of 3 feet 3 inches, dividing into two stems, the branches of which are very spreading, forming a crown of foliage 38 feet in diameter; the total height is only 20 feet. Mr. Daniel Hill of Watford, who kindly sent these measurements, says that the fork has been leaded over; and it is possible that the tree lost its leader early from some accident, and in consequence subsequently assumed its present peculiar habit.

At White Knights, near Reading, there was a large tree of this species which was cut down some years ago; and there are now many suckers arising from the roots.² There is another tree at Bicton about 35 feet high by $3\frac{1}{2}$ feet, which in August 1906 had full-sized fruit upon it which seemed likely to ripen.

¹ The girth of this tree given in *Gard. Chron.* xxvi. 162 (1899), is evidently erroneous, 14 feet $10\frac{1}{2}$ inches being a misprint for 4 feet $10\frac{1}{2}$ inches.

² Schenck, in *Biltmore Lectures on Sylviculture*, 56 (1905), says that in the forest old trees are often surrounded by an abundance of seedlings; but on abandoned fields it seems to come up from sprouts and not from seeds.

There are three small trees in Kew Gardens, the largest about 20 feet high, growing in a densely wooded part close to the Arboretum Nursery.

A tree growing in the garden at Harpton in Radnorshire, at an elevation of 700 feet above sea-level, was in 1905 27½ feet high by 2 feet 8 inches in girth. The owner, Sir Herbert E. F. Lewis, Bart., who kindly sent us particulars, has not noticed during the last forty years any considerable increase in the size of this tree. Its leaves turn bright yellow in autumn.

TIMBER

The wood seems to be unknown in commerce, and is not mentioned by any of the English writers, but Sargent says it is very durable under water and used for keels of boats, and being extremely difficult to split, is also used for yokes, rollers, wheel-hubs, and pumps. Sections of it in Hough's *American Woods*, Pt. I. No. 9, show a pale or reddish-brown wood of very close texture, somewhat resembling sycamore in appearance.

(H. J. E.)

NYSSA AQUATICA, COTTON GUM, TUPELO GUM

Nyssa aquatica, Marshall, *Arbust. Am.* 96 (1785); Linnæus, *Sp. Pl.* 1058 (*ex parte*) (1753); Sargent, *Silva N. Amer.* v. 83, t. 210 (1893), and *Trees N. Amer.* 711 (1905).

Nyssa uniflora, Wangenheim, *Nordam. Holz.* 83, t. 27, f. 57 (1787).

Nyssa denticulata, Aiton, *Hort. Kew.* iii. 446 (1789).

Nyssa tomentosa, Michaux, *Fl. Bor. Am.* ii. 259 (1803).

Nyssa angulisans, Michaux, *loc. cit.*

Nyssa grandidentata, Michaux f., *Hist. Arb. Am.* ii. 252, t. 19 (1812); Loudon, *Arb. et Frut. Brit.* iii. 1319 (1838).

A tree, attaining in America 100 feet in height, with a trunk 12 feet in girth above the greatly enlarged base. Bark thick, longitudinally fissured, and roughened on the surface by small scales. Young shoots pubescent towards the tip, becoming glabrous below in summer. Leaves (Plate 199, Fig. 10) elliptical or ovate-oblong, base rounded or tapering, apex long-acuminate; margin entire or repand, ciliate, often with one to three or more triangular teeth, usually ending in a bristle; upper surface dark green, glabrous; lower surface greyish in colour and with a scattered, fine pubescence; petioles more or less pubescent, 1 to 1½ inch or more in length.

Flowers on long, slender, pubescent peduncles: staminate flowers pedicellate in dense clusters, with a cup-shaped, obscurely five-toothed calyx and oblong short petals rounded at the apex; pistillate flowers solitary, with long, tubular calyx, ovate minute spreading petals, and included stamens with small mostly fertile anthers. Fruit solitary, on long, drooping stalks, oblong, dark purple, about an inch long; stone obovate, rounded at the apex, pointed at the base, flattened, with about ten wing-like ridges.

IDENTIFICATION. (See under *Nyssa sylvatica*)

In winter, specimens from the tree at White Knights showed the following characters:—Twigs stout, pubescent near the tip, glabrescent elsewhere. Leaf-scars slightly oblique on prominent pulvini, almost orbicular or obcordate, notched in the upper margin, surrounded by a slightly raised rim, and marked by three conspicuous bundle-dots. Lateral buds minute, globose, two-scaled, reddish, shining, glabrous, arising in the notch of the leaf-scar. Terminal buds nearly globose, short and broad, with four to five thick, pubescent, reddish scales, keeled on the back and apiculate at the apex; in December the three outermost scales had dropped the apiculus and showed a truncate apex with a terminal scar. The base of the shoot is marked by ring-like scars as in *Nyssa sylvatica*.

DISTRIBUTION

Nyssa aquatica is found growing in swamps throughout the coast region of the United States, from Southern Virginia to Texas, and in the Mississippi valley, in Arkansas, Southern and South-Eastern Missouri, Western Kentucky, and Tennessee, and in the valley of the lower Wabash River in Illinois.

An interesting account of the peculiar habit of this tree, as observed in the swamps of Arkansas, is given by Coulter.¹ Occurring in company with *Taxodium distichum*, wherever the ground is inundated with water, the trunk develops an enlarged, dome-like base, often of immense size. A tree only 45 feet high, of which a figure is given, had a swollen base 55 feet in girth at the point where the roots entered the ground. When the water-supply is scanty the base is only slightly enlarged; and trees growing in dry soil show no swelling of the trunk. Coulter saw numerous seedlings of *Nyssa*, and concludes that it is gradually ousting from the swamps the Deciduous Cypress, which rarely seeds itself. Wilson² states that around the swollen base of these trees in the swamps there are masses of roots extending 6 to 8 inches above high-water line, each root going vertically up out of the water, and after a sharp bend going down into the water again. He compares these roots, rising above the water for purposes of aeration, with the knees of *Taxodium*.

CULTIVATION

Nyssa aquatica was cultivated³ by Collinson near London in 1735. It is now scarcely known in cultivation in England, the only tree which we have found being one at White Knights Park, Reading, the residence of T. Friedlander, Esq. It is a slender tree, about 36 feet by 2 feet 2 inches, which looks of considerable age and is not vigorous in growth. Loudon⁴ states that most of the trees which he saw at White Knights in 1833 were planted between 1790 and 1810; and one was a fine specimen⁵ of *Nyssa aquatica*, perhaps identical with the tree now living.

¹ *Report Missouri Bot. Garden*, 1904, xv. 56, plates 18, 19.

² *Proc. Philadelphia Acad. Nat. Sc.* 1889, p. 69.

³ Aiton, *Hort. Kew*, iii. 446 (1789).

⁴ *Gardeners' Magazine*, ix. 664 (1833).

⁵ This tree is not referred to by Loudon in his large work, published in 1838.

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Michaux states that it endures the climate of Paris, and does not exact in Europe as moist a soil as it constantly requires in the United States. (A. H.)

TIMBER

According to Holroyd,¹ it has only recently been possible to market the timber of this tree, and under a fictitious name, so great has been the prejudice against this and others known as gums. Formerly when lands bearing tupelo and cypress were logged, the cypress alone was taken, and tupelo trees from 2 to 3 feet in diameter were left, because the lumbermen considered them to be worthless. At present, however, tupelo timber is extensively cut in Alabama, near Mobile, as well as in Southern and Central Louisiana. The best grades closely resemble the Yellow Poplar (*Liriodendron*). The wood has a fine uniform texture, is moderately hard and strong, not elastic, but very tough and hard to split, and easy to work with tools. It is not durable in contact with the ground, and requires much care in seasoning. It is now extensively used for house flooring and indoor finish. Mr. Weale informs me that it has a tendency to warp and split which cannot be prevented by any known process of seasoning; and only a small quantity has as yet been imported to England, in the form of boards, which are worth from 1s. 9d. to 2s. per cubic foot, and are used by the makers of cheap furniture. But he thinks that if it was sent in boards as well planed as those of the so-called Hazel Pine, it would be more attractive, and its consumption would increase.

(H. J. E.)

NYSSA SINENSIS, CHINESE TUPELO

Nyssa sinensis, Oliver, in Hooker, *Icon. Plant.* t. 1964 (1891).

A tree, attaining in China 40 feet in height. Young shoots covered with a dense appressed white short pubescence, retained in the second year. Leaves (Plate 199, Fig. 1) elliptical, base tapering, apex acuminate, margin entire and ciliate; upper surface dull, dark green, and glabrous except for some slight pubescence on the midrib towards the base; lower surface light green, shining, pilose on the midrib and chief veins and occasionally on the veinlets; petiole, $\frac{1}{4}$ to $\frac{3}{8}$ inch long, pilose.

Flowers, on long slender axillary peduncles, pedicellate, crowded in racemose clusters. Staminate flowers with a minute calyx, narrow oblong petals, and five to ten stamens on a fleshy disc. Pistillate flowers imperfectly known, but with bifid style and glabrous ovary. Fruit in clusters of about three, on short pedicels at the ends of long (two to three inches) erect or ascending pubescent peduncles; oblong, bluish, $\frac{3}{8}$ inch long; flesh scanty; stone with ten inconspicuous longitudinal ribs.

This is a rare tree, occurring in mountain woods in Central China, in the western part of Hupeh, and on the Lushan Mountains, near Kiukiang, in Kiangsi.² It was discovered by me in 1888, and was subsequently found by Mr. E. H. Wilson, who sent home seed to Messrs. Veitch in 1902, from which a single plant has been raised at Coombe Wood, where it is perfectly hardy so far. (A. H.)

¹ U.S. Dept. Agric., *Forest Service Circular*, No. 40 (1906).

² E. H. Wilson in *Gard. Chron.* xlii. 344 (1907).

SASSAFRAS

Sassafras, Nees ab Esenbeck u. Ebermaier, *Handb. Med. Pharm. Bot.* i. 418 (1830); Bentham et Hooker, *Gen. Pl.* iii. 160 (1880).

DECIDUOUS trees belonging to the order Lauraceæ, with alternate pinnately-veined simple leaves without stipules. Flowers diœcious or rarely perfect, in few-flowered racemes in the axils of bud-scales at the ends of the previous year's shoots. Calyx six-lobed, the lobes in two series, imbricated in bud; petals absent. Staminate flowers; stamens nine in three series, the three inner ones each with two stalked glands at the base; anthers opening with four valves. Pistillate flowers with flattened ovate pointed or slightly two-lobed staminodes, or occasionally with fertile stamens like those of the male flowers; ovary ovoid, glabrous, superior, one-celled; ovule solitary, suspended; one style elongated with a capitate stigma. Fruit an oblong-ovoid, one-seeded dark-blue berry, surrounded at the base by the enlarged and thickened calyx-limb, and supported on pedicels much thickened above the middle.

The genus comprises only two species, one occurring in North America and the other in China.

SASSAFRAS TZUMU, CHINESE SASSAFRAS

Sassafras Tzumu, Hemsley, in *Kew Bull.* 1907, p. 55, and in Hooker, *Icon. Plant.* t. 2833 (1907).
Litsea laxiflora, Hemsley, *Journ. Linn. Soc. (Bot.)* xxvi. 383, t. 8 (1891).
Lindera Tzumu, Hemsley, *op. cit.* 392 (1891).

This species grows sparingly in China in mountain woods at 3000 to 5000 feet elevation, south-west of Ichang, in the province of Hupeh; near Kiukiang in Kiangsi; and inland from Ningpo in Chekiang. It attains a height of 50 feet and yields a timber esteemed by the mountaineers, who call it the *tzu-mu* or *huang ch'iu* tree. Resembling very closely the American species in the characters of the foliage and inflorescence, it was considered by Prof. Sargent¹ and Mr. E. H. Wilson to be indistinguishable. Mr. Hemsley, however, points out certain differences in the floral organs, which entitle it to rank as a distinct species. The flowers are slightly smaller than those of the American tree, and are pubescent within and not glabrous as in that species. The male flowers have three staminodes alternating with the glandular row of stamens and a prominent pistillode, which are wanting in *Sassafras*

¹ *Trees N. Amer.* 336 (1905).

officinale. The female flowers have twelve staminodes in three rows of six, three, and three; only six staminodes in two rows of three each occurring in the American species.

There is a tree of this species, 10 feet high, growing in the Coombe Wood nursery, which was raised from seed sent by Wilson in 1900. It has made wonderful growth during the past summer, and is very handsome. It differs from the American species in having glabrous non-ciliate leaves, which are very lustrous on the upper surface; and the young branchlets are also devoid of pubescence.

SASSAFRAS OFFICINALE, SASSAFRAS

Sassafras officinale, Nees ab Esenbeck u. Ebermaier, *loc. cit.*; Bentley and Trimen, *Medicinal Plants*, iii. 220 (1880).

Sassafras Sassafras, Karsten, *Pharm. Med. Bot.* 505 (1882); Sargent, *Silva N. Amer.* vii. 17, tt. 304, 305 (1895), and *Trees N. Amer.* 337 (1905).

Sassafras variifolium, O. Kuntze, *Rev. Gen. Pl.* ii. 574 (1891); Sargent, in *Bot. Gazette*, xlv. 226 (1907).

Laurus Sassafras, Linnæus, *Sp. Pl.* 371 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1301 (1838).

A tree, attaining in America 90 feet in height and 18 feet in girth. Bark,¹ according to Sargent, dark red-brown, deeply and irregularly divided into broad scaly ridges. Young shoots green or reddish, pubescent when young, becoming glabrous, remaining green in the second year. Leaves (Plate 199, Fig. 5) deciduous, entire, or two- to three-lobed; the entire leaves oval with an obtuse apex and cuneate base; the others obovate, with a large triangular or oblong lobe on one or both sides, directed forwards and outwards; margin entire or repand, ciliate; upper surface dark green with a scattered short pubescence; lower surface pale with a long pubescence, often falling by the end of summer; petiole, 1 to 2 inches long, pubescent. The nerves are pinnate, the two lowest arising near the base of the leaf, running nearly parallel with the margin, and ending in the lobes when these are present.

Berry² gives an account with illustrations of the extraordinary variation which occurs in the leaves of wild trees growing in America. He has found leaves with four, five, and even six lobes.

SEEDLING

Out of some seed gathered by Elwes at the Arnold Arboretum late in September and sown at Colesborne in October 1904, only one germinated in the following June, and the seedling showed the following characters in August:—The cotyledons remain in the seed-case, the young stem emerging between them after the splitting of the seed into two halves. The terete glabrous and reddish stem first gives off alternately two minute scales, which are succeeded by true leaves; the first, $\frac{1}{2}$ inch long, arising $1\frac{1}{2}$ inch above the ground, is half-oval in shape, one side of the leaf

¹ In cultivated trees in England the bark is grey and fissured into longitudinal narrow ridges.

² *Bot. Gazette*, xxxiv. 426 (1902).

being scarcely developed, entire in margin, and on a short stalk about $\frac{1}{3}$ inch long. The second leaf, $\frac{3}{4}$ inch long, is obovate-spathulate, entire in margin, very unequal-sided, rounded at the apex, and tapering at the base. Succeeding leaves (six in all being produced by August) are oval, $1\frac{1}{2}$ to $2\frac{1}{2}$ inches long, stalked, unequal-sided, pinnately-veined, slightly undulate in margin; pale green and glabrous, with a raised midrib beneath.

IDENTIFICATION

In summer Sassafras is readily distinguishable by the aromatic leaves of different shapes, entire and two- to three-lobed, and by the branchlets, without stipules or their scars, remaining green for two or three years. In winter (Plate 200, Fig. 6) the following characters are available:—Twigs glabrous, green, shining, brittle, and strongly aromatic in odour when broken; lenticels few and inconspicuous; pith wide and mucilaginous. Leaf-scars alternate, oblique on prominent pulvini, very small, semicircular with a raised rim, and showing a transverse band of minute coalesced bundle-dots. Terminal buds ovoid, with a long sharp beak; external scales, four to five, imbricated, slightly pubescent, ciliate, green, often ridged or veined. Lateral buds minute, arising from the twigs at about an angle of 45° . Base of the shoot marked by ring-like scars, indicating where the scales of the previous season's terminal bud have fallen off. (A. H.)

DISTRIBUTION

Sassafras occurs usually in rich, sandy, well-drained soil; and is widely spread in the eastern half of the United States, crossing into Canada in Southern Ontario. The northern limit passes through the southern parts of Maine, Vermont, and Ontario to Central Michigan, whence the western limit is continued through Eastern Kansas and the Indian Territory, to the valley of the Brazos river in Texas. On the eastern side it extends from Maine to Central Florida. In the South Atlantic and Gulf States it often takes possession of abandoned fields.

In America the tree is very handsome at all seasons of the year, the light green foliage of summer turning delicate shades of yellow, orange, and red in autumn. The fruit, which is abundantly produced in some years, is showy, the berries dark blue in colour contrasting with the scarlet cups in which they sit. The tree produces root-suckers very freely.

In New England the Sassafras does not often become a tree of considerable size. Emerson¹ states that it rarely reaches 30 feet in height by a foot in diameter, and Michaux says that near Portsmouth, N.H., it is only a tall shrub rarely exceeding 15 to 20 feet high. But near Boston it sometimes grows much larger, and Emerson mentions one which grew at West Cambridge in 1842, and measured nearly 60 by 8 to 9 feet, with a clean straight stem 30 feet long. This tree was felled in order, as he says, "to allow a wall to run in a straight line." But such vandalism as this, which a generation ago was common in New England, is now disappearing; and great care is taken of the few surviving old trees of the original forest. Tree

¹ *Trees and Shrubs of Massachusetts*, p. 359.

wardens are appointed in most parishes, who are often ladies; and I am indebted to one of the most enthusiastic and active of them, Miss Emma G. Cummings of Brookline, Mass., for showing me some of the large Sassafras trees which still survive in the suburbs of Boston. These form a group on a slope on the south side of Covey Hill, the smallest being 6 feet in girth, and the largest 9 feet 7 inches and over 50 feet high. But these are far inferior to the trees in the forests of the south and west, where Ridgway measured, in the Wabash valley, a Sassafras 95 feet high by $7\frac{1}{2}$ in girth, and where, he says, it sometimes attains 12 feet in circumference.

CULTIVATION

The Sassafras was one of the earliest American trees introduced into England, having been cultivated in 1633 in a garden near London.¹ The tree is propagated by seeds, which should be sown as soon as ripe, and by suckers and root-cuttings. When large it is difficult to transplant, as the thick fleshy roots are scantily provided with rootlets.

Cobbett,² who gave an interesting account of the Sassafras, and was very enthusiastic in its praise, found that the seeds rarely if ever come up in the first year, and apparently often lie over for two years. Fresh seeds gathered by me in the Arnold Arboretum and sown in autumn, only produced one seedling in the first year, and no more have since germinated. This seedling though kept in a greenhouse grows very slowly, and at three years old is only 10 inches high. But though the tree is now rare in England there is no reason why it should not be grown on rich sandy soil in those districts where the summers are warm and dry, if young trees can be procured and established.

REMARKABLE TREES

The only really fine specimen of this species that we have seen in England is in the garden at Claremont, the seat of H.R.H. the Duchess of Albany. This is a handsome, healthy tree which in 1907 measured 48 feet by 6 feet 8 inches at 1 foot from the ground. It forks low down, and the main stem is 4 feet 10 inches at 5 feet. This tree flowers freely in the month of May, but Mr. Burrell has observed no seeds on it (Plate 146). A tree formerly grew at Beeston Hall, near Norwich, which Grigor states to have been 38 feet high in 1840, but this, as I am informed by Mr. Wall, the gardener there, died and was taken down about 1898.

There are four small trees in Mr. Friedlander's garden at White Knights Park, Reading, which appear to be suckers from the roots of an older one now dead; and in the adjoining properties, White Knights and the Wilderness, there are also trees of which the tallest is about 35 feet by 2 feet 10 inches. There is a younger tree in Mrs. Robb's grounds at Goldenfield, Liphook, and a small one in Kew Gardens planted by Sir W. T. Thiselton-Dyer. There is also a healthy young tree at Tortworth.

¹ Gerard, *Herball* (ed. Johnson), 1524 (1633).

² *Woodlands*, Nos. 489 seq. (1825).

The trees reported by Loudon to be growing in his time at Syon and at Croome cannot now be found.

MEDICINAL PROPERTIES

An interesting article on this tree by Prof. Sargent, with a figure of the trunk of an old one on Long Island showing the peculiar bark, is given in *Garden and Forest*, vii. 215; and from this I take the following:—

The Sassafras is one of the most interesting trees of eastern North America. The last survivor of a race which at an earlier period of the earth's history was common to the two hemispheres, it is the only tree in a large family which has been able to maintain itself in a region of severe winter cold. Towards the middle of the sixteenth century the French in Florida heard from the Indians wonderful accounts of the curative properties of a tree which they called *Pavame*, and which for no obvious reasons the Europeans called Sassafras. The tree and its virtues were first described by the Spanish physician, Nicholas Monardes, in his *Natural History of the New World*, published in Seville in 1569.

The reputation of the roots and wood as a sovereign cure for most human maladies soon spread through Europe, and extraordinary efforts were made to procure them. To collect Sassafras was one of the objects of the English expedition which landed in Massachusetts in 1602, and eight years later Sassafras is mentioned among the articles to be sent home, in the instructions of the English Government to the officers of the young colony in Virginia.

For nearly two centuries the reputation of Sassafras was maintained, and many medical treatises have extolled its virtues, though now it is generally recognised as simply a mild aromatic stimulant. Recently the thick pith of the young branches has been found to yield a mucilage useful to oculists, as it can be combined with alcohol and subacetate of lead without causing their precipitation. The oil of Sassafras, obtained from the wood and roots by distillation, is used to perfume soap and other articles; and perhaps after all the most useful product of the Sassafras tree is the yellow powder prepared from the leaves by the Choctaw Indians of Louisiana, used to give peculiar flavour and consistency to "Gumbo filé," one of the best products of the Creole kitchen.

TIMBER

The wood has little or no economic value and is unknown in Europe. Michaux says that it was never seen in the lumber yard, and was only occasionally used for joists, rafters, and bedsteads; and that it is not attacked by beetles on account of the odour, which it preserves as long as it is kept dry. Ashe says it is light, soft, weak, brittle, and coarse-grained, very durable in contact with the soil, and apt to crack in drying. But the unusual orange-brown colour of the heartwood seems to me to give it a value for ornamental carpentry, if it can be procured of sufficient size.

(H. J. E.)

CORYLUS

Corylus, Linnæus, *Sp. Pl.* 998 (1753); Bentham et Hooker, *Gen. Pl.* iii. 406 (1880); Winkler, in Engler, *Pflanzenreich*, iv. 61, *Betulaceæ*, 44 (1904).

DECIDUOUS trees or shrubs, belonging to the order Betulaceæ. Leaves alternate, distichous on the branchlets, stalked, simple, penninerved, doubly serrate; stipules two, caducous. Buds composed of numerous imbricated scales, corresponding to stipules.

Flowers monœcious, arising from buds on the branchlets of the previous year. Male flowers in cylindrical catkins, appearing in autumn; fascicled, or two to five on a common peduncle; composed of numerous imbricated bracts, each bearing on its inner side two partly adnate bracteoles and four stamens, without a perianth; filaments bifid, each branch bearing a single anther cell, tufted with hairs at its apex. Female flowers in buds resembling those which contain leaves only, but distinguishable in spring by the projecting styles. The lower scales of the buds bear leaves in their axils, the flowers, few in number, arising only in the axils of the uppermost scales, each scale bearing two flowers. Each flower, surrounded at the base by two minute bracteoles, more or less deeply cut and forming an involucre, consists of a two-celled ovary, surmounted by a short, denticulate perianth and two long styles; each cell containing one ovule.

Fruit, in clusters at the end of the short leafy branch into which the bud has developed; a one-celled, one-seeded nut, the remains of the other cell and ovule, which have aborted, being visible in its upper part. The nut is contained in a leafy involucre, open at the summit, and variously lobed or dentate. Seed without albumen; cotyledons thick, fleshy, containing oil, remaining on germination underground.

Eight or nine species of *Corylus* are known, all natives of northern temperate regions, and mostly shrubs or small trees. Only one species, *Corylus Colurna*, attains the dimensions of a timber tree, and comes within the scope of our work.

CORYLUS COLURNA, CONSTANTINOPLE OR TURKISH HAZEL

Corylus Colurna, Linnæus, *Sp. Pl.* 999 (1753); Loudon, *Arb. et Frut. Brit.* iii. 2029 (1838); Willkomm, *Forstliche Flora*, 377 (1887); Winkler, *op. cit.* 50.

A tree of moderate size, attaining 60 to 80 feet in height and 7 to 8 feet in girth of stem. Bark of trunk grey, thick, and scaling off in small irregular plates.

Corylus

Twigs brittle, the young shoots glandular pubescent, those of a year old glabrous and brown in colour, the bark of older shoots becoming corky. Leaves 3 to 5 inches long by 2 to 4 inches wide, broadly oval, ovate, or obovate, deeply cordate at the base, acuminate at the apex, doubly serrate or with large serrate teeth, dark green above, lower surface lighter green and sparingly pubescent, with glandular hairs on the principal nerves and midrib; nerves usually eight pairs; petiole $\frac{1}{2}$ to 1 inch long, glandular pubescent or glabrescent. Catkins¹ $1\frac{1}{2}$ to 3 inches long. Fruits crowded, three to ten in number, long, compressed, pubescent towards the apex. Involucres tomentose with intermixed glandular hairs, deeply and irregularly divided into linear, acute, stiff, long-pointed segments, which are either entire or toothed, exceeding in length two to three times the nut.

SEEDLING

The germination resembles that of the oak, the cotyledons, which are short-stalked, plano-convex and obovate, remaining in the seed and not being carried above ground. Caulicle stout, terete, tapering, ending in a long tap root with numerous branching fibres. Stem stout, terete, covered with numerous scattered glandular hairs, giving off an inch above the cotyledons a pair of opposite leaves, which are about 2 inches long, broadly ovate, acute at the apex, cordate at the base, with three to five pairs of lateral lobes, unequal in size, toothed and ciliate in margin; petiole $\frac{3}{4}$ inch, glandular-pubescent. Succeeding leaves are alternate and larger in size.

VARIETIES

In addition to the typical form described above, several geographical varieties occur, as the species is distributed over a wide area.

1. Var. *glandulifera*, A. de Candolle, *Prod.* xvi. 2, p. 132 (1864).—Occurs with the type in Europe and western Asia. In this variety the pubescence on the petioles, peduncles, and fruit-involucres is intermixed with glandular bristles; and the segments of the involucres are less acute and often dentate.

2. Var. *lacera*, A. de Candolle, *op. cit.* 131 (*Corylus lacera*, Wallich, *List*, 2798).—Leaves obovate, larger, up to 7 inches long, with ten to twelve pairs of nerves. Involucre-segments linear-lanceolate with glandular hairs. This variety occurs in the western Himalayas, from Kashmir to Nepal, at elevations of 6000 to 10,000 feet, and in many places is gregarious. Sir George Watt informs me that it is a handsome tree, usually growing in the mixed forests, and often attaining 80 feet in height.

3. Var. *chinensis*, Burkill, *Journ. Linn. Soc. (Bot.)* xxvi. 503 (1899) (*Corylus chinensis*, Franchet, *Journ. de Bot.* 1899, xiii. 197).—Leaves large, up to 7 inches long, with ten to twelve pairs of nerves, broadly ovate, unequal, acuminate; petioles bristly. Involucres striate and constricted above the fruit, lobes forked, lobules

¹ Abnormal male flowers with enlarged bracteoles are figured in *Gard. Chron.* xxvi. 691, fig. 135 (1886).

acute and falcate. This variety occurs in China, and grows to about 40 feet high in mixed forests in Yunnan, Szechwan, and Hupeh.

Apparently no varieties have originated in cultivation, but a hybrid has been obtained between this species and the common hazel, viz. :—

Corylus intermedia, Loddiges, *Catalogue* (1836) (*Corylus avellana* × *Corylus Colurna*, Rehder, *Mitth. Deuts. Dendrol. Gesell.* 1894, p. 43).—This is a tall shrub or small tree with the bark of the common hazel, *i.e.* darker and less scaly and fissured than that of *C. Colurna*. The fruit resembles that of the last species, but is shorter and scarcely glandular. Specimens of this are growing in the Botanic Gardens of Jena and Göttingen and in the Forestry Garden at Münden, but we know of none in England.

IDENTIFICATION

In summer the Turkish hazel is readily distinguishable by the scaly bark and the obovate leaves deeply cordate at the base and distichously placed on the branchlets. In winter (Plate 126, Fig. 6) the following characters are available :—Twigs : brittle, shining, brownish-yellow, with few and inconspicuous lenticels and scattered glandular pubescence, usually, however, dense near the base of the shoot, which is ringed with the scars of the previous season's bud-scales, one or two of the lowermost scales often persisting dry and darkened in colour; second year's shoot with corky bark, which fissures and exfoliates slightly. True terminal bud absent, a small oval scar at the apex of the twig, on the side opposite to the highest leaf-scar, indicating where the tip of the shoot fell off in summer. Leaf-scars semicircular with three to six bundle-dots,¹ somewhat obliquely set on prominent pulvini. Stipule-scars small, transverse, lunate, one on each side of the leaf-scar. Buds pretty uniform in size, alternate and distichous on the twig, from which they arise at a wide angle, ovoid, rounded at the apex; scales about ten, imbricated, pubescent, ciliate in margin. Pith small, circular. Male catkins present in winter on flower-bearing trees.

DISTRIBUTION

The Turkish hazel has a wide distribution, extending from south-eastern Europe, through Asia Minor and the Caucasus, to the Himalayas and Western China. In Europe it is found growing wild in Banat, Slavonia, Herzegovina, Bosnia, Servia, Roumania, and Greece.² In Banat, according to Willkomm, it sometimes forms pure woods in the mountains; and in Northern Albania it ascends as a bush to 3000 feet altitude.³ It occurs in Asia Minor in Bithynia, Paphlagonia, and Anatolia. According to Radde,⁴ it grows in small groups on the south side of the main chain of the Caucasus and in many localities in Georgia, at 3500 to 5000 feet elevation, where it is a stately tree 50 to 70 feet in height, and with a

¹ The cicatrices left by the leaf-bundles on the leaf-scar are very irregular in number and shape, being circular dots or curved lines.

² In Thessaly and Acarnania, according to Halacsy, *Consp. Fl. Græca*, iii. 135 (1904).

³ Beck, *Veg. Illyrischen Länder*, 300 (1901).

⁴ *Pflanzenverbr. Kaukasusland*. 187 (1899).

stem diameter of 18 inches. The nuts of the wild tree are small, with a thick and hard shell. It also grows in the mountains of Karabagh, but does not occur in the Talysch district. (A. H.)

CULTIVATION

The Turkish hazel was first cultivated in western Europe by Clusius, who obtained it from Constantinople in 1582. Linnæus states that in 1736 the finest specimen known was a tree in the Botanic Garden at Leyden, which had been planted by Clusius. It was apparently first cultivated in England about the year 1665 by John Rea,¹ who states that he had then "many goodly trees of the filbeard of Constantinople." He grafted these upon ordinary hazel stocks.

The Turkish hazel is now a rare tree in England, seldom to be got from a nursery, though perfectly hardy and easy to grow from seed, which it ripens in most seasons in the southern half of England. I have raised many from a tree at Tortworth Court, and the Earl of Ducie has done the same. The seed usually germinates in the following spring if sown when ripe, but if kept till spring, sometimes not until the next year. The seedlings, on my soil at least, have more inclination to become bushes than to make a single stem, but, if cut down two or three years after planting, will throw up strong suckers which may be trained into a tree, and should be planted in half-shady places or in an opening in a wood, as they are liable when young to be injured by spring frosts.

REMARKABLE TREES

No other place can show so many fine trees as Syon, where there are in the grounds at least five, all apparently of about the same age. The largest of these stands near the east bridge over the lake, and is about 75 feet high, with a bole about 30 feet long and 6 feet 9 inches in girth. Near the gardener's house is another fine tree more spreading in habit, about 70 feet by 7 feet 6 inches, which is probably not the same as one figured by Loudon, which was then 61 feet high. This has been figured by the Hon. S. Tollemache as the Hazel.²

At Bute House, Petersham, Henry measured a well-shaped tree which, in 1904, was 56 feet by 6 feet 7 inches.

At Corsham Court there is a remarkable tree about 50 feet high, which divides near the base into two stems, one of which is quite decayed, and the other, which has the appearance of having originated as a sucker from it, is quite sound and 6 feet 8 inches in girth. Lord Methuen tells me that he can remember this tree as formerly producing fruits which were sent up to table, but now it no longer bears any nuts.

At White Knights I saw a grafted tree from which seedlings had sprung up in the shrubbery, and one of these, growing at the base of a stump, is 10 feet high at about ten years old.

At Arley Castle there is a good tree which, in 1904, was by Mr. Woodward's measurement 60 feet by 5 feet 7 inches.

¹ *Flora*, 225 (1665).

² *British Trees with Illustrations*, 9 (1901).

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At Wollaton Hall, near Nottingham, the property of Lord Middleton, there is a tree 43 feet high which at 5 feet girths 7 feet 10 inches, and at 10 feet, where it forks, 8 feet. It has a spread of not less than 78 feet, which for this tree is very unusual (Plate 147). It is perhaps the most symmetrical of its kind that I have seen anywhere. In the Botanic Gardens at Oxford and Kew there are fair-sized specimens.

In Scotland and Ireland we know of no trees of great size, and none were recorded by Loudon; but at Glasnevin there is one about 35 feet in height, which divides into three stems close to the ground, and has very pendent wide-spreading branches.

TIMBER

Little or nothing is known of the timber in England, but a wood has been imported to France under the name of "Noisetier," which I believe to belong to this species, and which, as exhibited by M. Hollande of Paris, is very handsome. I purchased some very handsome veneer from Mr. Witt of London, which he told me had come to him direct from Constantinople, and which I believe was cut from the root of *C. Colurna*. Two good-sized logs of this tree were in the collection of Servian timbers shown at the Balkan States Exhibition in London in 1907; one of them is now in the Kew Museum. Gamble¹ says that in the Himalaya it is a well-grained timber, which does not warp, of a pinkish-white colour, and often shows a fine shining grain resembling that of bird's-eye maple. (H. J. E.)

¹ *Mau. Indian Timbers*, 684 (1902).

CARPINUS

Carpinus, Linnæus, *Gen. Pl.* 292 (*ex parte*) (1737); Bentham et Hooker, *Gen. Pl.* iii. 405 (1880); Winkler, in Engler, *Pflanzenreich*, iv. 61, *Betulaceæ*, 24 (1904).
Distegocarpus, Siebold et Zuccarini, *Flor. Jap. Fam. Nat.* ii. 103, t. 3 (1846).

DECIDUOUS trees belonging to the order Betulaceæ. Leaves, alternate, distichous on the branchlets, stalked, ovate, doubly-serrate, penninerved, the nerves ending in the points of the teeth; stipules scarious, caducous or persistent. Flowers appearing in early spring with the unfolding of the leaves, unisexual, monœcious, without petals. Staminate flowers in pendulous, cylindrical catkins, arising from buds produced near the ends of lateral branches of the previous year; stamens, three to twenty, crowded on a pilose receptacle adnate to the base of a concave scale; filaments short, two-branched, each branch bearing a one-celled anther, tipped with a cluster of long hairs. Pistillate flowers, in loose, semi-erect catkins, which are terminal on the branchlets of the year; in pairs at the base of an ovate, acute, deciduous scale; each flower subtended by a small bract and two minute bracteoles, and consisting of a two-celled ovary, surmounted by a minute epigynous calyx and two elongated styles; each cell containing one ovule.

Fruit, in pendent, stalked strobiles, composed of imbricated, foliaceous or membranous involucre, resulting from the developed bract and bracteoles of the flower, each with a nutlet at its base. Nutlet, ovoid, compressed, longitudinally ribbed, crowned by the calyx and remains of the style, one-seeded, and falling from the involucre in autumn. Seed, filling the cavity of the nutlet, without albumen; cotyledons fleshy, carried above ground in germination.

The genus consists of about eighteen species inhabiting the temperate regions of North America, Europe, and Asia. Two sections are distinguished:—

I. DISTEGOCARPUS, Sargent, *Silva N. Amer.* ix. 40 (1896).

Scales of the staminate catkins lanceolate, stalked. Fruit-involucre, membranous, infolded below, completely covering the nutlet, closely imbricated in the strobile. Trees with scaly bark. Two species, *C. japonica*, Blume, and *C. cordata*, Blume.

II. EU-CARPINUS, Sargent, *loc. cit.*

Scales of the staminate catkins ovate, sub-sessile. Fruit-involucre, foliaceous, open or only slightly infolded over the nutlets, loosely imbricated in the strobile. Trees usually with smooth bark. This section includes the remaining species.

Carpinus and Ostrya are very similar in foliage; and the following key, based upon the characters of the leaves and branches (Plate 201), distinguishes all the species of both genera which are in cultivation in England. *Carpinus laxiflora*, though not yet introduced, has been included, as it has been much confused with the other Japanese hornbeams.

KEY TO CARPINUS AND OSTRYA

- I. *Leaves not exceeding 2 inches in length.*
1. *Carpinus orientalis*, Miller. South-eastern Europe, western Asia.
Leaves $1\frac{1}{2}$ inch long, acute, deeply plicate.
 2. *Carpinus polyneura*, Franchet. Central China.
Leaves 2 inches long, acute, smooth and only slightly plicate.
- II. *Leaves exceeding 2 inches in length.*
- A. *Leaves lanceolate.*
3. *Carpinus japonica*, Blume. Japan.
Leaves about 4 inches long, much longer in proportion to their width than in the other species, with numerous (eighteen to twenty-four pairs) nerves.
- B. *Leaves ovate, acute at the apex.*
4. *Carpinus yedoensis*, Maximowicz. Central China. Cultivated in Japan.
Leaves $2\frac{1}{2}$ inches long, rounded at the base, with conspicuous bands of appressed pubescence on the upper surface. Branchlets pilose.
- C. *Leaves ovate, acuminate at the apex.*
- * *Leaves deeply cordate at the base.*
5. *Carpinus cordata*, Blume. China, Korea, Manchuria, and Japan.
Leaves 4 to 5 inches long, broad in proportion to their length, with fifteen to twenty pairs of nerves.
** *Leaves rounded or only slightly cordate at the base.*
† *Under surface glabrous between the nerves.*
6. *Carpinus laxiflora*, Blume. China, Japan.
Leaves $2\frac{1}{2}$ inches long, rounded at the base, abruptly contracted into a very long acuminate apex. Branchlets with scattered long hairs. Buds minute, $\frac{1}{8}$ inch long.
7. *Carpinus Betulus*, Linnæus. Europe, western Asia.
Leaves 3 inches long, slightly cordate at the base, turning yellow in autumn. Branchlets with scattered long hairs. Buds fusiform, $\frac{1}{4}$ to $\frac{1}{3}$ inch long.
8. *Carpinus caroliniana*, Walter. North America.
Leaves as in *C. Betulus*, but turning red in autumn. Branchlets with scattered long hairs. Buds ovoid, $\frac{1}{8}$ inch long.
†† *Under surface pubescent between the nerves.*
9. *Ostrya carpinifolia*, Scopoli. Southern Europe, Asia Minor, Syria.
Leaves 3 inches long, not velvety to the touch above, rounded at the base. Branchlets with dense appressed pubescence.

10. *Ostrya japonica*, Sargent. China, Japan.

Leaves 3 to 4 inches long, velvety to the touch above, slightly cordate at the base. Branchlets with dense, scarcely appressed, pubescence.

11. *Ostrya virginica*, Willdenow. North America.

Leaves 3 to 4 inches long, not velvety to the touch above, slightly cordate at the base. Branchlets glandular-pubescent. (A. H.)

CARPINUS ORIENTALIS

Carpinus orientalis, Miller, *Gard. Dict.* ed. 7, No. 3 (1759); Loudon, *Arb. et Frut. Brit.* iii. 2014 (1838); Winkler, *Betulaceæ*, 37 (1904).
Carpinus duinensis, Scopoli, *Fl. Carniol.* ii. 243, t. 60 (1772); Boissier, *Fl. Orient.* iv. 1177 (1879); Willkomm, *Forstliche Flora*, 366 (1887).
Carpinus nigra, Moench, *Verz. Ausländ. Bäume u. Staud.* 19 (1785).

A small tree or large shrub, rarely attaining 50 feet in height; bark smooth and greyish. Young branchlets covered with a very minute dense pubescence, with which are intermixed scattered long hairs. Leaves (Plate 201, Fig. 7) small,¹ strongly plicate, the nerves being deeply impressed above, about $1\frac{1}{2}$ inch long by $\frac{3}{4}$ inch wide, ovate or ovate-elliptical, acute at the apex, unequal and slightly cordate at the base; margin sharply bi-serrate, ciliate; upper surface dark green, shining, with scattered long hairs; lower surface light green, pilose on the midrib and nerves, glabrous between the nerves, with minute axil-tufts; nerves nine to thirteen pairs; petioles, $\frac{1}{4}$ to $\frac{3}{8}$ inch, pilose; stipules linear-lanceolate, pubescent at the apex, $\frac{1}{4}$ inch long, often persistent during summer. Fruit: strobiles, up to 2 inches long; bracts densely imbricated, $\frac{3}{4}$ inch long, obliquely ovate, not lobed, sharply and irregularly serrate.

This species is a native of south-eastern Europe and western Asia. It occurs in Italy and Sicily, reaching its northern limit in Istria, Croatia, Slavonia, Banat, and Transylvania, and extending southwards through the Balkan States to Macedonia and Greece. It is also met with in the Crimea, Asia Minor, and the Caucasus.

It was introduced into cultivation in England in 1739 by Miller. It appears to be exceedingly rare, the only specimens we have seen being at Kew, where there are several small trees, one of which, planted in 1878, is now about 20 feet high.

(A. H.)

CARPINUS POLYNEURA

Carpinus polyneura, Franchet, *Journ. de Bot.* xiii. 202 (1899); Burkill, *Journ. Linn. Soc. (Bot.)*, xxvi. 501 (1899).
Carpinus Turczaninowii, Hance, var. *polyneura*, Winkler, *Betulaceæ*, 38, f. 12 (1904).

A small tree, attaining 30 feet in height; bark greyish, slightly fissuring and scaly. Young branchlets with scattered long hairs. Leaves (Plate 201, Fig. 5)

¹ In wild specimens the leaves are often larger, 2 to $2\frac{1}{2}$ inches in length.

small, weakly plicate, the nerves being only slightly impressed above, about 2 inches long by $\frac{7}{8}$ inch broad, ovate, acute at the apex, unequal and slightly cordate at the base; margin bi-serrate, ciliate; upper surface dark green, shining, with scattered, appressed hairs; lower surface as in *C. orientalis*; nerves nine to twelve pairs; petiole, $\frac{1}{4}$ to $\frac{3}{8}$ inch, pilose; stipules linear, pubescent along the margins, $\frac{1}{4}$ inch long, persistent during summer. Fruit: strobiles 2 inches long; bracts loosely imbricated, obliquely ovate, $\frac{1}{2}$ inch long, outer margin slightly serrate, inner margin sub-entire, not lobed, without a basal auricle.

This species is a rare tree in the mountains of Eastern Szechwan and Western Hupeh in China; and is closely allied to, if not a mere variety of, *C. Turczaninowii*, Hance, which is common in Northern China. *C. polyneura* differs little in technical characters from *C. orientalis*, but is very distinct in appearance owing to the leaves being smooth and flat and not deeply plicate, as in the other species of hornbeam.

It is only represented in cultivation by a single tree, about 15 feet high, in Kew Gardens, which was raised from seed sent by me in 1889. (A. H.)

CARPINUS JAPONICA

Carpinus japonica, Blume, *Mus. Bot. Lugd. Bat.* i. 308 (1850); Shirasawa, *Icon. Ess. Forest. Japon.*, text 47, t. 24, ff. 1-17 (1900); Winkler, *Betulaceae*, 25 (1904).

Carpinus Carpinus, Sargent, *Garden and Forest*, vi. 364, f. 56 (1893); *Forest Flora Japan*, 64, t. 21 (1894).

Distegocarpus Carpinus, Siebold et Zuccarini, *Fl. Jap. Fam. Nat.* ii. 103 (1846).

A tree attaining in Japan 50 feet in height and 5 feet in girth; bark furrowed and scaly. Young branchlets with scattered long hairs, which fall off in autumn. Leaves (Plate 201, Fig. 1) ovate-oblong, up to 4 inches long by $1\frac{1}{2}$ inch broad, acuminate at the apex, oblique at the base, which is rounded or slightly cordate; margin finely bi-serrate, non-ciliate; upper surface dark green, pubescent on the midrib and nerves; lower surface pale green, with scattered long hairs on the midrib and nerves and slight axil tufts; nerves, eighteen to twenty-four pairs, impressed above; petiole $\frac{1}{2}$ inch long, pubescent; stipules $\frac{1}{2}$ inch long, linear-lanceolate, pubescent, persistent during summer. Fruit: strobiles $2\frac{1}{2}$ inches long; bracts densely imbricated, $\frac{3}{4}$ to $\frac{7}{8}$ inch long, ovate, sharply serrate; nutlet covered by a minute orbicular lobe, attached merely by its base to the bract, the outer margin of the latter being slightly infolded below.

This species is a native of central and southern Japan, and, according to Sargent, is common on the Hakone and Nikko Mountains between 2000 and 3000 feet elevation. It was collected near Nikko by Elwes, and at Nagasaki by Oldham.

It was introduced by Maries in 1879; but no trees of this date are now to be found, there being only small plants about 3 feet high in the Coombe Wood Nursery. It is perfectly hardy in New England, where it produced fruit for the first time in 1891 in the Arnold Arboretum, where it had been introduced a few years previously.

Young plants were sent by Prof. Sargent in 1895 and 1897 to Kew, which have now attained about 10 feet in height. At Tortworth a young tree has produced fruit.

The foliage of this species is remarkably distinct and handsome. (A. H.)

CARPINUS YEDOENSIS

Carpinus yedoensis, Maximowicz, *Mél. Biol.* xi. 314 (1881); Burkill, *Journ. Linn. Soc. (Bot.)*, xxvi. 502 (1899); Franchet, *Journ. de Bot.* xiii. 203 (1899); Winkler, *Betulaceae*, 35 (1904).

A small tree. Young branchlets densely covered with long hairs. Leaves (Plate 201, Fig. 3), $2\frac{1}{2}$ inches long by $1\frac{1}{2}$ inch wide, ovate, acute at the apex, rounded at the base; margin biserrate and ciliate; upper surface with conspicuous bands of long appressed pubescence in the intervals between the lateral nerves; lower surface pilose on the midrib and nerves, glabrous or with scattered long hairs in the intervals between the nerves; nerves ten to twelve pairs; petiole, $\frac{3}{8}$ to $\frac{1}{2}$ inch long, pilose; stipules, linear-lanceolate, caducous. Fruit: strobiles, $2\frac{1}{2}$ inches long; bracts loosely imbricated, $\frac{3}{4}$ inch long, semi-ovate, coarsely serrate on the outer side, subentire on the inner side, which is slightly infolded at the base, forming a small auricle partly covering the nutlet.

This species is only cultivated in Japan, where it was first seen by Maximowicz. It was discovered growing wild in the mountains of North-Eastern Szechwan in China by Père Farges, and may have been brought to Japan by Buddhist monks in early days, like many other Chinese plants. Young plants were raised from Japanese seed in 1901 by Purpus, in the Botanic Garden at Darmstadt. In the nursery at Kew there are two or three plants, growing vigorously, and about 3 feet in height, which were obtained from Simon Louis in 1904. (A. H.)

CARPINUS CORDATA

Carpinus cordata, Blume, *Mus. Bot. Lugd. Bat.* i. 309 (1850); Sargent, *Garden and Forest*, vi. 364 (1893), viii. 294, f. 41 (1895), and *Forest Flora Japan*, 65 (1894); Burkill, *Journ. Linn. Soc. (Bot.)*, xxvi. 501 (1899); Shirasawa, *Icon. Ess. Forest. Japon.*, text 46, t. 24, ff. 18-32 (1900); Winkler, *Betulaceae*, 26 (1904); J. H. Veitch, *Hortus Veitchii*, 359 (1906).

Distegocarpus (?) cordata, De Candolle, *Prod.* xvi. 2, p. 128 (1864).

A tree, attaining in Japan and China a height of 50 feet and a girth of 6 feet; bark, dark grey, deeply furrowed and scaly. Young branchlets covered with a very minute pubescence, intermixed with scattered long hairs. Leaves (Plate 201, Fig. 2), ovate, up to 5 inches long and $2\frac{3}{4}$ inches wide, acuminate at the apex, unequally and deeply cordate at the base; margin finely bi-serrate, non-ciliate; upper surface dark green, with scattered long hairs; lower surface light green, pubescent between the nerves, pilose on the midrib and nerves, without axil tufts; nerves fifteen to twenty

pairs, impressed above; petiole, $\frac{3}{4}$ inch long, with scattered long hairs; stipules caducous. Fruit: strobiles, 3 to 6 inches long, long-stalked; bracts densely imbricated, membranous, 1 to $1\frac{1}{8}$ inch long, irregularly serrate; the inner margin furnished below with an orbicular lobe, infolding and concealing the nutlet; the outer margin slightly inflected at the base. The basal lobe is much larger than in *C. japonica*, and is united to the bract, not only by its base, but also along one side.

Var. *chinensis*, Franchet, *Journ. de Bot.* 1899, p. 202.—Leaves, ovate-oblong, 3 inches long by $1\frac{3}{4}$ inch broad, with eighteen to twenty pairs of nerves, slightly cordate and unequal at the base, shortly acuminate at the apex. This variety strongly resembles in the shape of the leaf certain forms of *C. japonica*, but has the fruit of *C. cordata*. It seems to be intermediate between the two species, and is found in the mountains of Eastern Szechwan in China. It was introduced into cultivation by Mr. E. H. Wilson in 1901, and young plants are growing in the Coombe Wood Nursery.

According to Sargent, *Carpinus cordata* is one of the largest and perhaps the most beautiful of the hornbeams. It grows on the main island of Japan only at high altitudes, its true home being in the deciduous-leaved forest of central and northern Yezo. It is also a native of Korea and Manchuria; and occurs in China, in the typical form, in the province of Shensi,¹ the variety *chinensis* growing more to the south.

This species was introduced from Japan by Maries in 1879, and produced fruit in 1886 in the Coombe Wood Nursery, where the largest specimen now living is only 15 feet in height. A tree at Tortworth is about 20 feet, and has borne fruit, from which, however, Elwes did not succeed in raising seedlings. There is also a small tree at Grayswood, Haslemere. It seems to be very rare in cultivation, and there are no specimens growing in the Hornbeam Collection at Kew. (A. H.)

CARPINUS LAXIFLORA

Carpinus laxiflora, Blume, *Mus. Bot. Lugd. Bat.* i. 309 (1850); Oliver, in Hooker, *Icon. Plant.* t. 1989 (1891); Sargent, *Garden and Forest*, vi. 364 (1893), and *Forest Flora Japan*, 64 (1894); Burkill, *Journ. Linn. Soc. (Bot.)*, xxvi. 501 (1899); Shirasawa, *Icon. Ess. Forest. Japon*, text 48, t. 25, ff. 15-30 (1900); Winkler, *Betulaceæ*, 33 (1904).
Carpinus Fargesii, Franchet, *Journ. de Bot.* 1899, p. 202.

A tree, attaining in Japan 50 feet in height and 5 feet in girth; bark smooth, grey, sometimes almost white in colour. Young branchlets with scattered long hairs. Leaves (Plate 201, Fig. 8), $2\frac{1}{2}$ inches long by $1\frac{1}{2}$ inch broad, ovate or ovate-elliptical, contracted above into a long acuminate apex, rounded or slightly cuneate at the base; margin, bi-serrate, non-ciliate; upper surface with scattered long appressed hairs; lower surface with long appressed hairs on the midrib and nerves, glabrous between the nerves; nerves thirteen to fifteen pairs; petiole, $\frac{1}{2}$ inch long, pilose;

¹ Burkill, *loc. cit.*

stipules caducous. Fruit: strobiles, up to 3 inches long; bracts very loosely imbricated, about $\frac{5}{8}$ inch long, semi-ovate, outer side irregularly serrate, inner side sub-entire, with a lobe near the base, which is infolded, but does not conceal the nutlet.

This species is a native of China and Japan. According to Sargent, it is very like the European hornbeam in habit, fluted stem, and smooth bark. It is common in all the mountain forests of Hondo, where it is most abundant at elevations between 2000 and 3000 feet. Near Agematsu, in Shinshu, at 2000 feet altitude, it was collected by Elwes, who saw no tree of any great size or beauty, though the leaves turn red and yellow in autumn. In Yezo, it descends to sea-level on the southern shores of Volcano Bay, where, near the town of Mori, it is common in oak forests, and grows to its largest size. In China, this species grows in the mountains of Hupeh, Eastern Szechwan, and Kiangsi; but is rare, displaying considerable variation in the character of the leaves and fruit.¹

It has not yet, apparently, been introduced into cultivation. Plants at Kew, sent under the name of *C. laxiflora*, from the Arnold Arboretum in 1895, are *C. japonica*. (A. H.)

CARPINUS CAROLINIANA, AMERICAN HORNBEAM

Carpinus caroliniana, Walter, *Fl. Carol.* 236 (1788); Sargent, *Silva N. Amer.* ix. 42, t. 447 (1896), and *Trees N. Amer.* 190 (1905); Winkler, *Betulaceæ*, 31 (1904).
Carpinus americana, Michaux, *Fl. Bor. Amer.* ii. 201 (1803); Loudon, *Arb. et Frut. Brit.* iii. 2013 (1838).
Carpinus Betulus, Koehne, *Deutsche Dendrologie*, 116 (1893).²

A bushy tree, attaining, in America, rarely 40 feet in height and 6 feet in girth, with stem and bark like the common hornbeam. Young branchlets with a few scattered long hairs, the minute glandular pubescence often seen in *C. Betulus* never being present. Leaves (Plate 201, Fig. 6) as in the common hornbeam, but usually with fewer nerves, nine to ten pairs; and unequal, rounded, or slightly cuneate at the base. Stipules lanceolate, $\frac{1}{3}$ inch long, caducous. Fruits: strobiles, 2 to 3 inches long; bracts loosely imbricated, triangular-ovate, $\frac{3}{4}$ to 1 inch long, with two short unequal lateral lobes, and a much longer middle lobe, which is usually serrate on only one margin; pedicels of each pair of bracts united only at the base.

In the absence of fruit, this species is difficult to distinguish from *C. Betulus* from which Koehne could not distinguish it even as a variety. In autumn, the beautiful red tint of the foliage of the American species is diagnostic. The best mark of distinction lies, however, in the buds, which are small, ovoid, acute, $\frac{1}{8}$ inch long, with glabrous ciliate scales; those of *C. Betulus* being large, fusiform, $\frac{1}{4}$ to $\frac{1}{3}$ inch long, with pubescent ciliate scales.

This species, which is known in America as the blue beech or water beech, is found along the borders of streams and swamps, from Southern and Western Quebec

¹ Three varieties are distinguished by Burkill, *loc. cit.*

to Florida, extending westward to Northern Minnesota, Eastern Nebraska, Kansas Indian Territory, and Eastern Texas. It is also met with in a slightly modified form¹ in the mountainous regions of Southern Mexico and Guatemala. It is most abundant and of its largest size in the southern Alleghany mountains and in Southern Arkansas and Texas.

It was introduced into England by Pursh in 1812; but is very rare in cultivation, the best specimen we have seen being at Arley Castle. It has no claim to be considered as a forest tree, its only merit being the scarlet colour of the foliage in autumn. Elwes gathered seeds of this species near Ottawa in 1904, which did not germinate. (A. H.)

CARPINUS BETULUS, COMMON HORNBEAM

- Carpinus Betulus*, Linnæus, *Sp. Pl.* 998 (1753); Loudon, *Arb. et Frut. Brit.* iii. 2004 (1838); Willkomm, *Forstliche Flora*, 358 (1887); Mathieu, *Flore Forestière*, 396 (1897).
Carpinus vulgaris, Miller, *Gard. Dict.* ed. 8, No. 1 (1768).
Carpinus sepium, Lamarck, *Fl. Franç.* ii. 212 (1778).
Carpinus compressa, Gilbert, *Exerc.* ii. 399 (1792).
Carpinus ulmoides, Gray, *Nat. Arrang. Brit. Pl.* ii. 245 (1821).
Carpinus carpinizza, Host, *Fl. Austr.* ii. 626 (1831).
Carpinus intermedia, Wierzbicki, in Reichenbach, *Icon. Fl. Germ.* xii. f. 1297 (1850).
Carpinus nervata, Dulac, *Fl. Haut. Pyrén.* 141 (1867).

A tree, usually attaining only a moderate size, 60 or 70 feet in height and 8 feet in girth; but in England occasionally as large as 90 feet by 12 feet. Stem never perfectly circular in section, being more or less longitudinally fluted or ridged, with shallow rounded depressions between the ridges; bark smooth, thin, grey. Young branchlets with scattered long hairs, a very minute dense glandular pubescence being also often present. Leaves (Plate 201, Fig. 4) about 3 inches long by $1\frac{3}{4}$ inch broad, oval or ovate, acuminate at the apex; broad, unequal, and rounded or slightly cordate at the base; margin bi-serrate, non-ciliate; upper surface dark green, glabrous, or rarely pilose on the midrib and nerves; under surface light green, with appressed long hairs on the midrib and nerves and minute axil tufts; lateral nerves, ten to fifteen pairs, impressed on the upper surface, prominent beneath; petiole $\frac{1}{4}$ to $\frac{1}{2}$ inch long, pubescent; stipules narrow, lanceolate, $\frac{1}{2}$ inch long, caducous.

Male catkins, about $1\frac{1}{2}$ inch long; scales ovate, acute, entire, veined longitudinally; stamens, 4 to 12, with long yellow anthers. Female catkins, nearly 1 inch long; scales ovate, acuminate, ciliate. Fruit: strobiles up to 3 inches long; involucre loosely imbricated, in pairs, with their pedicels connate for the greater part of their length, three-lobed, the lateral lobes small and usually entire, the middle lobe, about $1\frac{1}{2}$ inch long, entire or minutely serrulate; nutlet, $\frac{1}{3}$ inch long, seven- to eleven-nerved, glabrous, with the apex umbonate and surrounded by a six-lobed calycine ring, within which are the remains of the style.

¹ Var. *tropicalis*, Donnell Smith, *Bot. Gaz.* xv. 28 (1890).

In winter, the twigs are smooth, shining, glabrous, with five-angled pith, and are marked at the base of the year's growth by ringlike scars, due to the fall of the accrescent scales of the bud of the previous season. Terminal bud not formed, the tip of the branchlet falling off in summer and leaving a small circular scar close to the uppermost axillary bud, the latter prolonging the shoot in the following season. Leaf-scars small, crescentic, three-dotted, with a short stipular scar on each side. Buds, distichous on the branchlets, unequal in size, on prominent leaf-cushions, appressed against the stem, fusiform, $\frac{1}{4}$ to $\frac{1}{3}$ inch long; scales, ciliate and pubescent towards the tips, brownish.

Seedling:¹ Primary root tapering, wiry, flexuose; caulicle terete, pubescent, $\frac{1}{2}$ inch long; cotyledons fleshy, rounded-obovate, $\frac{1}{3}$ inch long, auricled at the base, shortly stalked, glabrous, green above, whitish beneath; stem zigzag, pubescent, giving off alternate stalked bi-serrate leaves, which resemble those of the adult plant, but are smaller and occasionally lobulate in margin.

VARIETIES

The common hornbeam shows little variation in the wild state, the only form worth noticing being var. *carpinizza*, which is found in Transylvania. In this variety the leaves are often distinctly cordate at the base with only seven to nine pairs of nerves; and the fruit-involucre has very short lateral lobes.

Under cultivation, pyramidal,² fastigiate, pendulous, and variegated forms have originated. In var. *purpurea*, the young leaves have a reddish tint. Var. *incisa*, Aiton,³ has leaves with large sharp serrated teeth. A wide-branching tree of this variety at Beauport, Sussex, is 6 feet 3 inches in girth; and there is also a fine specimen at Smeaton-Hepburn, East Lothian. In var. *quercifolia*, Desfontaines,⁴ the leaves are smaller than in the type and are irregularly and deeply cut or lobed. In this variety, leaves of the ordinary form are often present on the same branch with those of the pinnatifid kind. Two remarkable trees of this variety are reported⁵ to be growing on the bowling green of the Woodrow Inn, in Cawston Parish, near Aylsham, Norfolk.

DISTRIBUTION

The common hornbeam is indigenous in the south of England; but its true native limits cannot now be exactly determined. It is recorded⁶ from Somerset, Wilts, Dorset, Hants, Berks, Oxford, Bucks, Herts, Surrey, Sussex, Kent, Essex, Cambridge, Suffolk, and Norfolk; but in many cases, especially in the south-western counties, the records are probably of planted and not really wild trees. In Dorset,⁷ it is a very rare tree; and Townsend⁸ considers it to be a doubtful native of Hampshire. Druce⁹ considers it to be indigenous in Oxfordshire on the chalk, but always

¹ Cf. Lubbock, *Seedlings*, ii. 532, f. 667 (1892).

² A solitary wild specimen of the pyramidal hornbeam formerly grew in the forest of Gremsey, near Vic in France. Godron, *Les Hêtres Tortillards* (1869).

³ Aiton, *Hort. Kew*, iii. 362 (1789).

⁴ Desfontaines, *Tab. Écol. Bot. Mus. Hist. Nat.* 212 (1824).

⁵ Rev. J. F. Noot in letter to Kew, March 1894.

⁶ Watson, *Comp. Cybele Brit.* 311 (1870) and *Topog. Bot.* 355 (1873).

⁷ Mansell-Pleydell, *Flora of Dorsetshire*, 246 (1895).

⁸ *Flora of Hampshire*, 313 (1883).

⁹ *Flora of Oxfordshire*, 268 (1886).

planted on other formations. There is no doubt, however, that it formed a considerable part of the ancient forests, which existed to the north and east of London; and in the Lea division of Hertfordshire¹ it still forms the chief portion of the underwood; whilst it is common in Essex and Kent, where it is usually treated as coppice.

The hornbeam has been found in the fossil state in Suffolk, in the interglacial strata at Hoxne, and in the preglacial strata at Pakefield.²

Carpinus Betulus is widely distributed on the continent of Europe, and occurs also in Asia Minor, the Caucasus, and Persia. In Europe, its northern limit, beginning in Norfolk in England, crosses over to Denmark and South Sweden, where it ascends on the west coast to lat. $56^{\circ} 30'$, and on the east coast to $57^{\circ} 13'$, reaching its extreme northerly point on the island of Gothland in lat. $57^{\circ} 20'$. In Norway, Schubeler says, it is not wild; but he has seen a tree at Christiania, planted in 1818, which in 1885 measured 36 feet by 4 feet. In Russia, the hornbeam occurs as far north as lat. $56^{\circ} 10'$ on the coast of Courland, and is confined to the provinces which lie west of an irregular line drawn from near Riga to the Sea of Azov, its most easterly localities being in the governments of Vitebsk, Mohilef, Chernigof, and Poltava, and in the Crimea. South and west of the above limits, the hornbeam is spread through France, Belgium, Holland, Germany, Austrian Empire, Balkan Peninsula, Greece, Switzerland, and continental Italy; but is not found wild in Spain, Portugal, Corsica, Sardinia, and Sicily.

In France, the hornbeam is most common in the north and east, where it forms a large part of the coppice forests, and also occurs as undergrowth in the high forests of beech and oak. Its southerly limit in France is a curved line extending from Grenoble through Toulouse to near Bordeaux. Towards the west and south, it becomes a rare tree, and is totally absent from Brittany. It is rather a tree of the plains and low hills than of the mountains; but ascends in the Vosges to 2000 feet, in the Jura to 2300 feet, and in the French Alps to 2800 feet. Treated as coppice, its growth is very rapid in France, where it takes the first rank as firewood.

In Germany the hornbeam is widely spread in the plains and low hills, where it grows usually, as in France, in company with the beech and other deciduous trees, either as scattered individuals or in small groups. In east Prussia, where the beech does not occur, the hornbeam replaces it and grows to great perfection, often forming part of the spruce and pine forests. Pure woods are rare, though some of considerable extent occur, according to Willkomm, in Alsace, Baden, and South Bavaria. In Austria, Hungary, the Balkan States, and Greece, the hornbeam is no longer a tree of the plain, but grows in the mountains in the beech forests. It ascends in the Harz mountains to 1250 feet, in the Bavarian Alps to 2900 feet, and in the Swiss Alps to 3000 feet.

According to Radde,³ it is met with through the whole region of the Caucasus, at elevations ranging from sea-level to 5600 feet. It is also recorded from the northern provinces of Asia Minor, and from Ghilan in Northern Persia.

(A. H.)

¹ Pryor, *Flora of Hertfordshire*, 373 (1887).

² C. Reid, *Origin Brit. Flora*, 144 (1899).

³ *Pflanzenverb. Kaukasuslind.* 183 (1899).

CULTIVATION

The seeds of the hornbeam ripen in October, but with few exceptions do not germinate until after a second winter, and must be treated in the same manner as those of the ash. The seedlings though very hardy as regards spring frosts, grow slowly at first, and require about four years in the nursery before they are strong enough to plant out. Though on sandy soil the tree produces fruit freely and the seedlings bear shade as well as those of the beech, yet the hornbeam does not in England, as in some parts of France, tend to overpower the oak; and its economic value was formerly much greater than it is now, on account of its being one of the very best trees for firewood. It may, however, be used for underplanting, and as a nurse for other trees on soils too wet for beech, and is admirably suited for making clipped hedges. When the shoots are interlaced they form an impassable barrier, and bear clipping as well as any tree. It also bears pollarding and coppicing extremely well, some of the old pollards which are seen in the eastern counties being of very great age; but when not so treated it does not appear to be a very long-lived tree, and rarely exceeds 200 years. In France, Mouillefert says, it lives 100 to 120 years, and rarely over 150 years, but I think it must considerably exceed this age in some parts of England.

The hornbeam is more critical as to soil and climate than most of our native trees; and though Loudon says it is always found on stiff clay and on moist soils where scarcely any other timber tree will grow, this is hardly correct. I have never seen a really fine tree on any but fertile soils, and though it is the most abundant tree of Epping Forest, from which Loudon probably derived his idea; there is not, so far as I know, a really fine specimen in that district, though this may be partly due to their being nearly all pollards. I searched in vain for self-sown seedlings, with roots fit to transplant, and of fifty sent me by Mr. M'Kenzie, superintendent of Epping Forest, only one survived. He tells me that though large numbers of seedlings may be seen after a good seed year, yet most of them very soon disappear, as the deer and cattle bite them off when not protected by bushes. As a wild tree it is principally found in the south-eastern and eastern counties where the lowest rainfall occurs, but it grows well in the west and in Ireland, and even as far north as Morayshire. Mouillefert says that in France fresh and permeable sandy soils suit it best; and that sandy, gravelly, and flinty clays also suit it well, even when calcareous, but that it languishes or perishes on those which are too stiff, marshy, peaty, or very dry; and I think this is correct as regards England also. On account of its weak development of roots when young it requires shelter at first, and though it will stand shade fairly, it succeeds best as an isolated tree when adult.

As a forest tree it can only be considered of secondary importance, and Forbes does not include it in his *Estate Forestry*. As an ornamental tree, it has great value, both on account of the graceful pendent branches, which when in flower and fruit are very beautiful, and for the brilliant yellow colour of the leaves in autumn.

REMARKABLE TREES

Large hornbeams are not at all common, and exist so far as I have seen in comparatively few places, mostly old parks. The largest and finest that I know of, though by no means the tallest, is near the reservoir at Cornbury Park, Oxford, where there is a tree whose height I could not measure exactly, though it probably exceeds 75 feet, with a bole 11 feet 10 inches in girth and 12 to 14 feet long, which spreads out at that height into an immense number of branches covering a circle of 95 paces (Plate 148). There are two other trees of nearly similar size and habit on the north side of the beech avenue, one of them leaning very much on one side with drooping branches. Sir Hugh Beevor has recently measured a tree, 100 feet in height and 9 feet 8 inches in girth, on Sir Robert Dashwood's property near West Wycombe.

But there is no place where I have seen hornbeams so tall or so numerous as at Cobham Park, Kent, where there must be hundreds of trees 70 to 80 feet high, and many with clean boles 20 to 40 feet long. Among so many it is hard to say which are the largest, but one which I measured near the old heronry, and not far from the ash grove, was over 90 feet high, dividing at about 7 feet into four stems, each of which ran up straight and clean for about 40 feet. Another, a pollard, hollow on one side, measured 13 feet 6 inches in girth. These grow on a soil which suits the ash perfectly. Four shoots from a stool in a wood here measured 76 feet high and 2 to 3 feet in girth.

At Mersham-le-Hatch, Ashford, Kent, the seat of Sir Wyndham Knatchbull, Bart., I saw, in 1907, a remarkable wood called Bockhanger, composed of very old pollard hornbeams many of which are hollow and much decayed. They grow on a sandy loam, covered in spring with bluebells, and have for generations served to supply the mansion with firewood, of which the steward told me twelve to fourteen cords were annually consumed. The largest of these trees was about 16 feet to the crown, and had a very large kidney-shaped wen on one side, over which it measured 16 feet 4 inches in girth. Another tree here showed the remarkable power of the hornbeam in repairing wounds in its trunk. A large double-stemmed tree, widely split and hollow at the base, had higher up completely covered the open cleft with young healthy wood and bark in the same way that old yews often do.

A most remarkable hornbeam, on account of its very wide-spreading branches, grows in Fredville Park, Kent, and though not over 35 to 40 feet high, covers an area of no less than 103 paces round. It has about fifteen main branches which show the characteristic irregularities that old hornbeams always have. The branches are so thick that foxes often choose the crown of this tree as a lair, and when covered with fruit, as it was when I saw it in June 1907, it is a most striking and beautiful tree. It grows in a deep fertile loam overlying chalk, but rather wet in winter.

The hornbeam is, in Essex, especially in Epping Forest, most commonly seen as a pollard, the practice of lopping the branches for firewood having been very general in old times. A photograph showing the appearance of the tree when so

treated was taken for me by Mr. Elsdon of Hertford, at Waterhall, a farm on Mr. H. Clinton Baker's property near Bayfordbury, Herts, in January 1907 (Plate 149). At Essendon, Herts, Mr. Baker, in 1906 measured a tree, 81 feet by 11 feet 2 inches; a pollarded tree at the same place being 56 feet high by 18 feet in girth. Sir Hugh Beevor measured in 1891 a hornbeam in Hatfield Park, Herts, which was 17½ feet in girth at about 4 feet from the ground.

The finest and largest examples of pollard hornbeams that I have seen are in Easton Park, Essex, the seat of the Earl of Warwick. A group of these trees, growing near the park-keeper's house, which was shown me by Mr. Rogers, agent for the Easton property, contains several trees of great beauty, which were in flower on 7th April. The largest of these measures no less than 28 feet round the head at about 8 feet from the ground, and 12 feet 2 inches at 2 feet (Plate 150). Another near it, dividing into two stems which are united at the crown, was 25 feet in girth at 7 feet and 17½ feet at 2 feet. A third, growing at some distance, has perhaps the finest head of all, and measures 26 feet round the head with a bole about 11 feet high. Mr. Shenstone tells me that the largest he has seen in Epping Forest is 27 feet in girth round the head, and he showed me another very old one in Braxted Park which was over 20 feet round.

Mrs. Delves Broughton has sent me a photograph (Plate 151) of a very fine group of hornbeams in Weald Park, Essex, the seat of C. J. H. Tower, Esq., in which, according to the measurements sent me by Mr. T. W. Bacon, the two largest trees are 75 feet by 16 feet 9 inches, and 88 feet by 15 feet 4 inches.

At Elveden, Suffolk, there is a very well-shaped and handsome tree in front of the house, which, as I was told by the late Prof. A. Newton, is probably not more than 140 years old, and measured, when I saw it in 1907, 75 feet by 10 feet.

At Nibley, Gloucestershire, there is a tree, of which Col. Noel has been good enough to send me a photograph, which measures about 80 feet by 11 feet 6 inches with a bole of 8 feet and a spread of 80 feet diameter. In Bitton churchyard, Gloucestershire, there is a tree planted since 1817 by Canon Ellacombe's father which is 65 feet by 8 feet 2 inches. At St. Pierre Park, near Chepstow, Major Stacey showed me a very fine hornbeam which, though not very tall, and with a bole only 10 feet high by 11 feet 7 inches in girth, spreads over an area 112 paces round.

In the wooded part of Kew Gardens, there are several fine trees, the best of which is 70 feet high and 10 feet in girth, dividing into three stems at 7 feet from the ground. One tree, 5½ feet in girth, has bark on the lower part of the trunk, divided into raised longitudinal ridges, which are covered with small scales. At Heron Court, Hants, there is a beautiful tree near the front entrance, 70 feet by 10 feet 5 inches with a spread of 25 yards.

At Brocklesby, Lincolnshire, Lord Kesteven measured, in 1906, a tree 77 feet high by 9 feet 4 inches in girth. At Castle Howard the hornbeam grows well and there are several large trees, the tallest being about 80 feet high, the thickest 9 feet 3 inches in girth. At Studley Park, Yorkshire, in the valley below Fountains Abbey, there are several very fine hornbeams, probably the same as those figured by Loudon (ff. 1933, 1934, 1935), which were in 1838 50 to 60 and one 73 feet high.

I measured three from 70 to 80 feet with a girth of $6\frac{1}{2}$ to $8\frac{1}{2}$ feet, one being covered with dense tufts of twigs, a kind of witches' broom, caused by *Exoascus Carpini*.

In Scotland the hornbeam is less common than in the south, but grows to a large size in the warmer districts; though, as it is not mentioned either by Hunter, or in the *Remarkable Trees of Scotland*, it is evidently looked on as a rare tree in the north. Walker¹ speaks of one formerly growing at Bargally, which was 70 feet high, with a clear trunk of 20 feet.

The finest I have seen is a tree at Gordon Castle, perhaps the one mentioned by Loudon as being then 54 feet high; in 1904, it was 68 feet by 8 feet (Plate 152). At Murthly, in the lower park near the Tay, there is an old tree measuring, in 1906, 65 feet by 9 feet 8 inches; and Henry measured one at Scone of the same dimensions.

Mr. J. Renwick sends me particulars of a very remarkable hornbeam at Douglas Support, in Lanarkshire, which, in 1900, measured 78 feet by 8 feet 1 inch, with a bole of 17 feet long, and a spread of 60 feet, the branches having long pendulous twigs, which form a screen all round the tree and hang nearly to the ground.²

Another remarkable tree is at Eglinton Castle, Ayrshire, which separates into three stems near the ground, and measures at the narrowest point below the fork 14 feet in girth; its three stems girth 5 feet 9 inches, 5 feet 6 inches, and 4 feet 11 inches respectively. Mr. Renwick sends me particulars of other fine hornbeams as follows:—at Househill, Renfrewshire, 10 feet girth, 72 feet spread; at Tullichevan Castle, Dumbartonshire, 60 feet by 8 feet 3 inches; at Gargunnoch House, Stirlingshire, 8 feet 11 inches girth, 83 feet spread.

The hornbeam is rarely planted in Ireland. The largest tree, which Henry has seen, is growing beside the Killarney Lake, at Mahony's Point. It measured, in 1904, 15 feet 8 inches in girth, at 18 inches above the ground, giving off six great stems, the three largest of which were—8 feet 4 inches, 7 feet 7 inches, and 6 feet 3 inches in girth. This tree is about 70 feet in height, and the diameter of its spread is 80 feet. It is in perfect health and bears fruit regularly.

At Adare, Co. Limerick, in 1903, Henry saw a fine tree, which measured 53 feet by 8 feet 8 inches, the spread of branches being 65 feet. At Glenstal, in the same county, there is a tree of exactly the same dimensions, as regards height and girth. At Kilruddery, Co. Wicklow, a tree, which had been blown down, measured 8 feet 9 inches in girth; and here there is a very fine hornbeam hedge, about 15 feet in height.

TIMBER

The wood of the hornbeam is the hardest, heaviest, and toughest of our native woods, but though extremely strong, is not flexible; and as it is seldom found large enough and clean enough to cut into planks, it is little used in England except for fuel, for which it is one of the best woods known, burning slowly with a

¹ *Essays*, p. 95, *file* Loudon.

² I am informed by Mr. Douglas that the peculiarity of this tree consists in the long drooping twigs, which are 20 to 30 feet in length, and hang like small cords to the ground on all sides, concealing the trunk, whilst the upper branches do not droop at all. He thinks that this is due to its being a grafted tree. A photograph, which he is good enough to promise me, will be given in a later volume.

bright flame, and making the best of charcoal. As it decays quickly when exposed to wet, it is of no use for outside work, and will not take creosote. The trunk of the tree is often very deeply furrowed, and the wood is said to be cross-grained and difficult to work. It is or was considered the best wood for cogs, mallets, and wooden screws for carpenters' benches, also for pulleys and butchers' blocks. Its value is uncertain, and depends largely on the locality, and on the size and age of the tree.

With regard to the use of this wood by pianoforte manufacturers, Mr. J. Rose, of Messrs. Broadwood and Sons, to whom I am indebted for much information, writes me as follows:—

“Hornbeam is still used for piano action work in England, though American maple has replaced it to a considerable extent. French hornbeam, and, I believe, Dutch also, are used for the purpose, because of larger size and more freely grown than the British product, and also because, when all charges are included, it is probably cheaper. There is a marked difference in the English hornbeam and that grown in France and elsewhere on the Continent. This is perhaps hardly perceptible in a small sample, but the English wood is smaller and more irregular, but of a distinctly firmer texture, so hard and close as sometimes to resemble ivory. It works beautifully with fine saws and small drills; but the waste is serious. The foreign timber is larger and more freely grown, producing much larger boards, but the grain is coarser, and the texture of the wood less firm, and more liable to split when in small pieces, such as are used in action work.”

(H. J. E.)

OSTRYA

Ostrya, Scopoli, *Fl. Carniol.* 414 (1760); Bentham et Hooker, *Gen. Pl.* iii. 406 (1880); Winkler, in Engler, *Pflanzenreich*, iv. 61, *Betulaceae*, 24 (1904).
Carpinus, Linnæus, *Gen. Pl.* 292 (*ex parte*) (1737).

SMALL deciduous trees, belonging to the order *Betulaceae*, agreeing with the genus *Carpinus* in the characters of the branchlets, buds, foliage, and staminate flowers. Pistillate flowers, in dense erect spikes, inserted in pairs on the base of ovate acute leafy scales, each flower enclosed in a sac-like involucre, formed by the union of a bract and two bracteoles, which is open at the apex at the time of flowering, afterwards becoming closed. Calyx dentate, adnate to the two-celled inferior ovary; style short, divided into two linear subulate stigmatic branches; ovules solitary in each cell. Fruits: disposed in stalked ovoid strobiles, composed of densely imbricated involucre, which are vesicular, closed, flattened, membranous, longitudinally nerved, reticulate, pubescent at the apex, and hirsute at the base with sharp, rigid, stinging hairs. Nutlet, sessile in the involucre, ovoid, compressed, longitudinally ribbed, crowned by the remains of the calyx; seed solitary, pendulous.

Four species of *Ostrya* have been distinguished:—*Ostrya Knowltoni*, Coville, a rare tree in Arizona, not yet introduced, and three species, occurring in North America, Eastern Asia, and Europe and Asia Minor, which are so closely allied that they have been considered by most botanists to be only geographical races of one species. These three species are all in cultivation, and as they can be distinguished (see Key to *Carpinus* and *Ostrya*, p. 526), will be treated by us separately.

OSTRYA CARPINIFOLIA, HoP HORNBEAM

Ostrya carpinifolia, Scopoli, *Fl. Carniol.* ii. 244 (1772); Willkomm, *Forstliche Flora*, 368 (1887); Mathieu, *Flore Forestière*, 403 (1897).
Ostrya vulgaris, Willdenow, *Sp. Pl.* iv. 469 (1805); Loudon, *Arb. et Frut. Brit.* iii. 2015 (1838).
Ostrya italica, Spach, *Ann. Sc. Nat. sér. 2*, xvi. 246 (1841).
Ostrya italica, sub-species *carpinifolia*, Winkler, *Betulaceae*, 22 (1904).
Ostrya Ostrya, Sargent, *Silva N. Amer.* ix. 32 (1896).
Carpinus Ostrya, Linnæus, *Sp. Pl.* 998 (1753).

A tree attaining 60 feet in height and 10 feet in girth; stem cylindrical, bark greyish, finely fissured, and scaly. Young branchlets with dense appressed

Ostrya

pubescence. Leaves (Plate 201, Fig. 11) about 3 inches long by $1\frac{3}{8}$ inch wide, ovate, shortly acuminate at the apex, unequal and rounded at the base; margin sharply bi-serrate and ciliate; covered above and below with appressed pubescence, spreading more or less over the whole surface, and not confined to the midrib and nerves, as in *Carpinus Betulus*, and with minute axil tufts on the lower surface; nerves twelve to fifteen pairs; petiole $\frac{1}{4}$ to $\frac{3}{8}$ inch long, appressed pubescent; stipules persistent during summer. Nutlet ovoid, $\frac{1}{8}$ inch long, crowned by a tuft of hairs; calyx-limb obsolete.

In winter the twigs are slender, zigzag, more or less pubescent. No true terminal bud is formed, the apex of the branchlet falling off in summer and leaving a minute circular scar at the side of the uppermost axillary bud. Buds small, $\frac{3}{8}$ inch long, ovoid, viscid, set obliquely on prominent leaf-cushions; scales 6 to 9, imbricated, greenish with a dark brown margin, more or less pubescent. Leaf-scar semicircular, with two bundle-dots above and one group of three smaller dots below.

Ostrya carpinifolia reaches its most westerly point in the extreme south-eastern corner of France, where it occupies a few isolated stations in the Basses-Alpes and Alpes-Maritimes Departments. In the forest of Miolans,¹ in the Basses-Alpes, which is mainly composed of *Pinus sylvestris*, it is found on a northern slope, over an area of about 400 acres, occurring chiefly as undergrowth and ascending to about 2700 feet altitude. In the Alpes-Maritimes it descends in some places to nearly sea-level. It extends eastward through Southern Switzerland, the Tyrol (where,² near Botzen, it ascends to 3500 feet altitude), Carinthia, and Lower Styria to Southern Hungary, and spreads southwards through Carniola, Croatia, and the Balkan States to Greece, growing usually in rocky situations, more commonly on limestone than on other formations. It is common throughout Italy and Sicily in the oak and chestnut regions, ascending to 3800 feet elevation; and forms woods of considerable extent around Lake Como, especially above Lecco, on the shores of Lake Lugano, and at Gaudria and Salvatore.³ It occurs as a rare tree in Corsica and Sardinia. It is also met with in Asia Minor and in the Lebanon. It attains about a hundred years of age; and according to Pardé⁴ produces coppice shoots like the hornbeam.

(A. H.)

CULTIVATION

It was introduced into cultivation in England some time before 1724, as it is mentioned in Furber's Nursery Catalogue published in that year. Though an ornamental tree which attains a good size and is perfectly hardy, it has always been very rare in this country. According to Mouillefert⁴ its growth is about equal to that of the Hornbeam. I have raised plants from French seed which grow faster on my soil than those of the hornbeam, and seem at least as hardy, as they were

¹ Fliche, *Bull. Soc. Bot. France*, xlv. 8 (1899). Cf. also *ibid.* xxxv. 160 (1888).

² Christ, *Flore de la Suisse*, 238 (1907). In the same work, p. 507, it is stated that this species has been found in the fossil state in miocene beds at Ardeche; and another species, probably a mere variety, has been found in the same strata at Var.

³ *Arb. Nat. des Barres*, 281 (1906).

⁴ *Principales Essences Forestières*, 148, note (1903). At Grignon in France, planted together in the arboretum, on calcareous soil with a chalky subsoil, at thirty years old the Hornbeam is 11 metres high by 70 centimetres in girth at 1 metre above the ground; and the *Ostrya* 11½ metres by 73 centimetres in girth. It bore here without injury the severe winter of 1879.

uninjured by the severe spring frost of May 21-23, 1905, and ripened their young wood well in October. They may be distinguished by the larger leaves with a pair of persistent linear stipules at the base.

REMARKABLE TREES

From the dimensions given by foreign authors I doubt whether in its native country the Hop Hornbeam ever attains a much larger size than the one which I figure (Plate 153). This remarkable tree is at Langley Park, near Norwich, the seat of Sir Reginald Beauchamp, and cannot be of great age, as it is not mentioned in an account of this place in Grigor's *Eastern Arboretum*, published in 1841. It is grafted on a stock of the hornbeam which measures 8 feet in girth below the graft, while the trunk above it is no less than 15 feet 8 inches. Its height is difficult to estimate, but may be about 50 feet.

A large tree formerly grew at Kew, on which Mr. J. G. Jack, in *Garden and Forest*, v. 602, remarks as follows:—"An unusually fine specimen of a hop hornbeam, 50 feet high, branching near the ground and spreading about 70 feet, with a trunk over 3 feet in diameter, was grafted on a stock of hornbeam at 2½ feet from the ground, and is a good deal larger than its stock, with a swelling at the point of juncture. No one can help remarking the striking contrast between the rough bark of the *Ostrya* and the comparatively smooth bark of the *Carpinus*."

This tree was perhaps the one figured by Loudon¹ in 1838, which was then said to be 60 feet high, with a trunk 3 feet in diameter, and the finest specimen in England at that time. In 1890 it was figured in the *Gardeners' Chronicle*² as a handsome wide-spreading tree, but soon after began to decay, and was cut down in 1897,³ when it measured 59 feet high by 9 feet 4 inches in girth at 3 feet. Fruit was abundantly produced; but no perfect seeds were ever developed. A part of its trunk is preserved in the Museum at Kew, and I am indebted to the Director for a sample of the timber, which somewhat resembles that of the pear. According to Mouillefert it has all the qualities of hornbeam wood in a superior degree.

There is a fine specimen in the Botanic Garden at Oxford, which measures about 40 feet by 4 feet. This tree, though quite healthy, is much infested by mistletoe. At Tortworth there is a tree about 40 feet high by 2 feet 7 inches in girth. At Munden, Watford, a tree, 32 feet by 2 feet 11 inches, is said to have been planted about 1830.

In Scotland we know of no tree of this species of large size now existing, though a large one formerly grew at Bargally,⁴ a place between Gatehouse and Newton-Stewart, once the property of Andrew Heron, a celebrated planter, who died in 1729. Loudon went there in 1831, and gives the dimensions⁵ of the *Ostrya*

¹ *Op. cit.* viii. 244 a.

² *Gard. Chron.* viii. 275, Fig. 47 (1890). Also figured in *Woods and Forests*, 1884, p. 318. The shapes of the trees figured in Loudon and in the *Gardeners' Chronicle* are very different.

³ *Kew Bull.* 1897, p. 404.

⁴ Walker, *Essays on Natural History and Rural Economy* (1812).

⁵ Bargally is fully described by Loudon, *op. cit.* i. 95-99 (1838).

from a letter of the then owner, J. Mackie, as 60 feet high and 4 feet 1 inch in girth at 4 feet in 1835. Henry could find no trace of this tree when he visited Bargally in 1904. At Glasnevin, Dublin, there are two trees, 30 and 25 feet high, narrowly pyramidal in habit. These are 34 years old and are growing on the bank of a stream.

(H. J. E.)

OSTRYA VIRGINICA, IRONWOOD, AMERICAN HOP HORNBEAM

Ostrya virginica, Willdenow, *Sp. Pl.* iv. 469 (1805); Loudon, *Arb. et Frut. Brit.* iii. 2015 (1838).
Ostrya virginiana, Koch, *Dendrologie*, ii. pt. ii. 6 (1873); Sargent, *Silva N. Amer.* ix. 34, t. 445 (1896), and *Trees N. Amer.* 192 (1905).
Ostrya Ostrya, Macmillan, *Metasperma Minnesota Valley*, 187 (1892).
Ostrya italica, sub-species *virginiana*, Winkler, *Betulaceae*, 22 (1904).
Carpinus Ostrya, Linnæus, *Sp. Pl.* 998 (1753) (in part).
Carpinus virginiana, Miller, *Dict.* ed. 8, No. 4 (1768).

A tree attaining 60 feet in height and 6 feet in girth, but usually smaller. This species, as seen in cultivation, is mainly distinguished from *Ostrya carpinifolia* by the presence on the young branchlets, petioles, and midrib of the leaf beneath, of short, erect, gland-tipped hairs. The leaves (Plate 201, Fig. 9) are usually larger, 3½ inches long, slightly cordate at the base, with fewer nerves, about twelve pairs. The nutlet in this species is larger, ¼ to ⅓ inch long, fusiform, flattened, without a tuft of hairs at the apex, surmounted by a plainly visible calyx-limb.

Two forms of this species occur in the wild state, which have been distinguished by Spach,¹ as follows:—

Var. *glandulosa*.—Young branchlets, petioles, and peduncles covered with gland-tipped short bristles. Specimens in the Kew herbarium from Ontario, Niagara Falls, and the Alleghany Mountains belong to this variety, which is the one known in cultivation in England.

Var. *eglandulosa*.—Glandular bristles not present on any part of the plant. Young shoots pubescent. This variety appears to be common in the western and southern parts of the United States, and does not appear to have been introduced into cultivation. In the absence of fruit, it would be difficult to distinguish this variety from *Ostrya carpinifolia*. (A. H.)

The tree grows, according to Sargent, on dry gravelly slopes and ridges, often in the shade of oaks and other large trees; and is a native of Canada and the United States, occurring on the northern shores of Lake Huron in western Ontario, eastward through the valley of the St. Lawrence to Chaleur Bay and Cape Breton Island; extending southward to Northern Florida and Eastern Texas, and westward to Northern Minnesota, the Black Hills of Dakota, Nebraska, and Kansas. It is most abundant and of its largest size in Southern Arkansas and Texas.

I saw it at Mt. Carmel in Illinois, and in the Arnold Arboretum, where it was a finer tree in size and habit than *Carpinus caroliniana*. It is known in America as

¹ *Ann. Sc. Nat.* sér. 2, xvi. 246 (1841), and *Hist. Vég.* xi. 218 (1842).

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Ironwood, and is used for levers and tool handles, the wood being very tough and strong. Michaux states that on the estate of Duhamel du Monceau, in France, there were trees 20 feet high, from which self-sown plants had sprung up.

It was introduced into England by Bishop Compton in 1692, but is rarely met with except in botanic gardens. At Kew there are four trees, 20 to 30 feet in height. Others are growing at Eastnor Castle and at Grayswood, near Haslemere, where, though not planted above twenty years, it is growing vigorously, and looks as if it would make a handsome tree. A tree in the Edinburgh Botanic Garden was, in 1905, 39 feet high by 3 feet 3 inches in girth. Seedlings raised in my garden grow more freely than those of the common hornbeam; but not so fast as those of *Ostrya carpinifolia*. (H. J. E.)

OSTRYA JAPONICA, JAPANESE HOP HORNBEAM

Ostrya japonica, Sargent, *Garden and Forest*, vi. 383, f. 58 (1893), *Forest Flora Japan*, 66, t. 22 (1894), and *Silva N. Amer.* ix. 32 (1896); Shirasawa, *Icon. Ess. Forest. Japon.* text 49, t. 25, ff. 1-14 (1900).

Ostrya virginica, Maximowicz, *Mél. Biol.* xi. 317 (1881).

Ostrya italica, sub-species *virginiana*, Winkler, *Betulaceæ*, 22 (1904).

A tree attaining in Japan a height of 80 feet, with a tall straight stem, 5 feet in girth, but usually smaller. This species is considered by Maximowicz and Winkler to be identical with the American species, and there is said to be little or no difference in the fruit, which I have not seen. In cultivation, the Japanese tree is readily distinguished as follows:—Leaves (Plate 201, Fig. 10) velvety to the touch on the upper surface, which is covered with a dense erect pubescence; nerves, ten to twelve pairs, fewer than in the other species; base slightly cordate. Young branchlets densely white pubescent, without glandular hairs, which are also absent from the petiole and midrib of the leaf.

According to Sargent, this species is nowhere abundant in Japan, occurring only as scattered individuals in the forests of deciduous trees which cover Central and Southern Yezo, and growing also in the province of Nambu in Northern Hondo. Shirasawa, however, gives a more extensive distribution, stating that it is found also throughout the central chain of Hondo, in the provinces of Musahi, Kai, and Totomi, and also at Nikko; and farther south, in the island of Shikoku. *Ostrya japonica* is also a native of China, being an exceedingly rare tree in the mountain forests of Eastern Szechwan and Western Hupeh, where it was discovered by Père Farges and by myself. *Ostrya mandschurica*, Budischtschew,¹ recorded from Manchuria, is probably identical with this species.

The Japanese Hop Hornbeam was introduced in 1888 into the Arnold Arboretum by seed sent from Japan by Dr. Mayr, and has proved hardy in the climate of Eastern Massachusetts. There are two trees at Kew, sent by Prof. Sargent in 1897, which are now about 15 feet high and growing vigorously. There is also a healthy young tree at Grayswood, Haslemere. (A. H.)

¹ In Trautvetter, *Act. Hort. Petrop.* ix. 166 (1884). I have seen no specimens of this.

NOTHOFAGUS

Nothofagus, Blume, *Mus. Bot. Lugd. Bat.* i. 307 (1850); Oerstedt, *Vidensk. Selsk. Skrift.* V. ix. 331 (1873); Solereder, *System. Werth Holzstructur*, 253 (1885); Krasser, *Ann. K.-K. Naturhist. Hofmuseums, Wien*, xi. 149 (1896).

Calucechinus and *Calusparassus*, Hombron et Jacquinot, *Voy. Pôle. Sud.* Atlas, tt. 6-8 (1853).

Lophozonia, Turczaninow, *Bull. Soc. Imp. Nat. Mosc.* xxxi. 396 (1858).

Fagus, section *Nothofagus*, Bentham et Hooker, *Gen. Pl.* iii. 410 (1880).

THIS genus comprises the beeches inhabiting extra-tropical South America, Australia, Tasmania, and New Zealand, and was formerly considered to be a section of the genus *Fagus*, which, however, as now limited, includes only the species of the northern hemisphere. The two genera are distinguished as follows:—

NOTHOFAGUS.—Trees or shrubs, with deciduous or evergreen foliage.¹ Flowers monœcious or rarely diœcious, either solitary or in groups of threes. Fruit: involucre, two-, three- or four-valved, usually bearing externally transverse entire, toothed or lobed lamellæ, with or without gland-tipped processes; or in rare cases the valves are smooth and without appendages; nuts, solitary or three in each involucre.

FAGUS.—Trees with deciduous foliage. Flowers monœcious; the staminate numerous in globose heads, the pistillate in pairs. Fruit: involucre, covered externally with bristly, deltoid or foliaceous processes; nuts, two in each involucre.

About seventeen² distinct species of *Nothofagus* are known, constituting three natural sections, based on the characters of the foliage:—

I. Leaves deciduous, soft in texture, folded in bud along the lateral nerves, crenate or serrate in margin.

1. *Nothofagus antarctica*, Oerstedt. Large tree, S. America. Introduced into cultivation. Leaves ovate, $\frac{3}{4}$ to 1 inch long; lateral nerves three to five pairs; margin slightly lobed, unequally crenate, with three to five teeth between the ends of each adjacent pair of nerves.

2. *Nothofagus Montagnei*,³ Reiche. Shrub or low tree. Chonos Archipelago. Not introduced. A little-known species, of which I have seen no specimen; leaves $\frac{1}{2}$ inch long, firmer in texture and more conspicuously veined above than those of the preceding species, from which it is also distinguished by the yellow-coloured pubescence on the branchlets.

¹ Bunbury, in *Bot. Fragments*, 322 (1883), writes an interesting article on the different types of foliage which are met with in this genus.

² *N. alpina*, Reiche (*Fagus alpina*, Poeppig et Endlicher), is a doubtful species.

³ *Calucechinus Montagnei*, Hombron et Jacquinot, *loc. cit.* t. 7 (1853). *Fagus Montagnei*, Philippi, *Linnaea*, xxix. 45 (1857).

3. *Nothofagus pumilio*,¹ Krasser. Shrub or low tree, S. America. Not introduced. Leaves ovate, 1 to 1½ inch long; lateral nerves five to seven pairs; regularly bicrenate in margin, with two teeth between the ends of each adjacent pair of nerves. Young branchlets clothed with dense yellow pubescence.

4. *Nothofagus obliqua*, Blume. Large tree, S. America. Introduced. Leaves, 1 to 2½ inches long, ovate-oblong, glaucous beneath; lateral nerves seven to eleven pairs; lobulate and serrate in margin.

5. *Nothofagus procera*,² Oerstedt. Large tree, S. America. Not introduced. Leaves, 2 to 3½ inches long, oblong; lateral nerves fifteen to sixteen pairs; doubly serrate in margin.

6. *Nothofagus Gunnii*,³ Oerstedt. Shrub, Tasmania. Not introduced. Leaves, ½ inch long, ovate; lateral nerves six pairs, prominent beneath; margin regularly crenate, with one tooth between the ends of each adjacent pair of nerves.

II. Leaves evergreen, margin not entire. In this section, the leaves are usually very coriaceous, and glabrous, or with only slight pubescence.

A. *Leaves minutely crenulate in margin.*

7. *Nothofagus apiculata*,⁴ Krasser. Tree attaining 40 feet in height, New Zealand. Not introduced. Leaves 1 inch long, elliptical, conspicuously mucronate at the apex.

B. *Leaves crenate in margin.*

8. *Nothofagus Menziesii*, Oerstedt. Large tree, New Zealand. Introduced. Leaves, ½ inch long, ovate, rhomboid or orbicular, doubly crenate, with two pubescent pits on each side of the midrib near the base on the lower surface.

9. *Nothofagus Cunninghami*, Oerstedt. Large tree, Australia, Tasmania. Introduced. Leaves, ½ inch long, ovate, deltoid or rhomboid, simply crenate; lower surface without pits or resinous papillæ.

10. *Nothofagus betuloides*, Blume. Large tree, S. America. Introduced. Leaves, ¾ to 1 inch long, ovate, crenate or obtusely dentate; lower surface dotted with resinous papillæ.

C. *Leaves serrate in margin.*

11. *Nothofagus Dombeyi*,⁵ Blume. Large tree, S. America. Not introduced. Leaves, 1 inch long, lanceolate; nerves six pairs; lower surface dotted with resinous papillæ.

12. *Nothofagus nitida*,⁶ Krasser. Large tree, S. America. Not introduced. Leaves, 1 to 1½ inch long, trapezoid-ovate, acuminate; nerves six pairs; lower surface not dotted.

13. *Nothofagus fusca*, Oerstedt. Large tree, New Zealand. Introduced.

¹ *Fagus pumilio*, Poeppig et Endlicher, *Nov. Gen. et Sp.* ii. 68, t. 195 (1835). *Fagus antarctica*, var. *bicrenata*, DC. *Prod.* xvi. 2, p. 120 (1864).

² *Fagus procera*, Poeppig et Endlicher, *Nov. Gen. et Sp.* ii. 69, t. 197 (1835).

³ *Fagus Gunnii*, Hooker, *Icon. Plant.* t. 881 (1852).

⁴ *Fagus apiculata*, Colenso, *Trans. N. Zeal. Instit.* xvi. 335 (1884).

⁵ *Fagus Dombeyi*, Mirbel, *Mém. Mus. Paris.* xiv. 467, t. 24 (1827).

⁶ *Fagus nitida*, Philippi, *Linnaea*, xxix. 44 (1857).

Leaves, 1 to 1½ inch long, thin in texture, ovate, rounded at the apex; serrations large, few, irregular; nerves four to seven pairs.

14. *Nothofagus Moorei*, Krasser. Large tree, Australia. Introduced. Leaves, 2 to 3 inches long, ovate-lanceolate, acuminate; sharply and finely serrate; nerves ten to fifteen pairs.

III. Leaves evergreen, entire in margin. In this section, the leaves on young trees are glabrous; but on older trees they become densely tomentose on the under surface. They resemble considerably the leaves of certain species of *Vaccinium*.

15. *Nothofagus cliffortioides*, Oerstedt. Large tree, New Zealand. Introduced. Leaves, ¼ to ½ inch long, ovate, rounded at the base; tomentum whitish.

16. *Nothofagus Solandri*,¹ Oerstedt. Large tree, New Zealand. Not introduced. Leaves ¼ to ½ inch long, oblong, cuneate at the base; tomentum whitish.

17. *Nothofagus Blairii*,² Krasser. Large tree, New Zealand. Not introduced. Leaves ¾ inch long, ovate, rounded at the base, apiculate at the apex; tomentum yellowish. (A. H.)

NOTHOFAGUS CLIFFORTIOIDES

Nothofagus cliffortioides, Oerstedt, *Vidensk. Selsk. Skrift.* V. ix. 355 (1873).

Fagus cliffortioides, J. D. Hooker, in *Hook. Icon. Plant.* tt. 673 (1844) and 816 B (1852), *Flora New Zealand*, i. 230 (1854), and *Handb. New Zealand Flora*, 250 (1864); Kirk, *Forest Flora New Zealand*, 201, tt. 101, 101 A (1889); Cheeseman, *New Zealand Flora*, 643 (1906).

An evergreen tree, attaining, in New Zealand, about 50 feet in height and 6 feet in girth. Young branchlets pubescent; buds minute, ovoid, shining, brown. Leaves (Plate 202, Fig. 4) persistent for two or three years, distichous and crowded on the branchlets, coriaceous, minute, ¼ to ½ inch in length, entire in margin; on young plants ovate, rounded at both base and apex, green and glabrous on both surfaces; on adult trees, ovate or ovate-oblong, rounded and unequal at the base, subacute at the apex, minutely punctate above, greyish-white with dense appressed pubescence beneath; petioles short and pubescent. Male flowers solitary; stamens eight to twelve. Fruit: involucre ⅓ to ¼ inch long, three-lobed, each lobe with two or three entire transverse lamellæ; nuts one to three, winged, one or two triquetrous, the third flattened.

This tree is known in New Zealand as the "mountain birch," and is confined to mountainous regions except in the south-western corner of the South Island, where it descends to sea-level. It is not found in the northern part of the North Island; but elsewhere is very common in the forests³ between 2000 and 4000 feet elevation,

¹ *Fagus Solandri*, Hooker, *Icon. Plant.* t. 639 (1844).

² *Fagus Blairii*, Kirk, *Trans. N. Zeal. Inst.* xvii. 297, 306 (1885).

³ A view of a forest of this species in the South Island at 3000 feet, showing a dense undergrowth of young beech and tall smooth stems of older trees, is given in Schimper, *Plant Geography*, 760, f. 460 (1904).

often forming the timber line, when it becomes a mere bush. The wood, though of no great size, is used for telegraph-poles, fencing-posts, railway sleepers, and wharf-piles, the heartwood being very durable in situations where it is exposed to alternations of dryness and moisture.

N. cliffortioides is extremely rare in cultivation. There are two specimens at Enys, Cornwall, which, according to Mr. John D. Enys, were 35 feet and 28½ feet high respectively in 1905; but when Elwes saw them in that year they were very slender and not thriving. These trees are semi-deciduous, most of the leaves, after turning brilliant red in autumn, falling off during winter; whereas, in New Zealand, the foliage is strictly evergreen. Another tree is growing at Messrs. Veitch's nursery at Coombe Wood, where it stands out of doors without any protection. It is very slow, however, in growth, and is only about 12 feet in height. (A. H.)

NOTHOFAGUS MENZIESII

Nothofagus Menziesii, Oerstedt, *Vidensk. Selsk. Skrift.* V. ix. 355 (1873).
Fagus Menziesii, J. D. Hooker, *Icon. Plant.* t. 652 (1844), and *Flora New Zealand*, i. 229 (1854);
Kirk, *Forest Flora New Zealand*, 175, t. 89 (1889); Cheeseman, *New Zealand Flora*, 640 (1906).

An evergreen tree, attaining in New Zealand 100 feet in height and 15 to 25 feet in girth. Bark silvery-white, resembling that of the common English birch. Young branchlets covered with dense erect brown pubescence. Leaves (Plate 202, Fig. 9) persistent for two or three years, distichous on the branchlets, about ½ inch long, coriaceous, deltoid, ovate or rhombic; cuneate at the base, obtuse at the apex; glabrous; upper surface dark-green, shining; lower surface pale-green, with usually two (occasionally only one or none) small pits fringed with brownish hairs near the base of the midrib; lateral veins about three pairs; margin irregularly and doubly crenate; petioles short, pubescent. Male flowers solitary; calyx four- to six-lobed; stamens six to twelve. Fruit: involucre ¼ to ⅓ inch long, cleft into four narrow lobes, each with five transverse scales, cut to the base into recurved linear gland-tipped processes; nuts three, one two-winged, two three-winged, the wings produced upwards into sharp points.

This species, which is known in New Zealand as the "silver birch" or "red birch," is common in the mountain forests of both the North and South Islands, ascending from sea-level to 3500 feet. The wood is dark-red, strong, and compact, and being easily worked, is suitable for making furniture.

A small tree of this species is growing in the Temperate House at Kew; and we are not aware that it has ever been tried in the open air. The tree has handsome foliage, and should be hardy in Cornwall and the south of Ireland. (A. H.)

NOTHOFAGUS FUSCA

Nothofagus fusca, Oerstedt, *Vidensk. Selsk. Skrift.* V. ix. 355 (1873).
Fagus fusca, J. D. Hooker, *Icon. Plant.* t. 630, 631 (1844), and *Flora New Zealand*, i. 229 (1854);
Kirk, *Forest Flora New Zealand*, 179, t. 90 (1889); Cheeseman, *New Zealand Flora*, 641 (1906).

An evergreen tree, attaining in New Zealand 100 feet in height and 25 feet in girth. Bark of young trees white and smooth, becoming on old trees furrowed longitudinally and brown in colour. Young branchlets minutely pubescent. Leaves (Plate 202, Fig. 8) persistent for two years, distichous on the branchlets, ¾ to 1½ inch long, thin in texture, glabrous, broadly ovate, cuneate at the base, rounded at the apex, dark-green and shining above, pale-green beneath; sharply serrate with a few large teeth in the upper two-thirds of the leaf; lateral nerves four to five pairs; petioles about ⅛ inch, pubescent. Male flowers solitary or in threes; calyx five-toothed; stamens eight to sixteen. Fruit: involucre nearly ½ inch long, viscid-pubescent, four-lobed, each lobe with three to five transverse entire or fringed scales; nuts three, as in *N. Menziesii*.

This species is a native of New Zealand, where it is known as the "black birch" or "red birch." It grows in forests at elevations between sea-level and 3500 feet, being a splendid tree. Its distribution is North Island from Monguni and Kartaia southwards, but local to the north of the East Cape; South Island from Nelson to Foveaux Straits, but rare in Canterbury and Eastern Otago. The wood is dark-red, strong and compact, and more durable than that of the other species; it is frequently used for wharves, bridges, and fencing posts.

A small tree of this species about 10 feet high, and said to be thirty years old, is growing in the Coombe Wood Nursery. At Castlewellan, Co. Down, there is a tree¹ about 18 feet high, which was imported from New Zealand some years ago as a small plant in a Wardian case. It is growing rapidly, making an annual growth of a foot. The old leaves remain on the branches till the new ones appear, changing before they fall to a brilliant red, which contrasts well with the light green of the young growths. (A. H.)

NOTHOFAGUS MOOREI

Nothofagus Moorei, Krasser, *Ann. K.-K. Naturhist. Hofmuseums, Wien*, xi. 163 (1896).
Fagus Moorei, F. v. Mueller, *Fragm. Phyl. Austral.* v. 109 (1865); Bentham, *Fl. Australiensis*, vi. 211 (1873).

An evergreen tree, attaining in Australia 150 feet in height. Young branchlets pubescent; buds ovoid, acute, brown. Leaves (Plate 202, Fig. 7) persistent for two or three years, distichous on the branchlets, coriaceous, glabrous; shining, dark-

¹ This is figured as *Fagus cliffortioides* in Earl Annesley's *Beautiful and Rare Trees*, 71 (1903).

green above; pale-green beneath; ovate or ovate-lanceolate; 2 to 3 inches long on barren branchlets, about 1 inch long on flowering shoots; unequally cuneate at the base, acuminate at the apex, finely and sharply serrate; lateral nerves 8 to 12 pairs, prominent on the upper surface; petioles very short, pubescent. Flowers unknown. Fruit: involucre about $\frac{5}{8}$ inch long, four-lobed; lobes lanceolate, acute with pubescent scales terminating in glandular processes; nuts three, two three-winged, the other two-winged.

This tree was discovered by Mr. C. Moore, Curator of the Botanic Gardens, Sydney, in New South Wales, and is the only southern beech occurring in a subtropical region. It forms dense forests at the head of Bellinger River and Bealsdown Creek, at about 4000 feet altitude; and a few trees have also been seen near the source of the Macleay River.

It was introduced into cultivation at Kew about fifteen years ago, and there is a small tree now growing there in the Temperate House. The only specimen living in the open air, so far as we know, is growing in the garden of Mr. Thomas Acton at Kilmacurragh, Co. Wicklow. It was 18 feet high in 1906, and had bark resembling that of *Prunus avium*. (A. H.)

NOTHOFAGUS CUNNINGHAMI

Nothofagus Cunninghami, Oerstedt, *Vidensk. Selsk. Skrift*, V. ix. 355 (1873).
Fagus Cunninghami, J. D. Hooker, *Journ. Bot.* ii. 152, t. 7 (1840), and *Flora Tasmania*, i. 346 (1860); F. v. Mueller, *Fragm. Phyt. Austral.* v. 110 (1865); Bentham, *Flora Australiensis*, vi. 210 (1873); Rodway, *Tasmanian Flora*, 182 (1903).

An evergreen tree, said to attain in Tasmania 200 feet in height and 40 feet in girth. Bark, as seen in cultivated trees, roughened by small scales and fissuring longitudinally. Young branchlets densely and minutely pubescent. Buds conical, sharp-pointed and curved at the apex, shining, brown. Leaves (Plate 202, Fig. 5) persistent for two or three years, distichous and crowded on the branchlets, coriaceous, about $\frac{1}{2}$ inch in length; broadly ovate, deltoid or rhombic; cuneate or cordate at the base, acute at the apex; unequally crenate in margin; both surfaces glabrous, veins inconspicuous and scarcely prominent beneath; petioles short, pubescent. Male flowers solitary; stamens eight. Fruit: involucre $\frac{1}{4}$ inch long, four-lobed, each lobe with five or six rows of dorsal transverse scales, split up into gland-tipped processes; nuts usually three, two lateral triquetrous and three-winged, the other flattened and two-winged.

This species is very common in Tasmania, where it is known as the "Tasmanian myrtle," and forms a large proportion of the forests in the mountainous and western humid districts. It ascends to 4000 feet, becoming at this elevation a mere shrub, a few feet in height. It also occurs on the mainland of Australia, in Victoria, in a few scattered localities, being most common according to F. v. Mueller on the Baw-baw mountains, and less common at Dandenong, Mount Juliet, Wilson's Promontory,

La Trobe, Tyre's and Thomson's Rivers, and in a few places in the cooler and moister parts of Gipp's Land. The wood¹ apparently varies: one kind, "red myrtle," being of a bright pink colour, with a grain like that of the English beech, and considered to be suitable for cabinetwork; another kind, "white myrtle," brownish-grey in tint, is not so attractive in appearance.

N. Cunninghami is very rare in cultivation. The finest tree (Plate 154), said by Lord Barrymore to have been planted about fifty years ago, is growing at Fota, Co. Cork, and measured, in 1904, 48 feet high by 3 feet 3 inches in girth. This tree has numerous branches, many of them ascending from near the base of the trunk. A tree at Kilmacurragh, Co. Wicklow, with branches ascending and curving at the tips, was 40 feet high by 3 feet 4 inches in 1906. This tree has excrescences on the trunk, similar to the so-called "wood-balls," which are often seen on the common beech. It flowered in 1906. At Osborne, Isle of Wight, there is a tree, 30 feet by 2 feet 2 inches, which when Elwes saw it in 1906 seemed thriving.

It seems to be as hardy as any of the genus, and might be planted with good prospects of success in the extreme south-west of England near the sea.

(A. H.)

NOTHOFAGUS BETULOIDES

Nothofagus betuloides, Blume, *Mus. Bot. Lugd. Bat.* i. 307 (1850); Reiche, *Chil. Buch.* 15 (1897); Wildeman, *Voy. Belgica*, 74 (1905); Macloskie, *Princeton Univ. Expedit. Patagonia, Botany*, 329 (1903-6).
Fagus betuloides, Mirbel, *Mém. Mus. Paris*, xiv. 465, t. 4 (1827); Loudon, *Arb. et Frut. Brit.* iii. 1982 (1838); Hooker, *Journ. Bot.* ii. 155 (1840), and *Fl. Antarct.* ii. 349, t. 124 (1847).
Fagus Forsteri, Hooker, *Journ. Bot.* ii. 156, t. 8 (1840).
Betula antarctica, Forster, *Comm. Goett.* ix. 45 (1789).
Calusparassus betuloides and *C. Forsteri*, Hombron et Jacquinet, *Voy. Pôle Sud*, Atlas t. 7 (1853).

A large evergreen tree. Bark smooth, grey; scaling near the base in old trees. Young branchlets slender, viscid, covered with short pubescence. Buds minute, brown, ovoid. Leaves (Plate 202, Fig. 3) persistent for two or three years, distichous and crowded on the branchlets, rigid, coriaceous, $\frac{3}{4}$ to 1 inch long by $\frac{1}{2}$ inch or slightly more in breadth, ovate, rounded at the base, acute at the apex, crenate or serrate in margin; upper surface shining, glabrous, often viscid; lower surface finely reticulate, glabrous, dotted with resinous papillæ; petioles short. Male flowers solitary; calyx funnel-shaped, four- to seven-lobed; stamens ten to sixteen, with long and slender filaments. Fruit: involucre four-lobed, with erect filiform glandular processes.

According to Loudon, both *N. betuloides* and *N. antarctica* were introduced in 1830, but he had not seen a specimen of either. Sir W. J. Hooker² states that healthy young trees of both species, the first, as far as he knew, that ever had reached Europe, were sent in Wardian cases to Kew from Cape Horn in 1843, being

¹ Report on Tasmanian Timbers by Mr. R. A. Ransome, of the Stanley Works, Chelsea, in *Kew Bull.* 1889, pp. 114, 115.

² *Notes Bot. Antarctic Voyage*, 64 (1843); cf. also Loudon, *Gard. Mag.* 1843, p. 442.

a consignment from his son, who was attached as botanist to the Antarctic expedition of the *Erebus* and *Terror*. (A. H.)

The largest and finest specimen which I have seen in cultivation is at Bicton (Plate 155). It measured in 1906 about 50 feet in height and 6½ feet in girth; but bore no fruit on two occasions when I saw it. At Pencarrow, Cornwall, a tree,¹ reported by Mr. Bartlett to have been obtained from Messrs. Veitch in 1847, was 36 feet by 4 feet 3 inches in 1903. One at Coldrinick in the same county was measured in 1905 by Mr. Bartlett, who gives its dimensions as 45 feet by 5 feet 5 inches. There is another specimen,² about sixty years old, growing on Sir John Llewellyn's property at Caswell Bay, near Swansea, which he tells me measured 25 feet by 3 feet 2 inches in 1907. It is close to the sea and in consequence has been shorn off by the sea wind to the same height as the Portugal laurels and poplars which grow beside it.

At Grayswood, Haslemere, at 600 feet elevation, a tree, said by Mr. B. C. Chambers to have been planted in 1882, measured 34 feet by 2 feet 3 inches in 1906. At Hafodunos, Denbighshire, a tree, reported by Col. Sandbach to have been planted in 1855, was in 1904 36 feet high by 5 feet 2 inches in girth at 3 feet from the ground, dividing at 5 feet up into two stems. There is no tree growing now at Kew, one, a healthy specimen, having been killed³ by frost in January 1867. There is also a tree growing at Ashridge Park, Herts, which is about 30 feet by 3 feet, on which Miss Woolward has observed fruit, and a smaller one is in the Knap Hill Nursery, near Woking. A tree at Powerscourt, Co. Wicklow, was, in 1906, 33 feet high by 2 feet 10 inches in girth.

I have a sample board from a tree of this species, which grew on the rockery at Lucombe and Pince's Nursery, Exeter. This was cut down when the nursery was cleared for building in March 1903. In 1886, it was 35 feet high and 2 feet 8 inches in girth at 3 feet from the ground,⁴ and had not grown much in the succeeding years. The timber was of poor quality, and had begun to decay.

(H. J. E.)

NOTHOFAGUS OBLIQUA

Nothofagus obliqua, Blume, *Mus. Bot. Lugd. Bat.* i. 307 (1850); Reiche, *Chil. Buch.* 8 (1897); Wildeman, *Voy. Belgica*, 75 (1905).

Fagus obliqua, Mirbel, *Mém. Mus. Paris*, xiv. 465, t. 23 (1827); Hooker, *Journ. Bot.* ii. 153 (1840).

Fagus glauca, Philippi, *Linnaea*, xxix. 43 (1857).

Lophozonia heterocarpa, Turczaninow, *Bull. Soc. Imp. Nat. Mosc.* xxxi. 396 (1858).

A deciduous tree, attaining in Chile a height of over 100 feet. Bark, according to Reiche, dark in colour and fissured. Young branchlets glabrous; buds small,

¹ Figured in *Gard. Chron.* xxxiii. 10, f. 5 (1903), where it is erroneously stated to have been introduced from New Zealand.

² Figured in *Gard. Chron.* 1872, p. 466, f. 136, and 1886, xxv. 104, f. 18.

³ J. Smith, *Records of Kew Gardens*, 277 (1880).

⁴ *Gard. Chron.* xxv. 104 (1886).

conical, sharp-pointed, glabrous, brown, few-scaled, and appressed to the branchlets. Leaves (Plate 202, Fig. 2) variable in size, 1 to 2½ inches in length, ½ to 1 inch in breadth, thin in texture, ovate-oblong, unequal at the rounded or cuneate base, sub-acute or obtuse at the apex; dark-green above, very pale beneath, both surfaces glabrous except for slight pubescence on the midrib and nerves; margin shallowly lobulate in the lower half, the lobules and upper part of the leaf serrate with minute triangular acute teeth; nerves 8 to 11 pairs, prominent on the lower surface, running obliquely to the margin; petiole ⅛ to ¼ inch long. Male flowers solitary; calyx irregularly lobed, stamens thirty to forty. Fruit: involucre four-valved, valves pubescent on the back with lobed appendages bearing stalked glands; nuts three, two trigonous and three-winged, one flattened and two-winged.

This species is very variable, especially as regards the size and pubescence of the leaf, and De Candolle¹ distinguished three varieties:—Var. *valdiviana*: leaves small, glabrous, with cuneate base; var. *macranthera*: stamens long, leaves pubescent beneath; and var. *macrocarpa*, with the nuts longer than the valves of the involucre.

N. obliqua was introduced² into England by Lobb in 1849, and in the following year it was said to have been growing freely in the open air in Messrs. Veitch's nursery at Exeter. None of the original plants appear, however, to have survived.

Plants raised from seed, brought from Chile by Elwes in 1902, have grown with great vigour at Kew,³ being now about 8 feet in height. At Monreith, Sir Herbert Maxwell, who received a plant from Kew, reports that it has borne without injury 20° of frost, and may be assumed to be perfectly hardy. In Lord Ducie's garden at Tortworth, this tree has grown with astonishing vigour, being now 12 feet high and 8 inches in girth; it endured the severe frost of May 1905 without any apparent injury. The seedlings which were raised at Colesborne, however, never throve, and died before attaining any size, which is possibly due to the presence of lime in the soil.

(A. H.)

NOTHOFAGUS ANTARCTICA

Nothofagus antarctica, Oerstedt, *Vidensk. Selsk. Skrift.* V. ix. 354 (1873); Reiche, *Chil. Buch.* 11 (1897); Wildeman, *Voy. Belgica*, 73 (1904); Macloskie, *Princeton Univ. Exped. Patagonia*, Botany, 326 (1903-1906).

Fagus antarctica, Foster, *Comm. Goett.* ix. 24 (1789); Loudon, *Arb. et Frut. Brit.* iii. 1982 (1838); Hooker, *Journ. Bot.* ii. 149, t. 6 (1840), and *Fl. Antarct.* ii. 345, t. 123 (1847).

Calucechinus antarctica, Hombron et Jacquinot, *Voy. Pôle Sud*, Atlas, tt. 6, 7 (1853).

A deciduous tree, attaining in Terra del Fuego at low elevations a very large size. Young branchlets covered with dense erect pubescence, persistent in the second year. Buds, ⅛ inch long, ovoid, slightly compressed, glabrous, few-scaled. Leaves (Plate 202, Fig. 1) ½ to 1 inch long, crumpled and uneven in surface, oblong-

¹ *Prod.* xvi. 2, p. 119 (1864).

² *Gard. Chron.* 1849, p. 563; Lindley, *Journ. Hort. Soc.* vi. 265 (1851); Lindley and Paxton, *Flower Garden*, ii. 166 (1852).

³ Cf. *Kew Bull.* 1906, p. 379.

ovate, unequal and usually cordate at the base, rounded at the apex, variable in pubescence, dark-green above, light-green beneath; nerves usually four pairs; margin with three or four pairs of shallow lobes, which are minutely and irregularly dentate, the teeth being rounded or acute; petiole $\frac{1}{8}$ to $\frac{1}{4}$ inch, pubescent. Male flowers solitary; calyx five-partite; stamens ten, as long as the calyx. Fruit: involucre four-partite, each lobe with three to four transverse reddish scales; nuts three, the central one two-winged, the lateral pair three-winged.

Two distinct forms occur:—

1. Var. *sublobata*, DC.¹—Petiole and upper surface of the leaf glabrescent; lower surface glabrous except on the nerves, which are clothed with long appressed hairs.

2. Var. *uliginosa*, DC.¹—Leaves pubescent on both surfaces with minute erect hairs.

This species was introduced in 1843, as mentioned in our account of *N. betuloides*, but it is doubtful if any of the original plants are still living. The only specimen which we have discovered is a bushy tree, about 15 feet high, which is growing alongside a fine tree of *N. betuloides* at Hafodunos, Denbighshire. Colonel Sandbach believes it to be about thirty years old.

Plants raised from seed, collected by Elwes in Chile in 1902, are now in cultivation at Kew,² in a peat-bed, and have attained about 6 feet in height. They are vigorous in growth, and have passed through the severe frosts of 1906-1907 without injury, and look as if they might grow to be trees of considerable size. (A. H.)

DISTRIBUTION OF THE SOUTH AMERICAN BEECHES

In extra-tropical South America, the beeches are the dominant trees, extending from a point on the west coast of Chile about lat. 33°, southward to Patagonia and Tierra del Fuego, and crossing the Andes into Argentina. The best account of the Chilean beeches is given by Reiche,³ from whom, supplemented by my own observations in 1901-1902, I take the following particulars.

The most northerly species is *N. obliqua*, which extends on the coast up to about lat. 33°, but in the extreme north does not form forest except in the interior valleys. About lat. 35° it is the principal tree in the forest which formerly clothed the lower slopes of the Andes, but which is now fast vanishing before the attacks of man. The tree is called Roble Pellin by the Spaniards, and grows to a large size with a tall straight trunk, attaining a height of 120 feet or more, and a girth of 20 to 30 feet. In the forest country, which commences south of the Maule River, it is mixed with *N. Dombeyi*; and these two species form the principal timber supplies of Chile, and are largely cut for house-building, railway sleepers, and other purposes. Some cargoes of this timber have lately been imported into England, under the name of Chilean Oak; and by the courtesy of the Great Western Railway Company, I have received one of these sleepers, which has a dense reddish wood, not at all resembling

¹ *Prod.* xvi. 2, 120 (1864). De Candolle's var. *bicrenata* is *Nothofagus pumilio*.

² Cf. *Kew Bull.* 1906, p. 381.

³ *Beiträge Kenntniss Chilen. Buchen* (Valparaiso, 1897).

that of the European beech, and apparently suitable to take the place of the lower grades of mahogany in the manufacture of furniture. It cracks, however, badly in drying, and will require very careful seasoning. In the forests of Chillan (lat. 36°), *N. obliqua* grows up to 4000 or 5000 feet, being replaced at higher elevations by *N. antarctica* and *N. pumilio*; and reaches its southern limit in the region of Lake Llanquihue. A photograph by Mr. Bartlett Calvert, who accompanied me on my journey, shows the appearance of this tree in the forest at about 3000 feet, near the source of the Renaico River (Plate 156). Here the undergrowth is usually composed of a dense thicket of the Chilean bamboo (*Chusquea sp.*); and in the more open places the ground is often carpeted with a dense bed of *Alstroemeria aurantiaca*, whose brilliant orange flowers produce a most lovely effect. In the wetter places it is associated with *Drimys Winteri* and many beautiful shrubs and herbaceous plants, of which *Eucryphia pinnatifida*, *Embothrium coccineum*, *Tropæolum speciosum*, and several species of Fuchsia and Calceolaria are the choicest ornaments of our gardens in the warmer and damper parts of the south-west of England and Ireland. In many parts of the Chilean forests it is often covered with a lovely parasitic plant, *Myzodendron linearifolium*, DC.,¹ which hangs in silvery masses from the branches.

Nothofagus Dombeyi is known to the Chileans by its Indian name of *Coigue*, and is a large and common tree in Chile. It is usually associated with *N. obliqua*, but does not extend so far to the northward, not being found to the north of the Maule river. It is widely spread in Araucania, Valdivia, and Llanquihue, and occurs also on the Argentine side of the frontier. It grows on the island of Chiloe, and has been collected on the river Aysen (lat. 45°); but its extreme southern limit is not accurately known.

Nothofagus nitida, which has been much confused with *N. Dombeyi*, is a common forest tree in the coast mountains of Valdivia, and grows on Chiloe and the Guaitecas Islands. The distribution of this species has not yet been satisfactorily determined.

Nothofagus procera, known as *Rauli*, is less common than *N. obliqua*, to which it is allied, and usually grows scattered in the forest. Its northerly limit lies between 35° and 36° lat., and it does not occur farther south than the province of Valdivia, where it becomes a stately tree. It does not cross the frontier into Argentina.

Nothofagus antarctica is widely distributed, extending from about lat. 38° to Tierra del Fuego. It is the commonest species which I found on my tour at high elevations, both on the Chilean and Argentine sides of the frontier. It is associated with Araucaria at 4000 feet, and is common also in the plain of Valdivia in marshy situations. In the mountains around the great lake of Nahuelhuapi, the leaves of this species had already assumed their autumnal tint in February. *N. antarctica* and *N. betuloides* are the dominant trees in Patagonia and Tierra del Fuego; and

¹ I found this species in the low country about Temuco in Chile, and also on the Argentine side of the frontier in two or three localities. Two other species also occur:—*M. oblongifolium*, DC., which I found on *Nothofagus antarctica*, near the baths of Chillan at 5000 to 7000 feet elevation; and *M. punctulatum*, DC., which I gathered on *Nothofagus Dombeyi* at Lake Meliquina, and in the dense evergreen forest which skirts the glaciers of the great Tronador mountain at 2000 feet in lat. 40°.

according to Dusén,¹ their distribution is regulated by the amount of rainfall. In the western parts of Tierra del Fuego, where the rainfall is heavy, the coast forest is evergreen and is mainly composed of *N. betuloides* and *Drimys Winteri*; and *N. antarctica* is only met with in the mountains. In the eastern part of Tierra del Fuego, where the rainfall is slight, the latter species descends to sea-level and grows in mixture with *N. betuloides* and *N. pumilio*.

In Western Patagonia, the evergreen forest predominates in the Archipelago and on the western side of the mountain range, where much rain falls and the prevailing winds are south-westerly; whereas, on the eastern slopes of the mountains, where the climate is comparatively dry, the forests are composed of deciduous trees. According to Dusén, the deciduous-leaved forest is well seen at a point 30 miles up the River Aysen. In the inland region the ground is covered by a thin park-like forest, which is almost exclusively composed of one species, *N. antarctica*. This tree does not grow in such close masses as the European beech, and, owing to the absence of dense shade, there is a luxuriant undergrowth of herbs and shrubs. These park-like forests prevail up to 2300 feet. Above this elevation steppes occur, which are studded with small groves of *N. pumilio*, the ground being covered with mosses. At 3000 feet *N. pumilio* is only a low tree, which gradually becomes smaller as it ascends, until at 4300 feet it forms a stunted forest of dwarfed trees, with their branches interlaced together.

An earlier account of the Antarctic beeches is given by Sir J. D. Hooker,² who states that *N. antarctica* strongly resembles the European beech in its deciduous leaves, form of trunk, and smooth bark. It ascends much higher at Cape Horn than *N. betuloides*, and is much the larger tree of the two when it is found growing at sea-level. *N. betuloides*, however, grows to a very large size about the Straits of Magellan, and being evergreen, is a marked feature of the scenery in winter, as its upper limit is sharply defined, and contrasts with the dazzling snow that covers the matted and naked branches of *N. antarctica*. Captain King³ observed many trees of *N. betuloides* 3 to 4 feet in diameter, one being as large as 7 feet. He describes the wood as heavy and far too brittle for masts or even boat-hooks, but cutting up into tolerable planks. Hooker considered the timber of the deciduous species to be superior.

N. betuloides, while much commoner in the south, extends along the coast range as far north as Valdivia.⁴ It is replaced in the Guaitecas Islands by *N. Dombeyi* and *N. nitida*.⁵

Nothofagus pumilio has been much confused with *N. antarctica*, of which it was made var. *bicrenata* by De Candolle. It is very distinct in both foliage and fruit. It extends from Chillan and Nahuelbuta in Chile southward to the Straits of Magellan, and is usually a shrub, constituting the scrubby growth which prevails

¹ Princeton Univ. Exped. Patagonia, Botany 2, 10, 26 (1903-1906); and Engler, Bot. Jahrbüch. xxiv. 179 (1897).

² Fl. Antarct. ii. 345.

³ Voyage of the "Adventure" and "Beagle," i. 576 (1839). Ball, Notes of a Naturalist in S. America, 225, says that *N. betuloides* "has a thick trunk, commonly three or four feet in diameter, but nowhere attains any great height. Forty feet appeared to me the outside limit attained by any that I saw at Eden Harbour or elsewhere."

⁴ Reiche, loc. cit.

⁵ Dusén, loc. cit.

above timber-line in the mountains. I saw this species near the baths of Chillan, lat. 37°, where it grew as a bush at 6000 to 8000 feet on the crests of the ridges in volcanic soil. According to Reiche, it occurs as undergrowth in the Araucaria forests at 4000 to 5000 feet elevation; but in sheltered situations in the mountains of Valdivia and Llanquihue it occasionally becomes a tree 60 feet in height.
(H. J. E.)

ARBUTUS

Arbutus, Linnæus, *Gen. Pl.* 123 (1737); Bentham et Hooker, *Gen. Pl.* ii. 581 (1876).
Unedo, Hoffmannsegg et Link, *Fl. Port.* i. 415 (1809).

EVERGREEN trees or shrubs, belonging to the order Ericaceæ. Leaves simple, alternate, spirally arranged on the branchlets, coriaceous, persistent, stalked, pinnately-veined, entire or serrate, without stipules. Buds with spirally imbricated scales, within which the young leaves lie flat and are not rolled or folded. Flowers perfect, regular, in terminal compound racemes or panicles. Pedicel with two bracteoles, in the axil of an ovate bract; bracts and bracteoles scarious, persistent. Calyx five-lobed, free, persistent, unaltered at the base of the fruit. Corolla gamopetalous, hypogynous, urceolate or globose, with five obtuse, recurved, imbricated teeth. Stamens ten, included; filaments free, inserted on the base of the corolla, dilated and pilose at the base; anthers deflexed, dorsifixed, two-celled, opening by two pores, each anther with two awns on the back, against which insects knock in their search for honey and scatter the pollen through the pores. Pollen-grains united in tetrahedral masses of four grains each. Disc annular. Ovary superior, five- or occasionally four-celled; style columnar, stigmatose and obscurely five-lobed at the apex; ovules numerous. Fruit a berry or drupe, the endocarp often being imperfectly developed. Seeds numerous, small, angled, with a coriaceous testa and a horny albumen.

About twenty species are known, inhabiting the western and south-western parts of North America, Central America, Ireland, the countries in Europe bordering upon the Mediterranean, the Canary Islands, Morocco, Algeria, Asia Minor, the Crimea, and the Caucasus. Many of the species are only shrubs or very small trees, and others are not hardy or have not been introduced. Only four species¹ attaining a considerable size in cultivation in the open air in England, one of which is a hybrid, will be dealt with:—

A. *Leaves serrate. Young branchlets glandular-pubescent.*

1. *Arbutus Unedo*, Linnæus. Ireland, Southern Europe, Asia Minor, Morocco, and Algeria.

Leaves green beneath; petiole $\frac{1}{4}$ inch. Older branchlets dark brown, rough, and fissuring.

¹ *Arbutus canariensis*, Lamarck, growing in the open air, is five feet high at Mount Usher in Wicklow; but at Newry this species requires protection in winter.

Arbutus arizonica, Sargent, a native of the high mountains of Southern Arizona, if introduced, might be hardy.

Arbutus

2. *Arbutus hybrida*, Ker-Gawler. A hybrid.

Leaves slightly glaucous beneath; petiole $\frac{1}{2}$ inch. Older branchlets fawn-coloured, smooth.

B. *Leaves entire. Young branchlets glabrous.*

3. *Arbutus Andrachne*, Linnæus. Albania, Greece, Asia Minor, Crimea, Caucasus.

Leaves slightly glaucous beneath, contracted into short broad points at the apex, tapering at the base in cultivated trees; petiole $\frac{1}{2}$ inch.

4. *Arbutus Menziesii*, Pursh. Western N. America, from British Columbia to California.

Leaves glaucous, almost white, beneath; rounded or with a minute sharp point at the apex; sub-cordate or rounded at the base; petiole 1 inch.

ARBUTUS UNEDO, STRAWBERRY TREE

Arbutus Unedo, Linnæus, *Sp. Pl.* 395 (1753); Loudon, *Arb. et. Frut. Brit.* ii. 1117 (1838); Boswell-Syme, *Eng. Bot.* vi. 28, t. 882 (1866); Hooker, *Stud. Fl. Brit. Islands*, 243 (1878); Mathieu, *Flore Forestière*, 225 (1897).

Unedo edulis, Hoffmannsegg et Link, *Fl. Port.* i. 415 (1809).

A small tree, attaining in Ireland 40 feet in height and 10 feet or more in girth, usually a shrub in the Mediterranean region. Bark rough, brownish-red, more or less fissured, and only rarely scaling off in part. Young branchlets reddish or green, covered with gland-tipped hairs, which persist in the second year; older branchlets brown, rough, slightly fissuring on the surface. Buds minute, reddish; scales imbricated, ovate, acute, ciliate. Leaves 2 to 4 inches long by 1 to 2 inches broad, very variable in shape, oblong, oblong-lanceolate, elliptic, or ovate, acute at the apex, tapering at the base; upper surface dark-green, glabrous and shining; lower surface pale-green, glabrous, with prominent midrib and inconspicuous pinnate-reticulate venation; margin serrate or biserrate, the serrations acute or rounded. Petioles short, about $\frac{1}{4}$ inch long, glandular-pubescent.

Flowers appearing in autumn, inodorous, in short drooping glabrous terminal panicles. Calyx-lobes minute, triangular. Corolla usually white, rarely pinkish, urceolate, with rounded ciliated teeth; ovary glabrous. Fruit ripening in the following autumn, at the same time as the appearance of the flowers of the succeeding year; a stalked berry, pendulous, sub-globose, $\frac{3}{4}$ inch in diameter, orange-scarlet, densely covered with minute pyramidal spine-like excrescences, edible, superficially resembling a strawberry, but entirely different in structure.

Seedling.—Cotyledons two, raised above ground on a short caulicle, oval, rounded at the apex, abruptly narrowed at the base into a flat petiole, entire, $\frac{1}{4}$ inch long, dull-green above, pale-green beneath. Young stem reddish, with short glandular hairs; primary leaves alternate, minute, oval or obovate, serrate and minutely glandular-pubescent in margin; tap-root about 2 or 3 inches long.

VARIETIES

In the wild state there is considerable variation in the size and shape of the leaves, dependent upon conditions of soil, shade, and climate. Fliche¹ describes two distinct forms in France. In the hot and dry region of the Esterel, the leaves are small in size, not exceeding $2\frac{1}{2}$ inches in length by $\frac{3}{4}$ inch in breadth, and are very coriaceous, spathulate, with feebly serrated and revolute margins. In the forest of La Pinouse, near Quillan in Aude, which is mainly composed of *Pinus sylvestris* with a slight mixture of beech and silver fir, the climate being cool and the altitude considerable, the *Arbutus* has very large leaves, often 5 inches long by 2 inches broad, which are lanceolate with sharply serrate and non-revolute margins.

The following varieties are often cultivated:—

1. Var. *rubra*, Aiton, *Hort. Kew*, ii. 71 (1789). (Var. *Croomei*,² Hort.)—Flowers pink or reddish. Mackay³ noticed a single plant of this variety, growing on red slate near Glengariff.
2. Var. *integerrima*, Sims, *Bot. Mag.* t. 2319 (1822) (vars. *integrifolia* and *rotundifolia*, Hort.)—Leaves entire and smaller than in the type. This is said to have been raised by Loddiges from seed of the ordinary form. The leaves vary in shape, often being obovate or almost orbicular.
3. Var. *quercifolia*, Hort.—Leaves obovate-lanceolate, with a few irregular teeth in the upper half, about 2 inches long by $\frac{3}{4}$ inch broad. In cultivation at Kew.
4. Var. *turbinata*, Persoon.—This variety occurs wild in Greece, and is remarkable for its large top-shaped fruit, more than an inch in length.
5. Other varieties have been noted, which I have not seen, as *salicifolia* with narrow leaves, *crispa* with crumpled leaves, and *plena*, with semi-double flowers.

DISTRIBUTION

This species is widely spread throughout the maritime regions of the countries bordering on the Mediterranean, occurring in Spain, France, Corsica, Sardinia, Italy, Istria, Herzegovina, Dalmatia, Greece, Turkey, Syria, Algeria, and Morocco. It is also met with in the maritime belt along the Atlantic from Portugal to Kerry in Ireland. It occurs either as undergrowth in the forests, where in favoured situations it reaches the dimensions of a small tree, or is one of the shrubs composing the *maquis* or heaths, which spread over large tracts of siliceous soil that have been denuded of trees in past ages. It is apparently only in Ireland that the *Arbutus* grows to be a forest tree, moderate in size, but equalling in height and girth the trees of other species, with which it is associated.

In France, the *Arbutus* is common in the departments whose shores are bathed by the Mediterranean and extends inland as far as Drôme and Lozère; it is not unfrequent along the west coast from Bayonne to La Rochelle, and is recorded⁴ from

¹ *Bull. Soc. des Sciences*, 1886, p. 26. ² Figured in *Garden*, xxxiii. 320 (1888). ³ *Fl. Hibernica*, 182 (1836).

⁴ *Arbutus* is very abundant, in company with oak and mountain ash, in a wood, about $1\frac{1}{2}$ mile in length, on the abrupt and rocky slope of the cliff of Trieux, near Paimpol, in Côtes-du-Nord. Cf. Dr. Avicé, in *Bull. Soc. Bot. France*, xliii. 123 (1896), and Coste, *Flore de la France*, ii. 506 (1903). In a note on the occurrence of this species in the Landes, in *Bull. Soc. Bot. France*, xlix. p. lvii. (1902), it is stated that wherever the *Arbutus* grows, in that region, holly is absent, the two species seeming to exclude each other.

an outlying station in Brittany. In Corsica, it is very common as a shrub in the *maquis*; but in some of the forests grows to be a considerable size, as in that of Bonifatte near Calvi, where I measured trees 25 feet in height and 1 foot in diameter, which were growing at 2000 feet altitude. In Corsica, a liqueur, called *acqua vida de bagui*, is made from the berries. In Spain and Algeria, I noticed it as a shrub, growing in ravines in the forests; but in Italy it sometimes attains a considerable size.

The *Arbutus* is unquestionably wild¹ in the south-west of Ireland, where it is associated with other plants, which like it are Mediterranean in type and not indigenous to other parts of the British Isles. It has been known to the Irish since early times, and is called *caithne* (pronounced *cahney*) in Kerry and *cuince* in Clare. The former name occurs in several place-names in Kerry, as Derrynacahney, the "oak-wood of the *Arbutus*," two miles south-east of Crusheen; Cahnicaun wood, near the Eagle's nest, Killarney, which is *coill caithneacan*, the "wood of the little *Arbutus*," in Irish; Ishnagahiny Lake, five miles south-east of Waterville, which is *uisge-na-geathne*, "Arbutus water," in Irish. The Clare name, *cuince*, is supposed to occur in several place-names, anglicised as *quin*, which, however, often represents a family name of another signification. Cappoquin, in Waterford, means the field of the *Arbutus*, and Feaquin, in Clare, the wood of the *Arbutus*. The occurrence of names like Quin, a parish in Clare, and Quinsheen, one of the islands in Clew Bay, Mayo, may point to an extension of the distribution of this plant far to the north in ancient times.

At present, *Arbutus Unedo* is restricted to Co. Kerry and the extreme south-western part of Co. Cork. In the latter county it is thinly scattered through the woods in the vicinity of Glengariff, growing in company with oak, birch, holly, hazel, and mountain ash, and attaining about 25 feet in height and 3 feet in girth. It is said to grow here and there among the mountains to the west of Glengariff, and was seen by R. A. Phillips at Adrigole, ten miles to the west, high up in the mountains amongst rocks, and without the shelter of other trees. Phillips believes that it does not now grow to the eastward of Glengariff; and he could not find it in its former station, Ballyrizzard, near Crookhaven.

The *Arbutus* has its head-quarters in Co. Kerry, in the Killarney district, being particularly abundant and luxuriant on the islands and shores of the lakes generally, where it forms a considerable part of the natural forest. At the base of Cromaglaun mountain, near the tunnel on the Kenmare road, there is a wood composed almost exclusively of *Arbutus*; and it is also met with on the Cloonee lakes south of the Kenmare River.²

About Killarney the tree is indifferent as regards soil, as it grows on limestone on Ross island, on sandstone on Dinis island, and on slate, grit, and conglomerate

¹ Its right to be considered an indigenous plant was contested by Smith, who, in his *History of the County of Kerry* (1756), states that it was introduced by the monks of St. Finian, who founded the Abbey of that name on the banks of the lake, in the sixth century. Babington, in *Mag. Nat. Hist.* ix. 245 (1836), says this idea is inconceivable as the tree grows in isolated spots far up in the mountains, and is truly an aboriginal. All Irish botanists, and they are supported by authorities like Sir J. D. Hooker and Prof. Fliche of Nancy, are agreed as to the tree being an undoubted native of the south-west of Ireland.

² There are six trees on the islands in Glenmore Lake near Dereen, and a few on the mountains beside the lake, according to information I received when visiting Dereen in July 1907.

elsewhere. It is much more affected by climate and aspect than by soil, and seeks the most humid and mildest situations. In the Killarney basin it occupies practically the whole northern shore of the northern lake, but does not grow on the exposed islands of this lake. It is absent from the shore itself, when this is marshy or composed of shingle or sand, and grows on the rocky headlands, where it forms a natural wood with oak, holly, and mountain ash. It is very common on the long indented promontory of Muckross, and reaches its greatest dimensions on Dinis Island, which is perhaps the dampest and most sheltered spot in the whole district, protected by high mountains on the east and west, but open to the south. It usually does not extend far from the lake shore, but in the very humid and shaded Torc ravine it recedes into the general woodland along the rocky banks of the torrent, and ascends to an elevation of several hundred feet. It flourishes also on the rocky and sheltered islands of the southern lake.

In dense woods it has a fairly straight and single trunk; but in the open it usually divides at a short distance from the ground into two or more stems, which tend to be spirally twisted and are often curved, each of them terminating in a much-branched wide crown of foliage. The bark of old trees scales off in longitudinal strips and becomes purplish-grey in colour, assuming in the sunlight a reddish tinge, resembling in this respect the branchlets, which are pale-green on the shaded side and crimson on the sunny side.

The largest trees seen by me were about 40 feet in height; one had three stems 4 feet 10 inches, 4 feet 3 inches, and 3 feet 2 inches in girth respectively, the butt measuring close to the ground 17 feet round. Plate 157 represents one of the finest of these trees on Dinis island. Major Waldron has recently found trees up to 5 feet 7 inches in girth. Much larger trees existed formerly, as one measured by Mackay in 1805, which was $9\frac{1}{2}$ feet in girth. The *Arbutus* woods, like those of Kerry generally, suffered much from the ironworks, which were established in the eighteenth century, and the largest trees were cut down at this period.

INTRODUCTION

The date of the introduction of the *Arbutus* into English gardens is unknown; but Mrs. J. R. Green has kindly sent me the following extract from the State Papers,¹ showing that its existence in Kerry attracted in the sixteenth century the attention of the English settlers, who called it *wollaghan*, a corruption of *ubhla caithne* (pronounced *oolacahney*), or "arbutus apples," a name used for the edible fruit:—

"You shall receive herewith a bundle of trees called wollaghan tree, whereof my Lord of Leicester and Mr. Secretary Walsingham are both very desirous to have some, as well for the fruit as the rareness of the manner of bearing, which is after the kind of the orange, to have blossoms and fruit green or ripe all the year long, and the same of a very pleasant taste, and growing nowhere else but in one part of Munster, from whence I have caused them to be transported immediately unto you,

¹ *Cal. State Papers, Ireland*, A.D. 1586, p. 240.

praying you to see them safely delivered and divided between my said Lord and Mr. Secretary, directing that they may be planted near some ponds or with a great deal of black moory earth, which kind of soil I take will best like them, for that they grow best in Munster about loughs and prove to the bigness of cherry trees or more and continue long." (A. H.)

CULTIVATION

Though the *Arbutus* can hardly be called a tree in most parts of England, because it is rarely planted in situations which will enable it to assume a tree-like habit, yet it is so beautiful as a shrub, that no garden should be without it in districts which are warm enough in winter and damp enough in summer to allow it to thrive. It is easily raised from seed, and I have found little difference between the growth of seedlings raised from English and from French seed. Both suffer severely from frosts exceeding about twenty degrees, and from cold dry winds, and should therefore be kept under glass in winter till they are 2 or 3 feet high, when they should be planted out in a well-drained but not dry or heavy soil, in a place well sheltered from the north-east, but not overhung by other trees. Severe winters injure and often kill *Arbutus* in the eastern and midland counties, and large specimens are rarely seen except on the west and south-west coasts. Even there I have never seen one rivalling what Henry describes in Ireland, and it does not seem to be a long-lived tree in England. The best I have seen, perhaps, is on Sir E. Loder's beautiful grounds at Leonardslee, which is about 30 feet high, with a clean stem 8 or 10 feet high and 3 feet 4 inches in girth. The largest tree on record¹ was one growing at Mount Kennedy, Wicklow, which in 1773 was 13 feet 9 inches in girth. It was supposed then to be somewhat more than 100 years old. In 1794 it was still living, though it had been split by the wind, and torn up by the roots; and fresh healthy shoots were springing up from some branches which had layered.

The wood, which is of a reddish-brown colour, is hard and takes a good polish, but is very liable to split in drying, and so far as I know is not used for anything but small ornamental work, though it seems very suitable for inlaying or parquet.

(H. J. E.)

ARBUTUS HYBRIDA²

Arbutus hybrida, Ker-Gawler, *Bot. Reg.* t. 619 (1822); Loudon, *Arb. et Frut. Brit.* 1119 (1838); *Gard. Chron.* ix. 211, f. 37 (1878).

Arbutus andrachnoides, Link, *Enum. Hort. Berol.* i. 395 (1821).

Arbutus serratifolia, Loddiges, *Bot. Cab.* t. 580 (1821).

Arbutus intermedia, Heldreich, *Flora*, 1844, p. 14.

Arbutus Unedo-Andrachne, Boissier, *Fl. Orient.* iii. 966 (1875).

Arbutus hybrida, being a cross between *A. Unedo* and *A. Andrachne*, is variable in the wild state, sometimes being exactly intermediate between the two

¹ Hayes, *Practical Treatise on Planting*, 128 (1794).

² This name, though not the oldest, is the one by which the species has been usually known, and is adopted by us.

parents, and sometimes more closely resembling one of them. As seen in cultivation, the bark is smooth, like that of *A. Andrachne*. The branchlets have the glandular pubescence of *A. Unedo*, and the leaves are serrate, as in that species; but have the slightly glaucous tint and conspicuous veins of the other species; petioles glandular-pubescent. The flowers are borne in spring in large drooping panicles, which are usually glandular-pubescent. The fruit is of moderate size, and slightly tubercular on the surface.

According to Loudon, var. *Milleri*, with large leaves and pink flowers, was raised in the Bristol nursery, being a cross between the red-flowered variety of *A. Unedo* and *A. Andrachne*. This seems to be rare in cultivation.

Arbutus hybrida originated in the Fulham nursery early in the nineteenth century. It is, however, known in the wild state, being recorded by Heldreich and Halacsy for several localities in Greece. It is also reported to have been found by Albow¹ at Pizunda, on the north-eastern shore of the Black Sea, which is remarkable, as *A. Unedo* does not occur wild in this district, and the identification was possibly erroneous.

A tree growing at Sedbury Park, near Chepstow, the residence of Colonel Marling, V.C., is by far the finest we have seen of this hybrid. It measures 39 feet high by 5 feet 10 inches at 5 feet, and 7 feet 4 inches at 3 feet from the ground. It is grafted on a stock of *A. Unedo*, but shows more of the character of *A. Andrachne* in its habit and bark. It has been propagated by inarching, and seems to be a hardier tree than *A. Unedo* (Plate 158).

There are fair-sized trees at Kew.

(A. H.)

ARBUTUS ANDRACHNE

Arbutus Andrachne, Linnæus, *Sp. Pl.* 566 (1762); *Bot. Reg.* ii. t. 113 (1813); *Bot. Mag.* t. 2024 (1819); Loudon, *Arb. et Frut. Brit.* ii. 1120 (1838).

Arbutus integrifolia, Salisbury, *Prod.* 288 (1796).

Arbutus Sieberi, Klotzsch, *Linnaea*, xxiv. 71 (1851).

A large shrub or small tree, attaining 30 to 40 feet in height. Bark peeling off in thin papery layers, smooth, thin, and reddish brown. Young branchlets reddish or green, glabrous; older branchlets olive-green or brownish, smooth. Buds minute, reddish. Leaves, larger usually in cultivated trees than those of *Arbutus Unedo*, oval-oblong, contracted into short blunt points at the apex, tapering at the base; upper surface dark green, glabrous, shining; lower surface glaucescent, glabrous, with prominent midrib and distinct lateral veins; margin entire. Petiole glabrous, about $\frac{1}{2}$ inch long.

Flowers in erect viscid glandular-pubescent panicles, yellowish white, appearing in spring. Calyx-lobes deep, ovate, acute. Corolla contracted at the apex, with five reflexed short rounded ciliate lobes. Ovary pubescent. Fruit small, about $\frac{1}{3}$ inch,

¹ Radde, *Pflanzenverb. Kaukasuslind.*, 127, note (1899).

rarely $\frac{1}{2}$ inch in diameter, globose, orange coloured, smooth, hard, glandular on the surface.

Arbutus Andrachne is a small tree or large shrub, resembling *A. Unedo* in habit, and like it occurring often in heaths and occasionally in the forests; and only rarely forming small pure woods. It occurs in Albania, Greece, Cephalonia in the Ionian Islands, Crete, Rhodes, Cyprus, in the maritime regions of Asia Minor, Syria, and Palestine, in the Crimea and in the district of the Caucasus bordering upon the Black Sea.

(A. H.)

It was introduced into England from Smyrna in 1724, and cultivated at Eltham by Dr. Sherard.

This tree though rarely planted in modern gardens¹ is, on account of its superior hardness and its extremely beautiful bark, a more ornamental tree than the native species. Though I have never seen or heard of its producing ripe fruit in England, seedlings may be obtained from Continental nurseries, and some that I brought from Pallanza, in October 1906, have survived the journey without injury. The tree seems to enjoy lime in the soil. The bark is like smooth reddish-brown leather, covered with a thin silvery paper-like skin which peels off annually, and for this alone it is well worth growing. There was a very fine though not tall tree of this species on the lawn at Williamstrip Park, Gloucestershire, on rather heavy soil, which endured the inclement season and severe winters of 1879-80-81 without much injury, but is now dead. I saw in 1903 another which was 36 feet high and 4 feet in girth lying on the ground at Haldon near Exeter, which had been blown down some years before but was still living. The best that I know now living is in the Botanic Garden at Bath, and measures 27 feet by 6 feet 3 inches at 1 foot from the ground, shortly above which it divides into several stems. There is also a handsome tree about 25 feet high at Westonbirt, and one at Mamhead, 30 feet high, which is decaying at the butt.

(H. J. E.)

ARBUTUS MENZIESII, MADROÑA

Arbutus Menziesii, Pursh, *Fl. Amer. Sept.* i. 282 (1814); Sargent, *Silva N. Amer.* v. 123, t. 231 (1893), and *Trees N. Amer.* 728 (1905).

Arbutus procera, Lindley, *Bot. Reg.* xxi. t. 1753 (1836); Loudon, *Arb. et Frut. Brit.* ii. 1121 (1838).

Arbutus laurifolia, Hooker, *Fl. Bor. Amer.* ii. 36 (1840). (Not Lindley.)

A tree attaining in America 100 feet in height and 20 feet in girth, but usually much smaller. Bark of branches and young stems thin, smooth, reddish, peeling off in large thin scales; of older trunks dark reddish brown and covered with small thick scales. Young branchlets glabrous; older branchlets reddish brown, smooth. Buds stouter than in *A. Unedo*, $\frac{1}{3}$ inch long; scales ovate, acute, apiculate. Leaves oval or oblong, larger than in *A. Andrachne* or *A. Unedo*, up to 5 inches long by 3 inches broad, rounded or contracted into minute sharp points at the apex,

¹ A tree in Kew Gardens, 20 feet high, is figured in *Gard. Chron.* iv. 724, f. 100 (1888).

subcordate or rounded (rarely tapering) at the base; upper surface dark green, shining, glabrous; lower surface glaucous, almost white in colour, glabrous, with prominent midrib and conspicuous lateral veins; margin entire, occasionally serrate on young plants. Petiole stout, $\frac{1}{2}$ to 1 inch long, glabrous, usually winged on one or both sides for some distance by the decurrent base of the leaf.

Flowers appearing in spring, in erect pubescent panicles, about 5 or 6 inches long and broad. Calyx-lobes scarious, white. Corolla white, urceolate. Ovary glabrous. Fruit ripening in autumn, sub-globose, $\frac{1}{2}$ inch in diameter, bright orange-red, glandular on the surface, with a thin flesh and a five-celled thin-walled cartilaginous stone.

Arbutus Menziesii occurs in the Pacific coast region from Southern British Columbia, where it grows on Vancouver Island and the islands at Seymour Narrows, through Washington and Oregon to California, reaching its most southerly point in the Santa Lucia Mountains. In Washington it is not uncommon on the cliffs along Puget Sound, and on high slopes, where it receives plenty of light. It usually grows on rich soil and, according to Sargent, is common and attains its largest size in the redwood forest of Northern California, becoming smaller to the north and south, and only growing as a shrub to the south of the bay of San Francisco. I did not observe it in the dense redwood forest near Crescent City; but found it common inland to the east of the coast range in South-Western Oregon. Here it grew on dry hills at 2000 to 3000 feet altitude, in mixture with *Pinus ponderosa*, *Libocedrus decurrens*, and oak, in thinly forested country; and resembled very much in habit, with its short trunk and broad branching crown, the *Arbutus* of Killarney. In a ravine near Kerby I measured a tree, 99 feet high by 5 feet 1 inch in girth, with a straight stem, clear of branches to 40 feet; but this grew in exceptionally good soil, and was crowded by other trees—Lawson Cypress, Sugar Pine, *Quercus densiflora*, *Acer macrophyllum*, etc. (A. H.)

The largest tree of this species known, which has been figured by Sargent,¹ is growing in the grounds of the reservoir at San Rafael in Marin county, California. It measures 100 feet in height and 23 feet in girth at 3 feet from the ground.

Arbutus Menziesii was introduced by Douglas in 1827; but is rather a rare tree in cultivation in England. It appears to be less hardy than the other species now described, and at Kew makes slow growth and often has its leaves and shoots injured by frost. It is found in gardens usually under the name of *A. procera*, and commonly attains the size of 20 to 30 feet. The largest that I have seen is at Bassetwood, near Southampton, the residence of J. R. Anderson, Esq. This tree is no less than 50 feet high, with a stem clear for about 20 feet, and 3 feet 2 inches in girth. A tree at Tortworth is 35 feet high by 4 feet 4 inches.² In Scotland, at Castle Menzies, I measured one in 1907 which was 37 feet by 5 feet 2 inches, and did not seem to have suffered much from the severe frost of the previous winter, though the flower buds were killed. (H. J. E.)

¹ *Garden and Forest*, v. 146, f. 23 (1892). In the same journal, iii. 509, f. 515 (1890), the tree is figured in its native forest.

² Mr. Clinton Baker informs me that there is a tree at Bayfordbury which was sent to his grandfather about twenty-five years ago from America, as a very small plant. It is now 30 feet high, and bears fruit every year.

SCIADOPITYS

Sciadopitys, Siebold et Zuccarini, *Fl. Jap.* ii. 1, tt. 101, 102 (1844); Bentham et Hooker, *Gen. Pl.* iii. 437 (1880); Masters, *Journ. Linn. Soc. (Bot.)* xviii. 502 (1881), xxvii. 276, 320 (1889), xxx. 21 (1893), and *Journ. Bot.* xxii. 97 (1884).

AN evergreen tree, belonging to the tribe Taxodineæ of the order Coniferae, attaining in Japan a height of 120 feet and a girth of 12 feet. Bark reddish brown, scaling off in long strips. Branches sub-verticillate. Branchlets brown, glabrous, bearing minute scales, which represent true leaves, and cladodes, which are long, green, and leaf-like, performing the functions of true leaves, but differing from them in structure. The scales are borne spirally on the internodes, and are dry, brown, membranous, ovate-lanceolate, and decurrent. At the apex of the shoot there is a ring of similar scales, deltoid in shape, and densely pubescent on their inner surface, out of the axils of which arise a whorl of cladodes, ten to thirty in number, spreading all round the branchlet. These are 2 to 5 inches long, averaging $\frac{1}{8}$ inch in width, linear, rigid, narrowed towards the base, obtuse and minutely rigid at the apex; upper surface dark green, shining, with a median groove; lower surface green on each side of a deep white stomatiferous central furrow. Buds globose, composed of numerous spirally imbricated greenish scales; terminal bud, at the apex of the shoot, in the centre of the whorl of cladodes, continuing the growth of the main axis in the following year; a smaller bud, often present at the side of the terminal bud, developing into a lateral branch in the next season. As a rule, the main axis is bare, except for the scales, below the apex, which bears the whorl of cladodes and the buds; but on strong-growing shoots a lateral branch is occasionally developed half-way up the internode. The cladodes are leaf-like shoots, and not true leaves, each representing an axillary branch with two coherent leaves; but their true nature has given rise to a great deal of discussion; and the elaborate papers of Dr. Masters cited above may be consulted on this subject.

Male flowers in a terminal compact raceme, about an inch in length; each flower $\frac{3}{8}$ inch long, subsessile; anthers numerous, spirally arranged, short-stalked, with an acute and reflexed crest and two pendulous cells, opening by a vertical slit; pollen-grains globular, minutely tuberculate. Female flowers, terminal small cones composed of spirally arranged lanceolate bracts, which are serially continuous with the true leaves, empty at the base of the cone, higher up with fleshy semi-lunar ovular scales in their axils, half the size of the bracts and bearing one to nine ovules in a transverse series on their inner surface. As the cones increase in size, the

ovular scales outgrow the bracts, and in the mature cone are much larger than and almost entirely coalesced with them.

The cones, which are borne on short stout stalks, clothed with a few membranous bracts, either remain terminal and erect or are pushed aside by the growth of a lateral branch. They take two years to ripen, and remain persistent on the tree for some months after the dehiscence of the seeds. Ripe cones, about 3 inches long by $1\frac{1}{2}$ inch in diameter, oblong-ovoid, obtuse at the apex, composed of woody scales, which result from the coalescence of the ovular scales and bracts of the flower. The scales are fan-shaped, about $\frac{3}{4}$ inch wide; upper margin rounded and reflexed; outer surface convex, marked by a transverse rugged irregular ridge; inner surface concave, with slight depressions for the seeds. Seeds, five to nine on each scale, reversed, oval, compressed, dark brown, surrounded by a narrow membranous reddish-brown wing, notched at the base and marked at the apex by the white hilum; seed with wing, about $\frac{3}{4}$ inch long by $\frac{1}{4}$ inch wide. The seedling has a long slender tap root, and a terete green glabrous caulicle about an inch in length, which bears two cotyledons. These are sessile, linear, tapering to an obtuse apex, a little more than $\frac{1}{2}$ inch long, dark green above, paler below with indistinct lines of stomata. Primary leaves like the cotyledons, but longer.

Sciadopitys is a monotypic genus, only one species being known, which is a native of Japan.

SCIADOPITYS VERTICILLATA, UMBRELLA PINE¹

Sciadopitys verticillata, Siebold et Zuccarini, *loc. cit.* 1844; Kent, *Veitch's Man. Coniferae*, 287 (1900); Shirasawa, *Icon. Ess. Forest. Japon.*, text 22, t. 8, ff. 15-36 (1900); Thistelton-Dyer, *Bot. Mag.* t. 8050 (1905); Mayr, *Fremdländ. Wald- u. Parkbäume*, 407 (1906).
Taxus verticillata, Thunberg, *Fl. Jap.* 276 (1784).

The species has been described above. The tree is known in Japan as *Koyamaki*, or pine of Mt. Koya, one of the localities where it is found growing wild. Thomas Lobb sent a living plant in 1853 from the Botanic Garden at Buitenzorg in Java to Veitch's nursery at Exeter; but it soon died. It was afterwards introduced by seeds brought from Japan by J. Gould Veitch in 1861, some being also sent about the same time by Fortune to Standish at Ascot.

A variety in which the leaves are striped with yellow was introduced by Fortune; but this seems to be now unknown in cultivation.

Plants only 3 feet high produced cones in 1876 in the nursery of Messrs. Thibaut and Keteleer at Sceaux.² The tree appears to have first borne fruit in Scotland³ at Ardkinglas, in 1878, and in England⁴ at Kew and Coombe Wood, in 1884. Proliferous cones,⁵ which bear cladodes at their apex, are of frequent occurrence in Japan, and have also been borne by trees cultivated in Europe. In

¹ This is a translation of *Sciadopitys*, a name given on account of the leaf-like cladodes spreading out from the apex of the shoot, like the ribs of an umbrella.

² *Gard. Chron.* v. 827 (1876).

³ *Jour. of Forestry*, 1879, p. 508.

⁴ *Gard. Chron.* i. 80 (1884).

⁵ Masters, *Journ. Bot. loc. cit.* f. 4.

these the bracts, which are ordinarily completely coalesced with the fruit-scales, become detached from them towards the apex of the cone, and are scale-like in character, producing cladodes in their axils. (A. H.)

Shirasawa states that the tree grows wild in mixture with *Abies firma* and *Cupressus pisifera* at 600 to 5000 feet in the forests of Kiso and Shinano. Matsumura adds Mt. Hoonokawa in Tosa.

According to Mayr, the tree is similar to the silver fir in its capacity for bearing shade; but is extremely slow in growth, only attaining in Kiso, where the climate is favourable to it, a height of 30 feet in fifty years. Trees 110 feet in height and 2 feet in diameter average about 250 years old. Mayr gives a figure of two old trees, growing at Agematsu, which were nearly 120 feet in height and 4 feet in diameter; and this shows how the tree, even at an advanced age, preserves a narrow pyramidal form with an upright leader, without any sign of flattening of the crown.

I saw this tree in its native forest to the best advantage in the lovely valley of Atera, on the west side of the Kisogawa, below Agematsu, at from 2000 to 3000 feet elevation. Here it was scattered in a forest of mixed conifers and hardwoods, and seemed to grow only on rocky slopes and ridges, where its narrow-pointed top made it conspicuous. The seedlings were numerous in dense shade growing on a bed of humus, and those that I took up had long but scanty roots, running deep, but spreading little. Their growth was very slow, not more than 3 to 6 inches annually for the first twenty years at least. On a steep rocky hill above the forester's house, at the end of the tramway which has been made up this valley, the largest trees were growing, mixed with *Thujopsis*, the undergrowth being very dense, and composed of *Rhododendron*, with *Shortia uniflora* spreading over the ground in great sheets. The largest that I was able to measure were 90 to 100 feet high and 9 to 10 feet in girth, one being 11 feet 9 inches at 5 feet from the ground. Plate 159A fairly represents the appearance of the tree here.

In the forest near Koyasan I saw it again, mixed with *Cupressus obtusa*, but not attaining so large a size, though it seemed that in the dense shade the seedlings of *Sciadopitys* were more numerous and vigorous. Though often planted in parks and temple gardens, I never saw any trees as fine as those figured by Mayr at Agematsu, and it is clear that shade, perfect drainage, and a rich forest soil are essential to this species.

According to Mayr, the wood is white in colour, the sapwood only $\frac{2}{8}$ inch thick being like the heartwood. The wood is comparable to the best kind of spruce, and is soft and elastic. It is used in Japan for boat-building, making bath-tubs and casks, planking, etc.

CULTIVATION

Though this interesting tree has been planted in many places, yet it usually grows very slowly and seems to require a high summer temperature, with a warm and sheltered situation. Ripe seed was produced in Ireland at Castlewella in 1900,

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but the seedlings which I raised from this source were always weakly, and notwithstanding every care died after two or three years. Seed sent from Japan in 1906 also germinated weakly, and many of the seedlings damped off in the winter without making roots, though very carefully watered. They seem to require a very light, sandy peat when young, and refuse to grow in soil which contains lime, or where moisture is deficient during the summer. By far the finest tree that I have seen in England is at Hemsted, in Kent, where a tree was in 1905 no less than 38 feet high by 2 feet in girth, and showed its true habit very well. Owing to its being rather crowded by other trees, a photograph of this was difficult to take, but after several attempts had been made, Mr. Edwards was able to get the one reproduced in Plate 159B. The next largest I have seen is at Coombe Royal, in South Devon, where a tree about 25 feet high is growing, with a forked stem.

As usually seen in gardens in England, it forms a shrubby pyramid, and I have seen no others over 15 to 18 feet high. At Castlewellan, however, it seems to thrive very well, and should do well in the south and west of Ireland and Wales.

At the Villa Trubetskoi, near Intra, on Lake Maggiore, I saw a vigorous tree about 45 feet high, which had divided into three stems, and in 1906 bore no cones.

Sciadopitys is perfectly hardy, and bears without injury the severe winter climate of Boston in New England, and of Grafrath in Bavaria, the thermometer descending in the latter locality to -18° Fahr.; but in severe winters the foliage turns brown.

(H. J. E.)

PINUS SYLVESTRIS, SCOTS PINE

Pinus sylvestris, Linnæus, *Sp. Pl.* 1000 (*excl. var.*) (1753); Lambert, *Genus Pinus*, i. tab. I. (1803); Loudon, *Arb. et Frut. Brit.* iv. 2153 (1838); Willkomm, *Forstliche Flora*, 193 (1887); Mathieu, *Flore Forestière*, 579 (1897); Kent, in *Veitch's Man. Conifera*, 379 (1900); Kirchner, Loew u. Schröter, *Lebensgesch. Blütenpfl. Mitteleuropas*, i. 175 (1904); Mayr, *Fremdländ. Wald- u. Parkbäume*, 347 (1906); Borthwick, in *Trans. R. Eng. Arb. Soc.* vi. 205 (1906).

A TREE commonly 100 feet, rarely attaining 150 feet in height, with a girth of 10 to 15 feet. Stem usually straight and cylindrical, with the branches regularly whorled in young trees, forming a pyramidal crown; in older and isolated trees, branching irregular, with a flattened crown. Bark different in the lower and upper parts of the trunk; towards the base thick, fissured into irregular longitudinal plates, scaly, and reddish brown or greyish brown in colour; on the upper part of the stem,¹ owing to the outer portion continually falling off in thin papery scales, the bark remains very thin, smooth, shining and bright red. Young shoots greenish, smooth and shining; becoming greyish brown in the second year; marked with the pulvini of the scale-leaves, which are early deciduous. Buds long-oval, pointed, usually non-resinous, covered by lanceolate acuminate scales, fimbriated on their edges, the upper ones with their tips free and not recurved. Leaves two in a bundle; sheaths at first white, $\frac{1}{3}$ inch long, speedily becoming shrivelled, brown, and short; the pair of leaves close together, but not appressed, usually about 2 inches long but varying under different conditions from 1 to 4 inches, dark green with interrupted lines of stomata on the convex side, glaucous with many well-defined lines of stomata on the flat inner side, plano-convex in cross-section, linear, stiff, acute at the apex, somewhat bent, smooth, finely serrate in margin; resin-canals marginal. The leaves persist usually three years.

Male flowers in dense clusters at the lower part of the current year's shoot, $\frac{1}{4}$ inch long, oval, short-stalked, surrounded at the base by four yellowish bracts; anther with small rounded upright connective. Female flowers, solitary, opposite or occasionally whorled, apparently terminating the young shoot, erect at first, but becoming pendant immediately after pollination, stalked, globose, reddish, composed of rounded bracts and almost circular ovular scales, the latter having a beak-like process on the upper side and bearing two minute ovules.

Cones shortly stalked, variable in shape, usually ovoid-conic with an acute apex, oblique or nearly symmetrical at the base, greyish or dull brown in colour, 1 to 3

¹ According to Shaw of Boston, who is the greatest living authority on the genus *Pinus*, this peculiarity of the bark of the upper part of the tree being thin and reddish, owing to the constant shedding of scales, occurs only in three pines, viz. *P. sylvestris*, *P. densiflora*, and *P. patula*.

inches long. Scales dark brown on the inner surface, oblong, ending in a rhomboidal apophysis, which is variable in form in different varieties and even in the same cone; flattened, with a transverse keel and an elevated or depressed umbo, or raised and pyramidal, with four to five concave sides; occasionally the apophysis ends in a hooked process. The cones open in spring to let out the seeds, which may be carried by strong winds to an immense distance; and the empty cones usually remain on the tree till the following autumn. Seeds long-oval, $\frac{1}{8}$ to $\frac{1}{5}$ inch, some blackish, others grey in colour, surmounted by a wing half-oval in shape, which is three times as long as the body of the seed.

Seedling.—Cotyledons, four to seven, triangular in section, linear, slightly curved upwards, about $\frac{1}{8}$ inch long; stomata absent on the outer surface, present on the inner two surfaces, without wax, so that the cotyledons are green in colour and not glaucous. Primary leaves elliptic in section with hairs on their edges. The seedling grows about 2 to 4 inches high in the first year, ordinary needles being produced in the second year; branches usually appear in the third year. The primary root is long, attaining about 8 inches in the first year, and giving off many lateral fibres.

VARIETIES

The common pine, spread over an immense geographical area and growing in the most diverse conditions of soil and climate, exhibits considerable variations in most of its characters. The stem may be straight and cylindrical with a single leader, only branching at the top and giving rise to a flattened crown of foliage in old age; or it may be dwarf, branched from the base and crooked, simulating the smaller forms of *Pinus montana*. The young cones are usually reversed immediately after flowering; but in certain regions they remain erect. The adult cones vary in size and shape and in the form of the apophyses, which may be flat or raised, pyramidal or hooked; but all these variations in the apophysis may occur on the same cone. The male flowers may be yellow or reddish in colour. The leaves vary in length from one to four inches, and may be broad or narrow, stiff and sharp-pointed or soft in texture; and in some cases they are much more glaucous than in others. They vary in duration from two to five years.

Many of these varieties occur in individual trees in the same forest; and in many cases, when the condition of the soil is changed as by draining, pines which have been small and stunted assume the ordinary tall form, and the shape of the cones probably does not remain constant, when the seedlings are raised in a new locality. It is difficult on this account to establish clearly marked geographical varieties.

The experiments, which have been carried out at Les Barres,¹ over a long term of years, show, however, that there are races of pines, which preserve their characters of straightness of stem, quickness of growth, or the reverse; but these races cannot be distinguished by characters of cones or leaves; and are the result of the selection of seed from vigorous or weak individuals.

¹ Cf. Pardé, *Arboret. Nat. des Barres*, 71 (1906), where a full account is given of the plots of Riga, Haguenu, Scotch, and certain French varieties of *Pinus sylvestris*, which were mostly planted between 1823 and 1835.

The following varieties, occurring in the wild state, have been distinguished, though they are not so clearly defined in nature, as they seem to be from their description.

1. Var. *genuina*, Heer. Cones usually solitary, long-stalked, symmetrical, acute at the apex; apophysis flat or convex, not hooked. Needles about 2 inches long, persistent three years.

This is the common pine, growing on good soil in Germany, Southern Scandinavia, Poland, and North-Western Russia. Two races have been distinguished on the Continent in cultivation:—

(a) *rigensis* (*Pinus rigensis*, Desf.). Riga pine, raised from seeds collected near Riga. At Les Barres, this is the best race of *P. sylvestris*, the stem being very straight and cylindrical, rising to a great height, and with few lateral branches; bark very red, stripping off above in very thin papery scales. Von Sievers states that the form native to the Baltic provinces of Russia is superior in growth and timber to that introduced there by seed from Germany. Willkomm, however, is of opinion that the so-called Riga pine is only a fine tall-growing form, and occurs in North Germany and Poland, as well as in Russia.

(b) *Haguenensis*, Loudon. Haguenu pine, raised from seed obtained in the forest of Haguenu in Alsace. At Les Barres, this form, though vigorous in growth, is defective, on account of its tendency to form numerous irregular branches, so that the stem is not so clean and does not reach the same height as the Riga variety. The bark is not so red, and is not so fine-scaled as in that variety.

Two trees of the Haguenu variety, raised from seed, procured by Loudon in 1828, are growing at Seggieden in Perthshire, and are now about 65 feet high by 8 feet in girth. According to the forester, they are distinguishable in bark, buds, shoots, and leaves from the Scots pine growing near them.

2. Var. *scotica*.—This variety, which grows wild in the Highlands of Scotland, differs in the redder bark of the stem; in the shorter more glaucous leaves ($1\frac{1}{2}$ inch long), often persistent four years; and in the shorter cones ($1\frac{1}{2}$ inch long), which are symmetrical, with apophyses usually flat near the base, tending to be pyramidal in the upper part of the cone.

3. Var. *engadinensis*, Heer.—Bark reddish; needles short, 1 to $1\frac{1}{2}$ inch long, thick and stiff, persistent for five years; buds resinous. Cones ovoid-conic, 2 inches long, oblique at the base; apophyses convex on the outer side of the cone, umbo large and blunt. A small tree, rarely 30 feet high, growing in the Engadine Alps.¹ It is perhaps a hybrid between *P. sylvestris* and *P. montana*.

4. Var. *lapponica*.—*Pinus lapponica*, Mayr, *Fremdländ. Park. u. Waldbäume*, 348 (1906). This variety, which grows in the north of Norway and Sweden and in Finland, is considered by Willkomm and Christ¹ to be identical with var. *engadinensis*, with which it agrees in the short, straight stiff leaves, persistent for

¹ Dr. Christ, in *Flore de la Suisse*, 197, and *Suppl.* 31 (1907), considers the Engadine pine to be precisely the same as specimens he examined, which were collected at Quickjock in Lapland (lat. 67°). He also mentions (p. 285) a curious form of the common pine, slender and tall in habit, with very short green needles, which grows at Flims in Switzerland, and also in one or two places in Silesia.

five years, in the resinous buds, and in the small cones with hook-like apophyses. Mayr, however, considers it to be a distinct species, and gives the characters which distinguish it from the common form of *P. sylvestris*, without pointing out in what respect it differs clearly from var. *engadinensis*.

5. Var. *nevadensis*, Christ.—Needles broad, short and stiff, very white on their flat surfaces. Cones nearly sessile, oblique, with very pyramidal apophyses. Occurs in the Sierra Nevada in the south of Spain.

6. Var. *reflexa*, Heer.—Needles as in the common form. Cones long and slender, conic, with long hooks to the apophyses. This variety has been found growing on high peat-mosses in Switzerland and on poor sandy soil in Prussia, and occurs sporadically elsewhere.

In the Caucasus and Asia Minor, *P. sylvestris* differs from the European form, in having very long and broad needles ($3\frac{1}{2}$ inches long), and very oblique cones with hooks on their outer side directed downwards. Specimens from the Amur have very long leaves (4 inches or more) with cones of the ordinary form. The pine of the Ural and Altai mountains (var. *uralensis*, Fischer) is only distinguished by having short and stiff leaves. In the dry climate of the south of France, in the Cevennes and in Provence, the needles of this species become short and are often disposed in slender tufts at the ends of the branchlets.

In the French Alps near Modane, *P. sylvestris* grows in mixture with *P. montana*, var. *uncinata*; and it is difficult to distinguish between these trees in this locality,—the branches densely covered with short leaves, persistent for four or five years, being alike in both species; and the cones of both have hooked apophyses.¹ However, at Modane, as elsewhere, the reddish bark and the dull colour of the cones will distinguish *P. sylvestris*; while in the other species the bark is never red and cones are shining brown.

Similar forests occur in Switzerland, where *P. sylvestris* and *P. montana* appear to pass one into the other; and the occurrence of these apparently transitional forms has given rise to the belief that they are hybrids between the two species; but this is not established beyond doubt.

Willkomm describes two interesting varieties, due to poverty of soil and exposure. One is the shore-pine of the Baltic provinces of Prussia, which has a short bent stem with an irregular crown of foliage or is a mere bush; the cones are very oblique and hooked. Another form is peculiar to the peat-mosses in Austria and Germany; the stems are rarely more than 6 feet high, very slender, and branched to the base; needles very stiff and short (about 1 inch long), persistent for two years; cones very small, with hooked apophyses.

Several varieties have arisen in nurseries or as sports in the wild state.

Var. *virgata*, Caspary.—Main branches irregularly whorled, arising from the stem at an angle of 30° to 60°, elongated and giving off a few twig-like branchlets, only the outermost of which are furnished with leaves. This curious variety² was first

¹ The young cones of *P. sylvestris* at Modane remain erect (like those of *P. montana*) and are not reversed immediately after pollination, as is usually the case elsewhere.

² Willkomm, *Forstliche Flora*, 199 (1887).

noticed in France; and some years later, in 1881, was found in the forest of Wandsburg in Prussia.

Var. *argentea*, Steven.—Cones and leaves with a silvery tint. Found in the Caucasus.

Var. *monophylla*, Hodgins.—A shrub, with the needles in each sheath attached to each other throughout their length, apparently forming one needle, but easily separated. Originated at Dunganstown, near Wicklow, about 1830.

Var. *microphylla*, von Schwerin.—Needles thin, sharply pointed, only $\frac{1}{2}$ inch long. Originated as a seedling in 1883 at Wendisch-Wilmersdorf.

Var. *aurea*.¹—A low tree of dense habit, with leaves of a golden yellow colour usually in spring, the foliage becoming green in summer.

Var. *variegata*.—Leaves variegated. This form has arisen several times in cultivation; but was once found wild in Prussia by Caspary.

Var. *pyramidalis*.—Fastigate in habit. Schübeler says that trees of this kind are common in the forests of Norway and Finland.

Var. *pendula*, Caspary.²—A weeping form, found in a wood near Tilsit, in East Prussia.

Various dwarf forms are known, as *pumila*, *nana*, *globosa*.

DISTRIBUTION

The common pine has an extraordinarily wide distribution, occurring in regions of the most diverse climates and on almost all soils, and in the mountains as well as in the plains. It grows in Eastern Siberia, where the temperature falls to -40° Fahr., and the period of vegetation hardly lasts for three months; and is met with in Southern Spain, where the summer heat reaches 95° Fahr., and the period of vegetation lasts for nine months of the year. It occurs in dry regions like Provence, where there is little humidity in the air, and in the west of Scotland, where the air is laden with moisture all the year round. It is by preference a tree of siliceous soils, but occurs on almost all geological formations; and in Scotland, Norway, and Sweden grows on peat-bogs too wet for the spruce to exist on.

The area of distribution includes almost all Europe and the greater part of Northern Asia. The northerly limit, commencing on the north-west coast of Norway at Alten (70° N. lat.), passes through Lapland, south of the Enara lake ($68^{\circ} 50'$), and touches Pasvig Fjord on the Arctic Sea at $69^{\circ} 30'$. Extending through the Kola peninsula from Kola bay, it crosses the White Sea at $66^{\circ} 45'$ and in the Petchora territory goes as far north as $67^{\circ} 15'$; and crosses the Ural at about 64° . In Siberia it never reaches quite as far north as the Arctic circle, though it nearly touches it on the Ob and the Yenisei rivers; east of the Lena river it descends to about 64° . It reaches its extreme easterly point (about 150° E. long.) in the Werchojansk Mountains. The eastern limit descends from there through the Stanovoi Mountains

¹ There is a useful note on the propagation of this variety in *Gard. Chron.* xi. 405 (1892).

² *Schrift. Phys. Oekonom. Gesell. Königsberg*, 1866, p. 49, fig. 1.

and the Seja territory to the Upper Amur. According to Komarov,¹ it is a scarce tree on the banks of rivers in Manchuria. Its southerly limit in Siberia is not well known; but it is known to occur in the mountains of Dahuria, in the territory around Lake Baikal, and in the Altai Mountains. Its southern limit in European Russia is a very irregular line, which begins in the Ural south of Orenburg at about lat. 52°, is most to the north in the government of Tula (lat. 54° 30'), and descends from there to Kharkof (lat. 49°), passing into Galicia about lat. 50°. Far south of this line, and separated from it by the Russian Steppes, on which no pine trees grow, occurs an area of distribution, not yet well made out, which includes the Caucasus, the mountains of the Crimea, Asia Minor,² and North-Western Persia. There is also an isolated area, in which the pine is found growing wild, in Macedonia, on Mount Nidjé. From Galicia the southern limit in Europe (exclusive of the last-mentioned area) passes southwards to the Transylvanian Alps; thence it extends along the mountains to Servia, where the tree grows on the Kopavnik mountain (about lat. 43°), continues through the mountains of Bosnia, Dalmatia, Illyria, Venetia, and through Lombardy to the Ligurian Apennines (about lat. 44°). It passes into France, across the Maritime Alps, into the Cevennes, and reaches the Eastern Pyrenees; in Spain it descends through the mountains of Catalonia, Aragon, and Valencia to the Sierra Nevada in Andalusia, which is its extreme southerly point in Europe (lat. 37°). The westerly limit beginning here, stretches north-west through the mountains of Avila to those of Leon in North Spain; and is continued through the mountains of Scotland to the north-west coast of Norway.

In this vast area the pine is very irregularly distributed. The largest forests occur in the Baltic provinces of Russia, in Scandinavia, in Northern Germany, and in Poland. Towards the south it only occurs in mountains, and rarely forms pure forests of considerable extent. According to Huffer,³ it is rare in Roumania, where he saw it at the confluence of the Lotru and Oltu rivers at 1700 feet altitude, and in the valley of Bistritza.⁴

In the British Isles, the common pine is found wild at the present day only in the Highlands of Scotland, where a few forests still remain. These occur in the valley of the Spey at Rothiemurchus, Duthill, Abernethy, and Glenmore, and in the valley of the Dee at Invercauld, Braemar, and Glen Tanar. There is also a fine wild forest, the "Black Wood," on the south side of Loch Rannoch in Perthshire.⁵ That of Ballochbuie near Invercauld is probably the finest now existing.

The pine was widely spread over the British Isles in ancient times, as is evidenced by the occurrence of remains of logs, stumps of trees, and cones in the

¹ *Flora Manchurica*, i. 175 (1901).

² *Pinus sylvestris* grows on the Armenian plateau, and has been described in *Linnaea*, xxii. 296 (1849), as *P. armena*, Koch; *P. Kochiana*, Klotzsch; and *P. pontica*, Koch. Cf. *Moniteur Jardin Botanique Tiflis*, ii. 26 (1906).

³ *Forêts de la Roumanie*, 6 (1890).

⁴ M. B. Gulesco, in an article on the forests of Roumania, in *Bull. Soc. Dendr. France*, i. 171 (1907), states that in the Muscel district *P. sylvestris* is only found on calcareous soils; and in a letter to Elwes confirms this statement, adding that it attains a diameter of one metre, and does not grow on the adjoining schist.

⁵ Buchanan White, *Flora of Perthshire*, 282 (1898), gives as additional localities for wild trees in Perthshire, Breadalbane, in Glen Lyon and near Killin and Tyndrum; and mentions one or two other places where the pine is doubtfully native. According to the Rev. E. G. Marshall, *Journ. Bot.* xlv. 160 (1906), it is certainly native in the forest of Glenavon, but quite scarce, and the seedlings appear to be destroyed by deer browsing on them.

peat-mosses and submerged forests.¹ In the south of England extensive forests occurred in Neolithic times, when the existing peat-mosses began to form; but in other parts of the three kingdoms it is probable that the pine existed in many places in historic times.²

Of its existence in a wild state until lately in England, the evidence is very meagre. Holinshed,³ writing in 1586, says: "The firre, frankincense, and pine we do not altogether want, especiallie the firre, whereof we haue some store in Chatleie Moore in Darbshire, Shropshire, Andernesse, and a mosse neere Manchester, not far from Leircesters house; although that in time past not onelie all Lancastershire, but a great part of the coast betweene Chester and the Solme were well stored." According to the Rev. Abraham de la Pryme⁴ there was a wood of wild pine on a hill at Wareton in Staffordshire in his day, the beginning of the eighteenth century; and, in an old deed, fir trees were mentioned as growing scattered in Hatfield Chase in Yorkshire about the year 1400, the last surviving aboriginal pine here being cut down about 1670. The Wareton pines were described by Ray in a note⁵ dated Oct. 14, 1669: "We rode to see the famous fir-trees, some 2½ miles distant from Newport, in a village called Wareton in Shropshire,⁶ on the land of Mr. Skrimshaw. There are of them thirty-five in number, very tall and straight, without a bough till towards the top. The greatest, and which seems to be the mother of the rest, we found by measure to be 14½ feet round the body, and they say 56 yards high, which to me seemed incredible. The tenant's name of the house close by these fir-trees is Firchild, whose ancestors have been tenants to it for many generations." These trees, according to Dr. Higgins⁷ of Newport, are mentioned in an old book, *Historia Vegetabilium Sacra*, published in 1694 by Westmacott, who says there were thirty-six of them, one of them being 47½ yards high. Withering,⁸ writing in 1776, states that the trees at Wareton were no longer existing in his time. Pine forests apparently occurred in Roman times in the north of England, and remnants of these may have existed down till a recent period, concerning which the late Professor Newton told me of some very old Scots pines that used to grow about forty-five years ago on Wretham Heath, Norfolk, which local tradition said had never been planted, but grew there wild. They were always spoken of as the "Deal⁸ Trees," all other trees of this species that were planted being named Scotch firs. Whether there is any real foundation for this tradition is very hard to say, but it is possible that the seed

¹ Cf. Clement Reid, *Origin British Flora*, pp. 16, 152 (1899):—"Remains of this tree are found in Neolithic deposits, in 'submerged forests' and at the base of peat-mosses, nearly throughout Britain and in Ireland. In late Glacial times at Bovey Tracey, Devon, and at Hoxne, Suffolk (in bed C?). Abundantly in the preglacial strata of Norfolk, but not in any of the interglacial deposits in Britain. During the Neolithic period it seems to have been one of our commonest trees; but afterwards disappeared from the southern half of England."

² The orchid, *Goodyera repens*, which was formerly supposed to grow only in wild coniferous forests, as in the Highlands of Scotland, has begun to appear, of late years, in various localities, where the Scots Pine has been planted, both in England and in France; and the problem as to how the seeds of the orchid reach these plantations is still unsolved. Cf. *Kew Bulletin*, 1906, p. 293; *Actes Premier Congrès Internat. Bot. Paris*, 382 (1900); and Fliche, in *Mém. Acad. Stanislas*, 1878.

³ *Holinshed's Chronicles*, i. 358 (1807), reprint of the edition published in 1586.

⁴ *Phil. Trans.* No. 275, p. 980 (1701).

⁵ Derham, *Memorials of John Ray*, 25 (1846).

⁶ Wareton, now usually written Warton, is in Staffordshire, not far from the Shropshire boundary.

⁷ *Botany*, ii. 593 (1776).

⁸ According to Britten and Holland, *Dict. Eng. Plant-Names*, 146 (1886), *deal-tree* is used for *Pinus sylvestris* in East Anglia and Northamptonshire, the cone being commonly called *deal-apple*.

from which these trees grew might have been brought from Norway in early times; and Sir H. Howorth suggests that the existence of the Capercaillie, whose bones have been found in Tertiary deposits in the eastern counties, would have been impossible unless either pines or spruce existed to feed them in winter.

The Rev. Leonard Blomfield read a paper before the Bath Antiquarian Field Club on December 9, 1885, in which he tried to prove that the numerous Scots pines, now growing in the neighbourhood of Bournemouth,¹ are descended from aboriginal trees; and gave the following list of names of places in England in which the word *fir* occurs, indicating that these localities were in early days probably noted for woods of *Pinus sylvestris*:—Firbank in Westmoreland; Furbecke or Firbeck, and Firbie or Firby, in Yorkshire; Furbie, Firby, or Firsby in Lincolnshire; Furcombe in the parish of Farnborough, Berkshire; Furler or Furleigh in Pevensey Rape, Sussex; Furland, a tithing of Crewkerne in Somerset; and Furland Hill, between Brixham and Dartmouth.

Loudon, p. 2167, says that the tree only began to be planted in Britain about the end of the seventeenth century; but the following extract from a letter² of James I. to the Earl of Mar, dated Oct. 30, 1621, shows that the introduction of the Scots pine into England was earlier.

"The Marquis of Buckingham, being desirous to have firre trees planted aboute his house at Burleigh on the Hille, hath earnestlie requested us to cause him to be furnished as well with the seede as with young trees, which his desire wee willinglie wold have performed with all expedition. And because wee know none who so readilie can give us satisfaction in this pointe as your selfe, we have thoughte good by these presentes to require you with all expedition to cause some store of seede to be gathered eyther in your owne boundes or in those of the Marquis of Huntlie, where it may be soonest had, and so soone as possiblie may be, sende a man of purpos to Burleigh on the Hille with so much of the freshest and fairest thereof as convenientlie may be caried. And that yee cause sette downe in writing at what time and in what kinde of grounde the same is to be sowed, and with the maner of sowing thereof; also when the time of year is fitting for removing and setting of plantes and young trees. Yee shall likewise sende one to Burleigh with four or five thousand of them, with the like instructions of time, place, and maner of setting and preserving."

There is no reference to these trees in the *History of Burley on the Hill*, published in 1901; and enquiries have elicited no information, except that there are now on the estate six or eight Scots firs, which are not more than 25 feet high. A local woodman, about 60 years of age, whose father was woodman before him, never heard of the existence of old pines at Burley.

The common Gaelic word for Pine is *gius*. It occurs in a few Scottish names of places, as Craiggush, Kingussie Altnaguish, Dalguise. This word is commonly used for pine also in Ireland, and *ochtach* occurs in books. In spite of the wide prevalence in ancient times of pine in Ireland, place-names with either of these words

¹ The submerged pine forest on the sea-coast at Bournemouth is described by Sir C. Lyell in *Principles of Geology*, ii. 536 (1872).

² *Historical MSS. Commission, Report on MSS. of Earl of Mar*, p. 103 (1904).

are rare. Mr. T. P. O'Nowlan, a competent Gaelic scholar, has given me the following list:¹—

- GOOSE ISLAND, *oilean gius*, in Lough Derg, Co. Tipperary, "island of pines."
 CLONYGOOSE, *cluain gius*, parish in Carlow, north of Borris, "meadow or plain of pines."
 MULLAGHANUISH, *mullach an gius*, near Ashford, Limerick, "hill-top of the pine."
 GARROOSE, *gardha gius*, near Bruree, Limerick, "garden of pines."
 KNOCKNAGUISE, *cnocan an giuis*, about three miles north of Kenmare, "little hill of pine." KNOCKNAGUSSY, similar in meaning, is situated about three miles south-west of Lough Mask in Co. Galway, "hill of the pine."
 KNOCKHOUSE, *cnoc gheainas*, three miles south-west of Mullinavat, Co. Kilkenny, "hill of pines"; the Gaelic word used here being a local variation of the common form.
 OUGHTY ISLAND, *oilean ochtaigh*, near Roundstone, Co. Galway, "pine island."
 DROMOGHTY, *drom ochtaigh*, about three miles north of the tunnel on the Kenmare road, Co. Kerry, "pine ridge."

Apparently, though the pine tree was centuries ago well known in Ireland, there is very scanty evidence as to its existence as an indigenous tree in modern times. Everywhere in Ireland the roots of pine trees are often found *in situ* in the upper layers of the peat-mosses, showing that forests of pine grew in the peat and attained a considerable size. These peat-mosses are probably of late formation.²

Ray³ quotes Mr. Harrison as an authority for pine "growing wild in the mountainous parts of Kerry where the *Arbutus* grows," about the beginning of the eighteenth century. Smith,⁴ writing in 1761, says that "these trees have been much destroyed in recent years; for, except a small shrub here and there among the rocks, there are none standing at present of any large size."

Mackay⁵ mentions, in 1825, a solitary pine tree standing near the foot of Mount Nephin in Mayo, which was supposed to be the last remnant of the pine forest of that county. This tree,⁶ very large and very old, was living in 1866, the exact locality being an open bog at Deal Castle, near Crossmolina, at the head of Lough Conn, and had been fenced in by the Earl of Arran.

Hayes,⁷ writing in 1794, speaks throughout his valuable book of *Pinus sylvestris* as Scots fir; and evidently in his day all the pines in Leinster at least were the product of Scotch seed.

In France the common pine is never met with growing wild in the plains. It is confined in the wild state to the Alps of Savoy, of Dauphiné, and of Provence, the

¹ While the above was passing through the press, Mr. O'Nowlan sent me a further list, as follows:—Lough Aguse, name of two lakes, one near Pettigo, Donegal, and another in Fermanagh; Lough Ayoosy and Aghoos, in Mayo; Cappayuse in Roscommon; Meenaguse in Donegal; Drumgoose and Derrynoose in Armagh; and Annagoose Lake in Monaghan.

² The evidence for this is too large a subject to be entered upon here. In certain peat-mosses no less than three distinct forests are discernible, occupying different depths; and the uppermost forest, always of *Pinus sylvestris*, probably dates from historic times.

³ *Synopsis Methodica*, 442 (1724).

⁴ *State of the County Kerry*, 372 (1761).

⁵ *Catalogue of Plants in Ireland*, 83 (1825).

⁶ *Cybele Hibernica*, 277 (1866).

⁷ *Practical Treatise on Planting*, 133, 167 (1794).

mountains of Auvergne, the Cevennes and Pyrenees, and is specially noted as occurring chiefly on the slopes with a southerly aspect.¹ It is common in the eastern part of the Pyrenees, between 4000 and 6600 feet altitude.

In Spain the common pine is also restricted to the mountains, only forming woods on northern slopes; and in the Sierra Nevada, forms the large and splendid forest of La Granja on the north side of the Sierra de Guadarrama, where it ascends to 6500 feet.²

In Germany very extensive and pure forests of pine occur in the north-east, always on sandy soil in the plain. These forests are called heaths, as they contain wide stretches covered only with heather and many swampy areas. Such forests are common in the provinces of East and West Prussia, Pomerania, Brandenburg, Posen, upper Silesia, Saxony, and in the kingdom of Saxony. Other large forests of the same kind occur more isolatedly in north Schleswig, Hanover, Jutland, and Holland. In the valley of the Rhine, both in Alsace and Baden, very fine forests of pine are also met with, as at Haguenau, likewise on sandy soil. In the mountains of Middle and Southern Germany, the pine only grows in small groves or as isolated trees. Similarly throughout the Alps and Carpathians, in Hungary, and on both shores of the Adriatic the pine is rare, only occurring in small woods.

The pine does not occur wild in the islands belonging to Denmark, and is totally absent from the Hungarian plain, the Bakony forest in Hungary, the Central Carpathians, Banat, and Slavonia, and is not met with in the alpine and subalpine regions of the high mountains of Central Europe. (A. H.)

In Switzerland this tree does not seem to attain such a large size as in Scandinavia. A tree at Campodials in the Grisons, figured on Plate xi. of *Les Arbres de la Suisse*, is said to be 80 feet high by 10 feet 6 inches in girth at 4 feet from the ground. It grows on the edge of a forest at about 3000 feet elevation, on crystalline rocks.

In Norway and Sweden the common pine constitutes by far the largest portion of the forest, and flourishes farther north than any other tree except the birch. Though truly virgin forest is now becoming a rarity in Norway, and in the more accessible parts of Sweden and Finland, yet the area of land covered with pine and spruce is still so large and so much better suited than England for the production of commercial timber that we shall, in my opinion, never be able to produce it of such good quality and at so low a price. I have seen *Pinus sylvestris* at its best in the forests of South-Eastern Norway in the valley of the Glommen; where the bright yellow bark of the upper part of the tall trunks on the banks of the river is a marked feature of the scenery; and in the far north in upper Saltensfjord where the oldest pines known to me now exist; though here, as elsewhere, they are rapidly being felled to supply the great demand for building and mining timber. In the more central provinces of North and South Trondhjem, and on the coast, the pine does not seem to grow to such a great size, probably because the soil and climate are too wet to suit

¹ It is not a native of the French side of the Vosges, but occurs on the German side at 1300 to 3000 feet altitude. It is not wild in the Ardennes or in the Jura.

² Mentioned by Christ in *Flore de la Suisse*, 198 (1907). Cf. *supra*, p. 574, var. *nevadensis*.

it as well as the spruce, for the pine is a lover of a sandy soil and a dry long winter, with a hot sunny summer.

Dr. Schübeler, in his *Viridarium Norvegicum*, i. 375, gives many details about the pine, from which I gather that its range extends from the south, where it reaches an elevation of 3500 feet above the sea, to the inner valleys of Finmark, where in lat. 70° N. it attains in Alten and Porsanger fjords as much as 60 feet high and 7½ feet in girth. He tells us that formerly there were pines on the Dovrefjeld, near Jerkin, at an elevation of 3200 feet, as much as 1 foot in diameter, where no trees now exist; and that near Roros, now one of the bleakest and coldest towns in Norway, the forest was, in 1773, so dense as to be almost impassable. The tallest pines in Norway that he mentions were near Holden in Lower Thelemarken, where one was measured 104 feet high, with a diameter at the ground of 2 feet 10 inches, and at 70 feet high of 9½ inches. Another at the same place was 105 feet high, and 5 inches in diameter at 96 feet up. At Klosterskogen in Skien, one was measured 108 feet by 6 feet 5 inches at breast height. The greatest girth that he mentions is about 15½ feet.

I have myself measured at Graddis in Junkersdal, within the Arctic Circle, and at an elevation of at least 1200 feet, pines of over 50 feet high and 12 to 13 feet in girth. One of these, which was cut down, was 34 inches in diameter and about 240 years old, but the outer rings were so close that I could not count them accurately, the first 100 years' growth being over 26 inches in diameter, showing that in this latitude at least the increase after this time is very slow. The tallest that I saw in this valley was 84 feet high near the Government Forest Nursery at Storjold. I observed that in Junkersdal the natural regeneration from seed was poor, and that in the upper parts of the valley the young seedlings were very small and stunted, and birch seemed to be taking their place. In this valley on July 10, 1904, vegetation had only just commenced, and the pines had not pushed their young growth, though *Cypripedium Calceolus* was in flower. A severe frost which took place in April, -14° to -16° Réaumur, after warm weather in March, had killed most of the young shoots where not protected by snow.

Schübeler gives several illustrations of the curious forms which this tree sometimes assumes. His Fig. 59 shows a tree in which the branches are very short and which has the shape of a northern spruce rather than that of a pine. Fig. 60 shows a branch with a great bunch of forty to fifty closely packed cones surrounding it. Figs. 61 and 62 show the power which the tree possesses of sending out upright stems of considerable size from a fallen trunk whose roots still retain their hold on the ground. Fig. 63 shows an immense witches' broom, forming a dense mass of living twigs in a ball 10 feet in diameter, which surrounds the trunk of a pine growing at Aaseböstäl in Nordfjord.

It is occasionally planted in Iceland,¹ but does not long survive the severe climate, though Hooker was told that a single dwarf tree grew on an island in a lake between the head of Borgarfjord and Reyholt.

As little is known with regard to the so-called Riga pine, which was for long

¹ Babington, in *Journ. Linn. Soc. (Bot.)* xi. 50 (1870).

the most celebrated for masts and shipbuilding purposes, and has been found in France to be the best variety in cultivation, we may refer our readers to a recent publication by Von Sivers,¹ with a map of the distribution of pine and spruce, which shows a comparatively small area of the former. The author states that though the pine is everywhere at home, it grows best on sand, especially where that is underlaid by good soil, and that in favourable places it reaches often a height of 150 feet. The area which is occupied by pine plantations in Estland, Livland, and Kurland is estimated at 638 square kilometres. It would, therefore, seem that the production of pine timber is not sufficient to continue the large export upon which in the past reliance could be placed. And though there are still large reserves of pine forest in Northern Sweden and Finland, yet it was stated by Mr. A. Howard at a recent meeting of the Society of Arts, in a discussion on Sir Herbert Maxwell's paper on Forestry, that the size of the deals imported from the Baltic is steadily diminishing, and that a much smaller proportion of 11-inch boards is now sent than was formerly the case.

In the forests of the lower valleys of the Altai Mountains in Siberia I have seen the pine attain a greater size than anywhere in Europe, some trees in the valley of the Biya river, a tributary of the Ob, which I observed in 1899, being estimated at 150 to 160 feet in height, and clean to 100 feet, at which height they looked as if they were 5 or 6 feet in girth.²

CULTIVATION³

Of all the many species of pine, none is so widely distributed in Europe, so common all over Great Britain, so easy to grow as the Scots pine, or Scotch fir, as it is often incorrectly called. Its vigorous constitution and rapid growth when young enables it to exist and even to thrive in almost all situations, and though the variations which it has produced in a wild as well as in a cultivated state are innumerable, yet the most casual observer can hardly fail to distinguish it from any other species which is likely to be seen in cultivation. I have seen the tree in the greatest perfection on the sandy soils of Surrey, Sussex, Bedfordshire, and Notts, on the rich loams of the south-western and midland counties, on the dry sandy glacial deposits and heath-clad hills of the Highlands, and in many parts of Europe.

Whether the Scots pine was at first principally propagated in England from native Scotch seed or from German seed is doubtful, and probably the earliest planted trees came from various sources; but so far as my experiments have gone, it seems as though the seedlings grown from acclimatised trees are now more flourishing, and grow faster in the south of England than those from German, Highland, or Scandinavian seed. I have tried plants of the same age from all these sources in Gloucestershire, and have found those sent me from the New Forest the most promising in their younger stages. If rapidity of growth at first is any indication

¹ *Die Forstlichen Verhältnisse der Baltischen Provinzen*, Riga, 1903.

² Farther east, near Krasnoyarsk, a pine has been measured, which at 200 years old was 40 archines (93 feet) high, and 11 vershoks (19½ inches) in diameter; but this is far surpassed by the pines found near Bélovège, where trees 150 years old are said to measure 60 archines (140 feet) high by 12 vershoks (21 inches) in diameter, and contain as much as 100 sagènes (about 250 cubic feet) of timber. Cf. *Les Forêts de la Russie*, Paris Exp. 1900.

³ Loudon's excellent account of the culture should also be referred to, pp. 2178-2183.

of vigour, I should prefer them, though I would not plant Scots pine as a forest tree on any soil where I could get larch to grow even fairly well; and on dry chalk and limestone soils it never grows with the vigour that it does on sandy soils.

Large parts of the open heath of the New Forest, though constantly pastured by horses, are becoming overgrown with Scots pine to such an extent that if they escape fire it seems as though they would eventually turn those open wastes into a more or less dense pine wood.¹ But on clay soils, and wherever a rank growth of grass, ferns, or briars is found, natural reproduction is comparatively rare, and over the whole of the Cotswold Hills I only know of a few places where self-sown pines can be seen.

If natural reproduction is desired, the best way of encouraging it is to uncover lines or patches of soil in the winter, on which the seed falling in April can germinate; but the growth of these self-sown plants is, as usual with almost all natural seedlings, at first much slower than that of planted trees. In very old pine woods of 100 to 150 years' growth, such as are found in Strathspey and in a few parts of England, the accumulated carpet of dead pine needles seems to prevent the young seedlings from establishing themselves; and in the Belvidere plantation at Windsor Park, which is one of the finest in England, I saw no self-sown seedlings under the fine old trees, many of which are 100 feet and more in height.

In such cases it is best to burn the heather or to graze it closely with sheep and cattle, and in many cases this is a necessary preliminary to preparing the ground for natural reproduction in Scots pine woods; but if the soil produces grass rather than heather, the regeneration is always less successful and requires more assistance.

I shall not attempt to give any estimate of the financial results of planting Scots pine as an unmixed plantation, because the conditions of soil and climate are so varied that any estimates, such as we see commonly given in books on forestry, are usually misleading. On very sandy, dry soil it will probably pay as well or better than any other tree, because it can be planted so cheaply, and will regenerate itself so easily.² But it must be kept thick enough to clean its stem before the branches get large, and in fact it may be better not to thin at all until 20 to 30 years old, when the weaker stems which will hardly pay to cut and carry out will be killed by their stronger neighbours. On high moorlands also it may be, and now often is, as profitable a crop as larch, because it grows well in windy and exposed situations; but I would not plant it, except as a nurse to other trees, on any soil where experience has shown that a more valuable tree will grow to fair timber size, and the plan often adopted of mixing it in larch plantations on calcareous soil has led in many places to absolute failure.

With regard to the possible yield of Scots pine in England, I have heard of nothing better than a part of the Dipton Woods near Hexham, Northumberland, the property of Lord Allendale. This was described in *Trans. Scott. Arb. Soc.* xx.

¹ I was informed during a recent visit to the New Forest that the commoners already complain that the pasture is deteriorating from this cause.

² I have seen no better example of natural regeneration than on the Duke of Bedford's property at Old Wavendon heath, near Woburn.

84 (1907), as containing something like 9000 cubic feet per acre, which at 4d. per foot works out at £150 per acre. Mr. Gillanders informs me that the soil is fine fresh sand, the elevation 550 feet, and the aspect north-east.

Some of the best foresters consider it an excellent nurse for oak, but beech is now usually preferred for this purpose, on any soil where the latter will thrive.

From 70 to 100 years, or in the Highlands 120 to 150 years, is about the age at which the tree is usually mature for felling; as, when younger than this, the timber is comparatively soft and inferior, though after creosoting it may be utilised for many purposes where strength is not important. Where pit-props are saleable, it is more profitable to cut the crop as soon as large enough for that purpose.

PROPAGATION

No coniferous tree is more easy to raise from seed, or easier to transplant. In Scotland the cones are usually gathered in autumn and the seeds extracted by kiln drying when required for sowing; but they are better left on the trees till spring, and the seeds may then be easily extracted by damping the cones and exposing them to the sun till they open. The seeds will keep good for several years, and if not wanted to sow at once, are better extracted in the summer after they are ripe and kept until the following March, when they will germinate as readily as, and perhaps produce stronger plants than, those extracted by artificial heat in winter and sown the next spring.

The best nursery practice is to sow them broadcast on slightly raised beds of sandy soil about three feet wide, and cover with about half an inch of fine earth, some of which may be raked off just before they begin to germinate, leaving a fresh surface uncaked by the rain and sun.

If sown too thickly, the plants will be drawn up closely, and will not remain two years in the seed-bed without becoming crowded. Some people advise transplanting at one year old, but in my experience two years is better, and, if carefully handled, the percentage of loss caused by transplanting is very small.

If the plants are to be put out on heath or sandy land, the stronger ones may be permanently planted out from the seed-bed; but in all soils which are grassy and weedy, it is better to keep them one or two years in nursery lines, which should be about 1 to 1½ feet apart, and the plants 3 to 6 inches apart in the rows, according to whether they are intended to remain one or two years in lines.

It is rarely desirable or necessary to allow them to remain more than four years in the nursery; but if plants larger than 1½ to 2 feet are required for special purposes, they must be transplanted when four years old and put in rows about one foot apart and two feet apart in the rows.

The best time for planting out large trees is in the autumn, as soon as the terminal buds become hard; but small plants should not be transplanted till after the period of severe frost has passed, or they will in most soils be lifted by frost. If, however, it is necessary to do so, stones should be put round the collar of the tree, not only to keep them fast in the ground, but also to keep out the drought during

the first year. I have found that this is a very successful method to adopt with all small trees on stony soil liable to drought.

An account of the best way of growing the Scots pine from seed was written by the Earl of Haddington in 1760 to his grandson, and is quoted in the Highland and Agricultural Society's volume on the *Old and Remarkable Trees of Scotland*, published in 1864. This account is very practical and based on personal experience, and interesting as showing how much care was taken by the planters of those days to ensure good results.

REMARKABLE TREES

As to the height the Scots pine attains in Great Britain, many particulars have been given by Loudon, which in most cases cannot be relied on for accuracy, but we have reliable measurements which show that the tree rarely exceeds 110 feet, and more usually is not over 100 feet.

In the *Victoria County History of Hants*, it is stated in vol. ii. p. 469, that trees 130 feet high were growing at Beaulieu, but Lord Montagu tells me that he has never actually measured one over 116 feet, of which height one was blown down some years ago. I saw these trees in June 1906, and though many exceed 100 feet, and are clean to 70 or 80 feet, with a girth of about 7 feet, I could find none over 110 feet. At Rooksbury Park, near Wickham, Hants, there are some which, I think, are taller, growing, mixed with beech and oak, in a dense thicket of rhododendron. The largest I measured here was about 115 feet by 10 feet 4 inches, dividing at about 17 feet into three tall, clean stems.

At Carclew, Cornwall, the seat of Colonel Tremayne, there is a fine avenue of pines, the tallest of which I found to be about 110 feet (Plate 160). At Pain's Hill, Surrey, Henry measured a tree of 106 feet. In the Belvidere plantation in Windsor Park, one of the finest old pine woods in England, planted about 1760, there are many trees of 100 feet and some perhaps a little more. There were some very tall trees at Hursley Park, Hants, of which I have no exact measurement, but I hear that few, if any, of them remain.

At Blickling Hall, Norfolk, the property of the Marchioness of Lothian, there is an immense tree, perhaps one of the oldest in England, which, when described by Grigor in 1841,¹ was 70 feet high and 16 feet in girth at 6 feet from the ground. He thought it the largest tree of the kind in Norfolk. When I saw it in April 1907 it was 96 feet by 17 feet 1 inch, dividing at about 10 feet into two main trunks, which were chained together 40 feet up. It had a large burr at the base. At Stratton Strawless there are some fine trees planted about 1740 by Robert Marsham, measuring about 100 feet by 9 feet. A tree was reported by Loudon at Castle Howard, Yorkshire, as being 120 feet high, with a bole 100 feet long, but I could not identify this tree as still living in 1905. At Cocklode House, in Sherwood Forest, there is a fine avenue of Scots pines about 160 years old, which are 90 to 100 feet high, and 9 to 10 feet in girth, but many of them have been blown down.

The tallest that I have ever seen or heard of is in the grounds at Petworth,

¹ *The Eastern Arboretum*, p. 100.

Sussex, the seat of Lord Leçonfield, where the soil seems particularly favourable to very tall trees. A careful measurement of this in 1905 gave the height as 120 feet by 11 feet in girth, and a bole of 35 to 40 feet, where it divides into two stems. Sir Hugh Beevor, who saw it in 1904, did not make it quite so tall. This tree appears in the foreground of Plate 162.

No park in England contains a greater number of fine and picturesque old pines than Bramshill Park, Hants, the seat of Sir Anthony Cope, who tells me that he believes them to have been planted about the year 1600, and to be some of the oldest in England. The soil here is very light and sandy, and the oldest pines are in avenues, which have become rather irregular in course of time. The tallest trees that I measured here were not over about 80 feet high by 10 to 12 feet in girth, but there is one splendid tree in the Gravel Pit drive which is about 80 feet by 16 feet, of which I give an illustration (Plate 161). There are many self-sown seedlings of various ages in this park, but no other trees of remarkable size.¹

At Dyrham Park, Gloucestershire, the seat of the Rev. W. T. Blathwayt, there is a very fine tree, of which I am indebted to the owner for a photograph, which measures about 73½ feet high by 14 feet 9 inches in girth, dividing at 4 feet into three trunks. There are some very fine clean Scots pines in Stowe Park, near Buckingham, one in the Queen's Quarter being over 100 feet high, with a clean bole over 60 feet long and 11 feet 3 inches in girth. In the Fir Grove, at Bayfordbury, Herts, there is a tree,² with a clear stem of over 50 feet, which measured in 1905, 95 feet high by 9 feet 7 inches in girth.

In Wales I have heard of no Scots pine of greater size than one at Penrhyn Castle, which Henry measured in 1904, and found to be 110 feet by 7½ feet, and about 70 feet to the first branch. At Gwydyr Castle he measured one about 85 feet by 11 feet 2 inches on which a mountain ash seedling was growing.

In Scotland there are so many fine old trees that it is impossible to mention more than a few of them. Perhaps the finest, if not the tallest, is a tree at Inveraray, of which a beautiful photograph by the late Vernon Heath is in the museum at Kew. I measured this tree in September 1905, when it seemed to have changed very little in appearance, and though supported by chains above the fork, is very sound and healthy. It measures 110 feet by 14 feet, forking at about 35 feet, and leaning considerably to one side. The Duke of Argyll informs me that it was probably planted about 1620. Plate 162 shows the present appearance of this tree. There are many other very fine Scots pines at Inveraray on the lower slopes of Dun-i-cuach, but none equal to this in height or girth.

On the banks of the Tay, near Dunkeld, there is a very graceful tree of weeping habit though of no great size (Plate 163), which measures 77 feet by 11 feet 6 inches in girth; and at Blair Atholl there are some curious old pines in a row

¹ Bunbury, who visited Bramshill Park in 1859, mentions the tradition that these trees were introduced by James I. from Scotland at the same time that he began building Bramshill, and states that there were three magnificent Scots pines at Eversley Rectory, which were coeval with those of Bramshill. Cf. Lyell, *Life of Sir C. J. F. Bunbury*, ii. 138, 139 (1906).

² This tree measured, in 1816, 5 feet 8 inches in girth, according to an entry in an old note-book, now in the possession of Mr. H. Clinton Baker.

by the Inverness road, which the Duke of Atholl informs me are probably part of the booty carried off by his ancestors in 1684 from Inveraray, as described in *Chronicles of the Atholl Family*, by the present Duke.¹ Nothing can better illustrate the importance which was paid to trees and planting even at this early period, when the Highlands were hardly civilised; than that so many exotic trees should have existed at Inveraray, and that it should have been thought worth while to carry them to such a distance when wheeled carriages could not have traversed the country.

An immense Scots pine, which I have not yet been able to visit, grows at Guisachan, Inverness-shire, now the property of Lord Portsmouth, whose forester, Mr. Davidson, informs me that in February 1907 it was 53 feet 10 inches high and 16 feet 8 inches in girth at the ground, and 15 feet 7 inches at 5 feet. At 11 feet from the ground, below the first branch, it is 16 feet 10 inches in girth. The trunk has been cut into at the base, which is believed by old people living near to have been done by smugglers, as an illicit whisky-still once existed near it. A drawing of this tree was made for the late Sir Dudley Marjoribanks, of which I have a copy. Mr. E. Ellice tells me that there are a number of very large old pines in the Guisachan Woods, girthing over 14 feet.

Mr. E. Ellice of Invergarry informs me that there are a considerable number of old native Scots pines at that place, among them one which attracted the late Mr. Gladstone's attention, and of which he sends me a sketch, with the following measurements:—Height, 70 to 80 feet; girth at the ground, 20½ feet; at 5 feet, 16 feet 3 inches; at 10 feet, 15 feet 9 inches; at 13 feet, 17 feet. A figure of this will appear in Vol. IV. Other trees near it measure 14 feet 3 inches, 12 feet 10 inches, and 12 feet 9 inches; and these appear to be the parents of many more which may be divided, according to their age, into three classes: those of 120 to 150 years, of which there are some hundreds; those of from 80 to 100, of which there may be 15,000 to 20,000; and younger trees.

The finest forest in this locality is in Glen Malie, on Lochiel's property,

¹ "In 1684 or 1685 the Marquis of Atholl did carry out of the orchard enclosures and shrubberies at Inveraray—

	£	s.	d.	Scots
600 Silver and Spanish fir trees, 6 years' growth				1800
500 Pinaster trees, 12 years' growth				500
500 Pine trees, 10 years' growth				500
400 Yew trees, 16 years' growth				266 13 4
6000 Holland trees (holly)				1800
600 Beech trees				600
2000 Lime trees, 4 years				400
400 Buckthorn, 8 years				120
600 Black and White Poplars, 13 years				200
400 Chestnut				266 13 4
200 Horse Chestnut				200
300 Walnut				200
200 Fir trees, 5 years				400
20,000 Ash, Plane, and Elm trees				2400
200 Pear and Apple trees				400
200 Plum trees				200
300 Cherry				300
1000 Apple and Pear stocks				3000

This claim was settled for £13,000 Scots or £1333, 6s. 8d.—*Chronicles of Atholl Family*, i. 265.

£13,553 6 8 Scots.

running up from the shore of Loch Arkaig for five miles, and in it there is one tree, even larger than that last mentioned, of which Mr. Ellice has sent me a sketch. At the narrowest part of the trunk, three feet from the ground, this tree measures 18 feet 8 inches in girth, and at about 10 feet divides into three tall trunks, each of which girths between 11 and 12 feet. Just below this fork it girths about 30 feet, and appears to be sound throughout.

At Novar, in Ross-shire, there is an old plantation containing a number of very fine Scots pines, one of which measures 105 feet by 10 feet 3 inches, and larger ones can probably be found in this district, as well as in the sandy district which extends east from Inverness, where many large plantations of this tree flourish exceedingly.

The finest individual trees and the finest Scots pine plantation that I have seen is in a place called Wishart's Burn, near Gordon Castle, Banffshire, on red sandstone soil. Though supposed to be about 180 years old, most of the trees are still in good health and quite sound, though wind has made some gaps in the plantation. When I visited them in April 1904 the tallest tree was about 117 feet high by 10 feet 11 inches in girth. It forks at about 45 feet, but carries its girth so well that the bole would, I think, measure 45 feet by 28½ inches quarter girth, about 245 cubic feet, and the tops might contain 50 feet each, making a total of 345 cubic feet (Plate 164). Another tree standing near it was 114 feet by 8 feet 10 inches, and I estimated that the older trees here average over 100 feet high by 8 feet in girth. Mr. Webster, gardener to the Duke of Richmond, who showed me this beautiful spot, agreed with me that the average number of trees to the acre here was about sixty, and their average contents about 100 cubic feet; but many have been cut and sold at as much as £7:10s. each, to make masts for large herring boats. One of these trees probably is the one figured by Loudon (p. 2162) as a model of a fine Scots pine clear of branches to 50 feet, and containing 260 feet of timber.

There are also very fine plantations of Scots pine in the neighbourhood of Castle Grant, the seat of the Dowager Countess of Seafield, in Inverness-shire, a place celebrated for its good forestry, and where better examples of thickly grown self-sown pine may be seen than anywhere else in Scotland. Mr. Grant Thomson, who has had charge of the extensive woods here for forty-five years, told me that the oldest planted trees are about 180 years old; many of these are 80 to 90 feet high and 8 feet in girth, and number sixty to seventy per acre. Some have already begun to decay at the heart, and it was noticeable that on the thick bed of decayed pine needles under them seedlings would not grow. This has been referred to by Prof. A. Schwappach in a paper on the "Forests of Scotland" in *Trans. Roy. Scot. Arbor. Soc.* xv. 13 (1898).

In this neighbourhood are the most celebrated and extensive natural forests of Scots pine in Great Britain, which I visited in April 1904. Glenmore forest, the property of the Duke of Richmond, was perhaps the best of these until 1783, when a great part of the mature timber was sold to an English merchant named Osbourne, who cut it down in twenty-two years and floated the timber to Spey-

mouth, where forty-seven ships of upwards of 19,000 tons burden were built from them at an expense for labour only of £70,000 (cf. Loudon, p. 2161). Glenmore Lodge lies at an elevation of 1050 feet on the shore of Loch Morlich, where some of the finest pines still stand. One of them (Plate 165) is interesting as having for many years been the eyrie of an osprey whose nest is visible in the photograph, which was taken in the interval between two snowstorms; but the birds, though carefully protected, have not bred there since 1900.¹ This tree measures 56 feet by 13 feet, and is very characteristic of the native Scots pine in its habit. But perhaps the most interesting tree in this forest is one from which a plank, now preserved at Gordon Castle, was cut and presented by Mr. Osbourne to the Duke, in 1806, as a memento of the forest. I could not count the rings of wood in it exactly, but the Duke of Richmond informs me that there are about 236. I measured the plank 5 feet 5 inches wide at the butt end and 4 feet 4 inches at the top. The sapwood is worm-eaten, and the colour of the wood has become very dark. I saw still lying on the hillside above Glenmore Lodge, near the upper limit of the Scots pine, at an elevation of about 1400 feet, a huge top, over three feet in diameter where it was cut off, and was assured by Francis M'Pherson, an old woodman, who showed it to me, that it was the top of the identical tree from which the above-mentioned plank was sawn. Though overgrown with moss and heather, much of the wood appeared to be still sound, after lying for nearly a hundred years. In confirmation of this I may state that Mr. J. Michie showed me, in Ballochbuie Forest, the remains of a pine which was sawn up and found sound after lying seventy years on the ground.

In Abernethy Forest there are also many fine old pines, one of which, Mr. Grant Thomson's favourite, is shown in Plate 166. It measures about 60 feet high by 14 feet 3 inches in girth, and, though it divides into five tops, is a most graceful tree. Much of this forest was burnt down many years ago, but has become self-sown with young trees, and is now open wood covered with long heather, and a favourite wintering ground for deer. We measured a group of the best clean self-sown trees supposed to be about 120 years old, and estimated them at about 120 per acre, with an average timber height of 40 to 50 feet and a cubic content of about 25 feet (Plate 167). Such trees, where they stand, are worth about 6d. per foot. Many cones are gathered in this forest for seed, of which about 8 ounces from a bushel is the average produce; and there is a large nursery where they are raised, the growth being very slow as compared to what one sees in England, on account of the cold and damp situation.

I next visited Ballochbuie Forest, by the kind permission of His Majesty, who preserves this beautiful forest with great care. It is now perhaps the largest area of natural forest in Scotland, extending for several miles along the south side of the upper valley of the Dee. The photographs, Plates 168 and 169, give a good idea of the picturesque scenery of this forest and of the fine trees in it, many of which are 80 to 90, and some as much as 100 feet high, by 7 to 8 feet in girth. The

¹ Mr. S. R. Clarke has sent me a photograph of a Scots pine at Fasnakyle, which is used annually as an eyrie by the Golden Eagle.

best of those which I saw might measure 60 feet timber height by 18 inches quarter-girth or 135 cubic feet. In the best stocked areas the trees might average 120 per acre at 120 years old, of which forty trees of the first class would average perhaps 40 feet, forty second class 25 feet, and forty of the third class perhaps 12 feet each, or about 3000 feet to the acre. But these figures are only a rough estimate, as the King's trees are not cut for sale, and in consequence Mr. Michie could not give me exact figures, but thinks they are worth from 6d. to 8d. per foot standing.

The Black Wood of Rannoch is an ancient natural pine wood extending for about three miles along the south shore of Loch Rannoch, and though there are no trees of exceptional size, there are many very picturesque ones, which are protected by the owner, B. C. Vernon-Wentworth, Esq., whose residence at Dell is near the east end of the wood. The largest which I measured was 91 feet by 11 feet 7 inches, with a very spreading base 15 feet 5 inches round at one foot from the ground. The greater part of the wood is open and covered with long heather, among which seedlings were fairly numerous wherever the soil was exposed. Many of the large trees were blown down thirteen years ago, and their timber, which was of very fine quality, was used by Sir J. Stirling Maxwell in the interior work of his house at Corrour.

There is an excellent account of the Black Wood of Rannoch and its history in chap. xxxiv. of that admirable book, Hunter's *Woods and Forests of Perthshire*, which, though now getting out of date, as it was published in 1883, gives a better account of the great estates and their trees than exists for any other county in Great Britain. In this work dimensions are given of the finest trees then existing in the Black Wood, which are remarkable more for their great girth, spreading and massive branches, and picturesque appearance than for their height.

On the shores of Loch Hourn, on the west coast of Inverness-shire, there are many native pines scattered among the birches, but none of large size, a few of those near the sea resembling the stone pine of Italy in habit. Henry observed that many of these trees do not ripen seed.

With regard to the elevation at which the Scots pine grows in Scotland, we have various somewhat conflicting estimates. Mr. Michie tells me that Craig Doin (1900 feet) is about the highest level he knows it to reach in Ballochbuie. Mr. Seton P. Gordon, however, says¹ that he has seen a young Scots pine growing at a height of about 2700 feet not far from the source of the river Dee on the south slopes of Brae Riach, though he regards this as very exceptional. Mr. Hugh Boyd Watt² also considers 2700 feet quite an unusual altitude, and says, "From personal observations made on and around the Cairngorm mountains (and in no other district in this country do forest trees attain higher levels) I can say that even at 2000 feet above sea-level the Scots pine has difficulty in holding its ground. . . . On the southern slopes of Beinn a' Bhuird (Glen Quoich) considerable numbers of fairly well-grown Scots pines reach up from 2000 feet to 2100 feet, and I know no other place where what may be called the forest line is so high. . . . In other localities, apparently favourable to their growth, the pines do not in any numbers exceed an

¹ *Country Life*, 17th Aug. 1907, p. 245; 31st Aug. 1907, p. 322.

² *Op. cit.* 7th Sept. 1907, p. 359.

altitude of 1500 to 1700 feet. This is approximately the level at which they die out in Abernethy, Rothiemurchus, Glen Feshie, Glenavon, Invercauld, Birse, and Glen Tanar." When stalking on Ben Avon I saw with the telescope some pines in the upper part of Glen Derry which I supposed to be at an elevation of about 2000 feet, and Mr. Michie, who has seen these trees, thinks that this estimate is not far from the mark.

(H. J. E.)

In Ireland the common pine grows with great vigour and beauty, the bark becoming bright red in colour and the leaves very glaucous. The tallest trees, which I have seen, are at Curraghmore, the seat of the Marquess of Waterford, where, near a stream, I measured one 110 feet high and 7 feet in girth; some, but difficult to measure accurately on account of their position in a dense wood, were probably 120 to 125 feet in height, the largest of these having a girth of 9 feet.

At Doneraile Court, Co. Cork, there are some fine pines, growing scattered in an oak wood, the largest of which I made 97 feet by 11½ feet, with a clean stem to 50 feet. These trees are supposed by local tradition to be of native origin, and are called Irish pines; but they have evidently been planted, and there is no means of determining whether they originated from seed collected in Kerry from aboriginal pines still existing there in the 18th century, or, as is more probable, from Scotch seed, as they are probably about the same age as the famous larches at this place, which are reputed to have been sent to Doneraile by the Duke of Atholl.

At Emo Park, Portarlinton, there are many fine trees, the largest seen measuring 91 feet by 7½ feet and 88 feet by 9 feet 1 inch. There is also a splendid tree, growing near the gate of Mr. Walpole's beautiful garden at Mount Usher, on the Rossanagh property, which is 11 feet 9 inches in girth, and probably 80 feet in height. At Castledawson, Co. Derry, an old tree measures 80 feet in height by 11 feet 4 inches in girth. There are many fine trees scattered through Coollattin in Wicklow. These grow on moist boggy soil; and I measured two clean of branches to 60 feet, which were 87 feet in height, and 9 feet 5 inches and 8 feet 1 inch respectively in girth.

At Luttrellstown, near Dublin, Hayes¹ measured a "Scots fir, eighty-five years' growth from the seed, of 11 feet 6 inches in circumference, and another of very great height 11 feet 10 inches round." He gives several other instances of the rapid growth of the tree in Ireland.²

Mr. T. W. Webber, late Deputy Conservator of Forests in India, in the appendix to his book on the *Forests of Upper India*, gives an interesting account of the growth of Scots pine in Ireland, the planting of which he strongly advocates. To the objection that home-grown timber is of inferior quality, he replies that the wood of *Pinus sylvestris* found in bogs in Ireland is often of great length and thickness, sound, fine-grained, solid and straight, and so excellent that it has been used by coach-builders as superior to Memel timber. Where such timber grew ages ago,

¹ *Practical Essay on Planting*, 133, 167 (1794).

² At Powerscourt an immense Scots pine was blown down by the great gale of February 1903, which I saw on the ground soon afterwards and which measured about 12 feet in girth. Some boards cut from the tree were kindly sent me by the late Lord Powerscourt, which show its growth to have been very rapid.

(H. J. E.)

similar material might be produced to-day, if close planting and slow growth were the rule. To prove this, he gives the actual dimensions of Scots fir grown under two different conditions in Ireland.

Grown thirty to the acre, with spreading crowns.	Grown 200 to the acre, with small crowns.
Girth 5 feet	5 feet.
Height 50 "	75 "
Age 40 years	100 years.
Diameter 20 inches	20 inches.
Heartwood 12 "	19 "
Sapwood 8 "	1 inch.
Rings per inch 4, uneven	10, regular.

These trees are quickly grown on deep soft soil, and are liable to be blown over. Timber, coarse, knotty, light, and perishable; large amount of sapwood.

These trees were slowly grown on a hill-side on poor and stony soil; standing close they resist storms. Timber fine-grained, hard, heavy, durable, and equal to best Memel. Scarcely any sapwood.

Mr. Webber has kindly written to me that the trees just mentioned grow on his own property at Kellyville, near Athy, in Co. Kildare. A beam, made out of the fine pine timber grown on the hill-side, placed in the front of a conservatory twenty-five years ago, is still sound and good. Mr. Webber has Scots pine thriving on pure rock, where there is little or no soil. He states that at Emo Park near Portarlinton and on the road to Maryborough there are striking instances of pine succeeding on pure black bog, and self-sown seedlings may be seen spreading all over the turf-moss. He reiterates the conclusions given above, namely, that the pine should be planted densely on poor soils, where it will resist the wind and yield timber without any appreciable sapwood, whereas on deep soft soils it is easily blown over and yields coarse and valueless timber. In the bog in Emo Park, Mr. Webber found great bases of Scots pines with their roots in the boulder clay, of gigantic size, showing that the tree was indigenous before the bog began to grow ages ago.

In some parts of Ireland, Scots pine may be seen thriving on deep peat-moss, the condition necessary for success being judicious preliminary drainage. In mosses soaking with water, trees languish and die on account of the lack of air at their roots. On the other hand, if the drainage is too deep, the upper layer of the peat becomes so dry, that the trees suffer from want of water. Near Castledawson in Co. Derry, a considerable area of undrained peat-moss is covered by healthy and vigorous pine trees, which are natural seedlings, the product of seeds blown from an adjoining plantation. Here, however, the peat-moss rests on the side of a sloping sandhill and is not waterlogged. Natural pine seedlings are often seen on peat-mosses, struggling for life in the wettest situations; and doubtless, if cattle and rabbits were excluded, these would in time take possession. At Churchill in Co. Armagh, the property of Harry Verner, Esq., considerable plantations of Scots pine, intermixed with a small proportion of larch, were made in 1861 on deep peat-moss, which had been thoroughly

drained. These trees, planted $3\frac{1}{2}$ feet apart, are now forty-four years old and average 44 feet in height by 3 feet in girth. Two-year-old seedlings, one year transplanted, were used and a system of pitting was adopted. The holes were made about a foot deep, and were filled in with a mixture of clay and peat. The clay was brought from a distance, and no doubt its use added considerably to the cost of planting. Possibly peat-ashes, obtained by burning peat, heather, etc. on the spot would have answered equally well, and been less costly. The Scots pine succeeds better than any other tree on pure peat-moss, though alder and larch may be added in a certain proportion. At Clonbrock, in Co. Mayo, on an overcut bog, where the peat left uncut was 3 to 4 feet deep, Scots pine eighty years old averages only 47 feet in height by 4 feet in girth. Probably the lesser growth in this case is due to insufficient drainage. As there are immense areas of peat-mosses in Ireland, now yielding no return whatever, the possibility of afforesting them with Scots pine, or with a mixture of Scots pine and larch, is an important question; and the success of the Churchill plantations is encouraging.¹

Throughout Ireland there are extensive mountain tracts of barren land, covered with stones and rocks, which are of merely nominal value for grazing and are impossible to reclaim for agricultural purposes except at a ruinous expenditure. The Scots pine renders excellent service in turning these wastes to account. The late Lord Powerscourt made extensive plantations on the hill-sides of Co. Wicklow at 500 to 900 feet above sea-level, which paid handsomely. These plantations consisted in the main of a mixture as follows:—200 larch, 1500 Scots fir, and 500 spruce per acre, the plants being notched in, as, in Lord Powerscourt's opinion, they came on eventually as well as those which had been pitted at a much greater expense. The Scots fir have been gradually thinned out, the larch being left as the final crop. Lord Powerscourt was favoured by ready access to the sea, and by proximity to Wales, where his thinnings were readily sold as pit-props. He estimated that the initial cost of planting and fencing is £4 to £5 per acre, and that, during the first twenty to twenty-five years, the thinnings pay for the expense of cutting and the interest on the first cost. After that the thinnings should bring in annually eight shillings an acre; the final crop of larch at fifty years being probably worth about £50 an acre.

(A. H.)

In the United States the Scots pine has been planted with more or less success, but does not seem likely to be as valuable for timber as the native pines. The largest I saw was in the Wellesley Arboretum, near Boston, which was 49 feet high in 1904. In Professor Sargent's grounds it seems to be short-lived, only living for thirty to forty years. Ten miles from Boston, however, near Ponkapoag, it succeeds better on dry sandy soil, and I found some self-sown seedlings. At the Central Experimental Farm, near Ottawa, trees planted in 1888 were about 30 feet high in 1906, but Mr. W. T. Macoun² reports that it suffers much from shade, and does not grow so fast as Norway spruce or European larch; though he recommends it for nurses to other trees, and for producing fuel.

¹ The plantations on bog land at Knockboy, Co. Galway, were badly made, and turned out a disastrous failure. Cf. Dr. Schlich's report in *Kew Bull.* 1903, p. 22; and in *Trans. Roy. Scot. Arbor. Soc.* xvi. pt. ii. 249 (1901).

² *Canadian Forestry Journal*, iii. 77 (1907).

Cases of inosculation are rare among pines, but a remarkable instance of this was pointed out to me by Mr. Savile Foljambe in the Catwhins, near the lodge leading out of Thoresby park into the Retford road. It seems probable that when the trees were young they had come in contact, and eventually fused; the iron bands were put on afterwards, but the trees are now dead.

Another case, somewhat similar, occurs in a pine tree growing on the estate of Chenevières, near Montbour (Loiret), France, which a photograph kindly sent me by M. Maurice de Vilmorin illustrates. Here it seems that one tree had forked at or close to the ground, and become connected by a thick branch at a much later period. A third instance of natural inarching in the Scots pine is described and figured by Count von Schwerin¹ from a tree near Teltow in Germany. In this instance a branch of one tree grew into the bark of another and broke off, eventually forming just such a living connection between the two trees as is shown in Vol. I. Plate 4, but much thicker in proportion. The sap of the left hand tree appears to pass through this branch to the other, as the stem is thicker above the junction, and the branch has assumed the yellow bark of the upper part of the trunk.

The large, usually globular masses of dense shoots which sometimes appear on this species, and more rarely on larch and spruce, are not caused by a parasitic fungus. Prof. von Tubeuf² says that their origin is unknown, no insect or fungus having yet been discovered which might have caused the growth, which is composed of a mass of small buds, producing densely crowded tufts of short leaves. A specimen which was found at Schwarzenraben in Germany measured 53 centimetres in height and about the same in diameter, the weight of this mass being over eleven pounds.³ Such growths are not uncommon⁴ in England, and I have a photograph of one on a tree at Colesborne, which was about a foot in diameter.

TIMBER

On the timber of the Scots pine so much has been written that I will refer specialists to Laslett,⁵ who gives a long account, mostly from a shipbuilder's point of view, of the various foreign varieties known to him as Dantzic, Memel, Riga, and Swedish fir; but makes no reference to the quality of native-grown timber, which, though men-of-war were built from it by Osbourne in the last century, seems to have been unused by the Admiralty since then, as it is now by the Post Office authorities in England, and by architects and builders generally. The reason of this is, no doubt, that the rapid growth of the tree in this country, in our mild climate, causes the wood to be much softer,

¹ *Mitt. D. D. Gesell.* 194 (1906).

² *Ibid.* 222, fig. 13 (1905).

³ Count von Schwerin, *Mitt. D. D. Gesell.* 222 (1905), says that in Bavarian Allgau, between Oberstaufen and Weiler, he has seen a forest of sixty-year-old spruce in which almost every tree was more or less affected by these growths, and supposes that the cause, whatever it is, must be contagious. He has seen similar growths on *Picea orientalis* and suggests that some of the horticultural monstrosities such as *Picea excelsa echiniformis* and *C. Lawsoniana forsteckensis* have originated from a similar cause.

⁴ A specimen from a tree growing at Hunstanton Hall, Norfolk, was shown at a meeting of the Scientific Committee of the Royal Horticultural Society in April 1899. Cf. *Gard. Chron.* xxv. 270 (1899).

⁵ *Timber and Timber Trees*, ed. 2 (London, 1894).

coarser, and less durable than that from North Germany, Russia, and Scandinavia; whilst over-thinning causes it to be much more knotty. It is hardly possible to believe that the same tree can produce timber so different as examples which I showed at a lecture on English timber at the Surveyors' Institute, on 22nd February 1904, taken from an immense tree grown at Powerscourt, of about 12 feet in girth; and the beautiful fine-grained wood which I brought from Northern Norway, and which when well planed shines with a silky gloss. Every intermediate form may be found in this country; but, as a rule, it is little valued in England except for mining timber, for cheap fencing, packing cases, and other uses. In Scotland, where it is as a rule slower grown, and better in quality, its value is kept down by foreign importations, though it is very largely used in making staves for herring barrels and many other purposes.

But when old enough to have produced a large proportion of red heartwood, and free from knots, I have sold Scots pine for as much as 8d. per foot, and have found it very useful and durable timber for roofing and many other estate purposes; and I am informed by Mr. Mitchell, forester to the Duke of Bedford at Woburn, that in that neighbourhood, where it is of good quality, it is largely used for rending lath, and that the buyers will give a high price for it when suitable for that purpose.

Loudon gives many interesting particulars of the uses and quality of pine timber at home and abroad, and quotes¹ Mr. T. Davis who, in 1798, was the Marquess of Bath's forester at Longleat, to the effect that a cart-house, built from it on that estate, remained perfectly sound after eighty years' use. And Pontey, in his *Forest Primer*, published in 1805, also defends the Scots pine against the "almost universally prevalent prejudice against it, which is no doubt based partly on ignorance and partly on the fact that it is often used when too young and unseasoned."

But, whatever may be said against the wood when grown in the south of England, there can be no question that the Highland native pine timber, when clean, is a valuable, and in some cases also a very ornamental timber. I have seen at Castle Grant a very beautiful sideboard made on the estate, which showed the curiously twisted red and yellow grain which Mr. Grant Thomson tells me is only produced by the self-sown native trees; and I am indebted to the kindness of Lady Seafield for some of the same wood, which was cut in the Forest of Abernethy. The entrance hall and a room at Balmoral Castle have been recently panelled with the same sort of wood, which has a very ornamental effect, and Mr. Michie tells me that it has also been largely used for internal decoration in Mar Lodge. I saw in the house of the postmaster of Bodö, in Norway, a very handsome table made from a variety of the wood, which is there called "Rie," and which seems to be caused by a disease in the tree producing excrescences and distortion in a part of its trunk, and I possess a piece of this wood which is so unlike pine wood that no one could recognise it as such. But these trees seem to be as rare in Norway as in Scotland, and command a high price locally.

The oldest example of this wood in the form of panelling that I have seen or heard of is in the room known as Queen Mary's room in Castle Menzies, which was

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occupied by Mary Queen of Scots in 1577. This is now perfectly sound, and much darkened in colour by age. The width and somewhat knotty character of the boards tend to confirm what the late Sir R. Menzies told me, that it was made from locally grown Scots pine, which may have come from the Black Wood of Rannoch, or from other native forests that have now disappeared.

It is remarkable that, notwithstanding all that has been written since the Earl of Haddington first raised the question as to the existence of different varieties of this tree in his *Treatise on Forest Trees*, in 1760, there seems to be as yet no exact knowledge as to whether the different kinds of timber produced by different trees are, as I believe, individual variations, largely due to soil, or whether, by sowing seeds from trees possessing superior qualities, they may be reproduced in other soils and situations. The best and most exact records of such experiments that I know of are given by M. M. de Vilmorin in his account of the varieties of *Pinus sylvestris* collected by his grandfather at Les Barres in France, and published in the *Catalogue des vegetaux Ligneux sur le Domaine des Barres* (Paris, 1878), which show how much one family have done for the better knowledge of the economic value of trees, and for the benefit of their country.

Briefly, this trial, extending over a period of over sixty years, shows that, in the soil and climate of Central France, the Riga variety of *P. sylvestris* has, on its first introduction as well as in the second generation, preserved its superiority over other varieties of the same tree—from the various parts of France, from Haguenau on the Rhine, from Switzerland, and from Scotland—by its good growth, freedom from branches, quality of timber, and facility of transplantation. Though this superiority might not be as marked in England, it points to the necessity of careful trials of seed from Riga which, so far as I know, have not yet been made in this country.

In *Scott. Arb. Trans.* ix. 176 (1881), there is a very valuable paper by J. M'Laren and W. M'Corquodale, on "The Supposed Deterioration of the Scots Pine"; it having been stated by George Don and other writers that there were two or more varieties, one of which was very inferior to the other. They conclude, after reviewing the experience of many competent foresters, that the quality of the timber depends on the subsoil and the climate more than on the variety, and that the rich red resinous timber, for which the Highland pine is distinguished, is not to be expected in the south. They say that, since the days of the fine old Memel pine, there is no pine timber imported to our country equal to the old Highland pine, and that what has caused it to fall into disrepute is that it is grown too fast and cut too young, coupled with the fact that it is more difficult to manufacture and dress than foreign timber.

(H. J. E.)

CARYA

Carya,¹ Nuttall, *Gen. Am.* ii. 220 (1818); Bentham et Hooker, *Gen. Pl.* iii. 398 (1880).

Scoria, Rafinesque, *Med. Repos. New York*, v. 352 (1808).

Hicorius, Rafinesque, *Fl. Ludov.* 109 (1817).

Hicoria, Rafinesque, *Alsog. Am.* 65 (1838).

DECIDUOUS trees belonging to the order Juglandaceæ. Branchlets with solid continuous pith, not chambered as in Juglans and Pterocarya. Leaves alternate, compound, unequally pinnate, without stipules; leaflets sessile or sub-sessile, serrate, penninerved.

Flowers monœcious, without petals. Staminate catkins slender, drooping, in threes on a common peduncle or clustered and sessile or subsessile, arising either from buds in the axils of the leaf-scars of the previous year's branchlets or from the base of the current year's shoot, and appearing after the unfolding of the leaves; flowers numerous in the catkin; calyx two- to three-lobed, subtended by an ovate bract; stamens three to ten, filaments short. Pistillate flowers, two to ten, in a cluster or spike, terminal on a leafy branchlet of the year; ovary superior, one-celled, surrounded by a four-lobed cup-shaped involucre, formed by the union of a bract and two bracteoles; calyx one-lobed; stigmas two, sessile; ovule solitary.

Fruit, a nut, enclosed in a four-valved, thickened, hard and woody involucre, four-celled at the base, two-celled at the apex, tipped by the remains of the style; seed solitary, without albumen, filling the cavity of the nut.

The cotyledons remain underground in germination, the plumule being carried by the lengthening of their petioles out of the nut, which splits into two valves. The germination resembles that of the oak, the young stem bearing at first three to eight alternate minute lanceolate scales, above which the leaves are developed. The first leaf is simple, tri-lobed, or trifoliolate; those succeeding, about five or six in the first year, being trifoliolate; all are serrate and stalked. The difference observed in the length of the stems, in two or three seedlings, seen at Colesborne, may not be constant for each species.²

Twelve species of hickory are distinguished by Sargent,³ all natives of North

¹ The generic name, *Carya*, though not the first one published, has always been used in England, and is now sanctioned by the regulations drawn up by the International Congress of Botany at Vienna in 1905. Cf. *Verhand. Internat. Bot. Kongress. Wien*, 1905, p. 239. With regard to the specific names, I have not altered those of Nuttall, which have been long in use.

² Rowlee and Hastings, *Bot. Gaz.* xxvi. 349, pl. xxix. figs. 9, 10, 12 (1898), give figures of the seedlings of *C. alba* and *C. porcina*.

³ In *Trees N. Amer.* 132 (1905). Ashe, in *Flora South-Eastern United States*, 333 (1903), raised two varieties to the rank of species, making fourteen species in all.

America, four species extending as far north as Canada, and one species confined to the high lands of Mexico. Six species¹ (Plate 203) are in cultivation in the British Isles, and will be dealt with in the following account.

The genus is divided into two sections:—

I. *Apocarya*, De Candolle, *Prod.* xvi. 2, p. 144.

Buds, with four to six valvate scales, which are often obscurely pinnatifid at the apex; axillary buds, often two to three superposed, the uppermost one stalked. Husk of the fruit thin, and prominently ridged at the sutures.

1. *Carya olivæformis*, Nuttall.

Buds greyish, densely pubescent, without glands. Leaflets, eleven to thirteen, rarely nine; margin densely ciliate.

2. *Carya amara*, Nuttall.

Buds yellowish, slightly pubescent, glandular. Leaflets, seven to nine; margin irregularly ciliate.

II. *Eucarya*, De Candolle, *Prod.* xvi. 2, p. 142.

Buds with ten to twelve imbricated scales, the outer falling early, the inner accrescent and becoming much enlarged and reflexed at maturity. Husk of the fruit thick, not ridged at the sutures.

* *Leaflets five, pubescent.*

3. *Carya alba*, Nuttall.

Young branchlets with brown stellate hairs; base of the shoot marked with a dense pubescent ring. Leaflets, stellate-pubescent beneath, ciliate in margin.

** *Leaflets five or seven, glabrous.*

4. *Carya porcina*, Nuttall.

Young branchlets glabrous or with only an occasional hair; base of shoot without pubescent ring. Leaflets glabrous beneath, except for axil-tufts, non-ciliate in margin.

*** *Leaflets, seven or nine, pubescent.*

5. *Carya sulcata*, Nuttall.

Branchlets reddish-brown, glabrous towards the tip. Leaves not fragrant; rachis nearly glabrous; nerves in upper lateral pair of leaflets more than twenty pairs.

6. *Carya tomentosa*, Nuttall.

Branchlets purplish-grey, pubescent and glandular. Leaves fragrant; rachis pubescent and glandular; nerves in upper lateral pair of leaflets less than twenty pairs. (A. H.)

¹ *Carya aquatica*, Nuttall, the water hickory, a native of river swamps in the southern parts of the United States, is not likely to succeed in any part of the British Isles. Loudon, *op. cit.* 1444, mentions a tree of this species 40 feet high growing at Milford near Godalming; but his identification was probably incorrect.

CARYA OLIVÆFORMIS, PECAN NUT

- Carya olivæformis*, Nuttall, *Gen. Am.* ii. 221 (1818); Loudon, *Arb. et Frut. Brit.* iii. 1441 (1838).
Carya angustifolia, Sweet, *Hort. Brit.* 97 (1827).
Carya illinoensis, Koch, *Dendrol.* i. 593 (1869).
Carya Pecan, Schneider, ex Sargent in *Bot. Gazette*, xlv. 226 (1907).
Juglans Pecan, Marshall, *Arbust. Am.* 69 (1785).
Juglans illinoensis, Wangenheim, *Nordam. Holz.* 54 (1787).
Juglans angustifolia, Aiton, *Hort. Kew.* iii. 361 (1789).
Juglans cylindrica, Poirer, in Lamarck, *Dict.* iv. 505 (1797).
Juglans olivæformis, Michaux, *Fl. Bor. Am.* ii. 192 (1803).
Hicoria Pecan, Britton, *Bull. Torrey Bot. Club.* xv. 282 (1888); Sargent, *Silva N. Amer.* vii. 137, tt. 338, 339 (1895), and *Trees N. Amer.* 133 (1905).

A tree, attaining in America 170 feet in height and 18 feet in girth. Bark, brownish, deeply and irregularly divided into narrow forked ridges. Buds, similar to those of *C. amara*, but greyish-white in colour, densely pubescent and without glands; lateral buds ovoid, pointed. Young branchlets densely pubescent, especially towards the tip, where no glands are present, but with minute glands at the base of the shoot. Leaves (Plate 203, Fig. 6), 12 to 20 inches long. Leaflets, eleven to thirteen or more, rarely nine, lanceolate, falcate, sessile, acuminate, very unequally divided by the midrib; upper surface with stellate pubescence on the midrib and nerves; lower surface covered throughout with fine scattered pubescence and numerous glands; margin plainly ciliate; rachis densely pubescent.

Staminate flowers in sessile or subsessile clustered catkins, usually on the previous year's branchlets. Fruit in clusters of three to eleven, pointed, four-winged and -angled, 1 to 2½ inches long, ½ to 1 inch broad; husk thin, brittle, dark-brown, coated with yellow pubescence, splitting when ripe nearly to the base; nut, thin-shelled, reddish-brown with irregular black markings; seed sweet, reddish-brown.

(A. H.)

The Pecan is a native of the Middle States, occurring from Indiana, Southern Illinois and Iowa, southward through Western Kentucky and Tennessee to Alabama and Mississippi, and extending westward through Missouri, South-Eastern Kansas, Arkansas, Indian Territory and Louisiana to the valley of the Concho River in Texas. It is also met with in the mountains of Mexico.

It chiefly grows on rich alluvial soil, along the banks of streams, and attains a greater size than any other hickory. Ridgway says it is one of the very largest trees of the forest, being only exceeded in height by the tulip tree and the scarlet oak. He records one tree, measured by Dr. Schneck, which was 175 feet high by 16 feet in girth, and another 30 feet in girth at the ground. It is largely cultivated in the Southern States for its fruit, which has been improved by selection and grafting, and is considered the best of the nuts of North America.

It requires a much longer and hotter summer than any part of Great Britain affords; and even in the south of Europe we have not heard of its being successfully

grown. Pardé¹ has not heard of its having ever produced fruit in France, where it is hardy as far north as Grignon,² but grows very slowly.

It was introduced, according to Loudon, in 1766 into England, and he mentions, with some doubt as to the species, trees growing in the Horticultural Society's garden and other places near London; but it is probable that this tree has never attained a considerable size in England. At Tortworth, a tree with the bark beginning to scale was, in 1905, 24 feet high and 1½ foot in girth. Dr. Warre, the late headmaster at Eton, raised, from seed sent to him from New York, a tree, which is growing in the garden of Mr. E. C. Austen Leigh, at Eton, who informs us that it is about 11 feet high. Miss Woolward raised at Belton in Lincolnshire a plant, which is now about 4 feet high; but it suffers severely from frost, the young growths being killed back every year. None of the seedlings which I have raised at Colesborne have thriven, as the summer here is evidently much too short and cold. (H. J. E.)

CARYA AMARA, BITTERNUT

- Carya amara*, Nuttall, *Gen. Am.* ii. 222 (1818); Loudon, *Arb. et Frut. Brit.* iii. 1443 (1838).
Carya cordifolia, Schneider, ex Sargent in *Bot. Gazette*, xlv. 226 (1907).
Juglans alba minima, Marshall, *Arbust. Am.* 68 (1785).
Juglans cordiformis, Wangenheim, *Nordam. Holz.* 25 (1787).
Juglans angustifolia, Poiret, in Lamarck, *Dict.* iv. 504 (1797).
Juglans sulcata, Willdenow, *Berl. Baumz.* 154 (1796).
Juglans minima, Borkhausen, *Handb. Forstbot.* i. 760 (1800).
Juglans mucronata, Michaux, *Fl. Bor. Am.* ii. 192 (1803).
Juglans amara, Michaux f., *Hist. Arb. Am.* i. 177 (1810).
Hicoria minima, Britton, *Bull. Torrey Bot. Club*, xv. 284 (1888); Sargent, *Silva N. Amer.* vii. 141, tt. 340, 341 (1895), and *Trees N. Amer.* 135 (1905).

A tree, attaining in America 100 feet in height and 9 feet in girth. Bark grey, smooth, ultimately separating on the surface into small thin scales. Buds bright-yellow, glandular; terminal buds elongated, pointed and oblique at the apex, about ½ inch long, with two pairs of valvate scales, often obscurely pinnatifid at the tip; lateral buds, often two superposed, the uppermost stalked, four-angled, and pointed, the lowermost minute. Young branchlets, with scattered short pubescence, glandular towards the tip. Leaves (Plate 203, Fig. 5) 6 to 10 inches long. Leaflets, five to nine, variable in shape, lanceolate, ovate-lanceolate, or obovate-oblong, long-acuminate; margin with occasional cilia; lower surface with stellate hairs, especially along the midrib; rachis minutely pubescent.

Staminate catkins, pubescent, in threes on a slender peduncle, usually on the previous year's branchlet. Fruit, one, two, or three at the top of the branchlet, about an inch long; husk thin, glandular, four-winged from the apex to about the middle; nut thin-shelled; seed bitter, reddish-brown. (A. H.)

This species has a wide distribution, extending to the northward as far as Southern Maine, Ontario, Central Michigan, and Minnesota. It was the only hickory which I found near Ottawa, where it was common in the Gatineau Valley,

¹ *Arbor. Nat. des Barres*, 253 (1906).

² Seen by Henry in 1906.

but not there a large tree. It extends westward to South-Eastern Nebraska, Eastern Kansas, Indian Territory, and Eastern Texas, and reaches its southern limit in North-Western Florida and Northern Alabama. It is usually found in lower and moister situations than the other species, and is one of the largest and commonest hickories in Southern New England, where it attains 70 to 80 feet in height and 10 to 12 feet in girth. It grows to its largest size on the alluvial lands of the lower Ohio basin; and in Southern Indiana, Ridgway records a tree 113 feet in height and 6 feet 3 inches in girth.

The bitternut is the commonest species of hickory in England, and grows to a considerable size. The finest tree is perhaps the one at Bute House, Petersham, which was, in 1903, 76 feet in height by 7 feet 5 inches in girth (Plate 170).

At Barton, near Bury St. Edmund's, there are three trees, two in the arboretum, one of which I found in 1905 to be 80 feet by 5 feet 4 inches, and the third on the lawn, 74 feet by 7 feet 6 inches, but forked near the ground. These trees ripened fruit¹ in 1864; but of late years do not appear to have borne any.

At Syston Park, Lincolnshire, there are four trees of this species, one of which was flowering freely on 16th May 1905, when it measured 71 feet by 5 feet 3 inches. Two of these are figured on Plate 171 from photographs taken by Miss F. Woolward.

At Arley Castle there are five trees, the tallest of which measures 72 feet by 4 feet, the others being about 60 feet high with girths ranging from 3 feet 7 inches to 4 feet 7 inches. These are supposed to have been planted about 1820.

At Bicton, a tree measured, in August 1906, 65 feet by 4 feet; and another growing at the Wilderness, White Knights, near Reading, is exactly the same size. At Devonhurst, Chiswick, a tree, now cut down, measured, in 1903, 68 feet by 5 feet.

There is a tree, 58 feet by 6 feet 2 inches, in the Botanic Garden, Glasnevin; but we have heard of no others in Ireland, where hickories seem to have been very little planted. (H. J. E.)

CARYA ALBA, SHAGBARK HICKORY

- Carya alba*, Nuttall, *Gen. Am.* ii. 221 (1818); Loudon, *Arb. et Frut. Brit.* iii. 1446 (1838).
Carya ovata, Schneider, ex Sargent in *Bot. Gazette*, xlv. 226 (1907).
Juglans ovata, Miller, *Dict.* ed. 8, No. 6 (1768).
Juglans ovalis, Wangenheim, *Nordam. Holz.* 24 (1787).
Juglans compressa, Gaertner, *Fruct.* ii. 51 (1791).
Juglans alba, Michaux, *Fl. Bor. Am.* ii. 193 (1803).
Juglans obcordata, Poiret, in Lamarck, *Dict.* iv. 504 (1797).
Juglans squamosa, Michaux f., *Hist. Arb. Amer.* i. 190 (1810).
Hicoria ovata, Britton, *Bull. Torrey Bot. Club*, xv. 283 (1888); Sargent, *Silva N. Amer.* vii. 153, tt. 346, 347 (1895), and *Trees N. Amer.* 139 (1905).

A tree, attaining in America usually 70 to 90 feet, rarely 150 feet in height and 15 feet in girth. Bark grey, ultimately separating into long strips, attached by the

¹ Bunbury, *Arboretum Notes*, 100 (1889).

middle and free at one or both ends, giving the trunk a characteristic appearance. Terminal buds ovoid, obtuse, $\frac{1}{2}$ to $\frac{3}{4}$ inch long, with ten to twelve imbricated scales; outer scales persistent during winter, falling a little before the unfolding of the leaves, triangular, keeled, apiculate or contracted into long points, dark-brown, pubescent; inner scales downy, enlarging to 2 or 3 inches long, as the bud opens. Lateral buds about $\frac{1}{3}$ inch long, with four to five scales visible externally. Branchlets purplish-grey, covered with brown stellate hairs, scattered below, denser nearer the tip, and with a few yellow glands; base of the shoot girt with a dense ring of pubescence. Leaves (Plate 203, Fig. 1) 8 to 14 inches long. Leaflets, five, upper three obovate, lower pair ovate, all shortly acuminate; margin ciliate with irregular tufted hairs, densest near the points of the serrations; upper surface glabrous, except for stellate hairs on the midrib and nerves; lower surface with a fine stellate pubescence, densest on the midrib and nerves; rachis stellate-pubescent.

Staminate catkins, glandular-hirsute, pedunculate in threes at the base of the year's shoot. Fruit solitary or in pairs, sub-globose, 1 to $2\frac{1}{2}$ inches long, splitting freely to the base; husk dark reddish-brown, glabrous, $\frac{1}{8}$ to $\frac{1}{2}$ inch thick; nut four-angled and -ridged, white; seed large, lustrous, light-brown, sweet with an aromatic flavour.

The above description is drawn from trees cultivated in England, which resemble in all essential characters, except the imperfect development of the fruit, specimens obtained by Elwes at the Arnold Arboretum. The size and shape of the leaflets, which are always five in number, and the amount of pubescence on the branchlets and on the rachis and surface of the leaves are very variable. Two or three trees¹ of this species at Kew, which are about 25 feet high, have very large leaves which turn a brilliant yellow in autumn. Another tree at Kew, which was labelled *Carya alba*, differs from all other specimens which I have seen, as follows:—Branchlets and leaf-rachis almost glabrous, only showing when young a few stellate hairs. Leaflets, five, lanceolate, narrow, long-acuminate, nearly glabrous, with only a few stellate hairs, confined on the upper surface to the midrib, and scattered over the lower surface; margin non-ciliate. Buds, as in the typical form, but pointed and smaller. This tree, which is about 30 feet high, has very smooth bark, and is growing very vigorously. It is probably a glabrous form of *Carya alba*, and may possibly be *Hicoria borealis*, Ashe,² which grows in Michigan and Southern Ontario.

(A. H.)

The Shagbark, according to Sargent, is widely distributed from the St. Lawrence valley near Montreal, along the northern shores of Lakes Erie and Ontario, west to South-Eastern Nebraska, and south throughout the Middle States and along the Appalachian mountains to Western Florida, Northern Alabama, Eastern Texas, and Central Kansas.

It attains its largest size in the Southern Alleghanies and in the lower Ohio basin, the largest trees recorded, one of which is figured in *Garden and Forest*, ii.

¹ These have been labelled *C. tomentosa*, from which they differ in having five-foliolate non-fragrant leaves; and are the trees referred to in *Gard. Chron.* xxviii. 295 (1900).

² Ashe, *Notes on Hickories*, 1896; Britton and Brown, *Illust. Flora N. United States*, iii. 512, fig. 1156 b (1898). This form is not recognised by Sargent as a distinct species.

463, being in Southern Indiana, where Ridgway¹ says that trees of 130 feet high by 3 to 4 feet in diameter were not rare, and that some were certainly 150 feet, many trunks which seemed less than half the total height being 70 or 80 feet to the first limb. One of these in Wabash Co. measured 78 feet to the first limb, and was $14\frac{2}{3}$ feet in girth.

Such giants, however, hardly exist now; and during my travels in America I never saw a hickory more than about 100 feet high; whilst those in New England and Canada are usually from 60 to 80 feet in height, and seldom exceed 6 feet in girth. The bark, which separates externally into long loose flakes, serves to distinguish this species readily from the others. The nuts, which vary much in size and shape and thickness, are superior in quality to any other native nut (except that of the Pecan), and are largely eaten. Some of the better varieties, which have thin shells and larger kernels, have been selected and propagated, so that the improvement of this fruit in cultivation is likely to be as great as that of the walnut.

This species was introduced in 1629, according to Loudon, who mentions large trees growing in 1838 at Syon, Fulham Palace, and other places near London. None of these are now living, and apparently the tree does not attain a great age in England. It succeeds about as well as the Bitternut.

The largest tree that I have seen in England is hidden in a thick shrubbery at Botley Hill, Hants, the residence of Lady Jenkyns, and has an historic interest from the fact that it is almost certainly one of the trees planted by Cobbett, who lived there for some years about 1820. The old brew-house and oven, which, in his opinion, were two of the most necessary parts of an Englishman's house, still remain, as well as some rather stunted black walnuts. This hickory is about 75 feet high by 5 feet 4 inches in girth, with a bole of 30 feet.

At the Wilderness, White Knights, near Reading, a tree measures 55 feet by 5 feet 8 inches. At Castle Howard, Yorkshire, there is a healthy symmetrical tree, growing on the site of an old nursery near the timber yard, which may have been sown *in situ*. I found it in 1905 to be 50 feet high by 3 feet 3 inches in girth.

In the Pinetum, Brocklesby Park, Lincolnshire, there is a fine tree, which Mr. W. B. Havelock informs us is 79 feet high by 4 feet 10 inches in girth, with a straight stem running nearly to the top. It is growing in strong loam, sheltered by surrounding belts of trees, and is supposed to be about sixty years old. The bark is shaggy, and hangs in strips from the trunk (Plate 173).

A fine tree of this species is growing in Syston Park, near Grantham, the seat of Sir John Thorold, who told me that his father planted it and the four bitternut trees mentioned above about fifty years ago. It measured in 1905 62 feet by 4 feet 4 inches, and has the characteristic scaly bark.

At Boynton Hall, Bridlington, Yorkshire, there are three trees of this species, which Sir Charles Strickland informs us are respectively 50 feet by 7 feet, 40 feet by 4 feet, and 25 feet by 6 feet, the last being very bushy in habit, and growing in a very exposed position. These trees were raised from seed brought from America by

¹ *Proc. U.S. Nat. Mus.* 1882, p. 77.

Sir William Strickland, grandfather of the present owner; and several other hickories planted at the same time have disappeared, one being blown down.

At Golden Grove, Carmarthenshire, a seat of Earl Cawdor, a tree, which is supposed to have been planted in 1865, is 42 feet by 3 feet 1 inch. At Fonthill Abbey, Wilts, a tree, with very scaly bark, is 62 feet by 4 feet 1 inch. At Althorp there is a tree 75 feet by 3 feet 6 inches, growing in a dense thicket of laurels near the house.

A hickory which was perhaps of this species grew close to the house at Moncreiffe near Perth, and is mentioned by Hunter as being the finest in Scotland. It had a bole 20 feet long by 5 feet 9 inches, and was cut down about six years ago. The timber was used for making gates.

At Kinblethmont, Arbroath, H. Lindsay Carnegie, Esq., reports a tree 46 feet high by 2 feet 11 inches in girth. It was planted by his father about 1825.

In Ireland, the only specimens which Henry has seen are two small trees about a foot in diameter, growing in the Botanic Gardens at Glasnevin, and two at Kilmacurragh, in Wicklow, about 35 feet high. (H. J. E.)

CARYA PORCINA, PIGNUT

Carya porcina, Nuttall, *Gen. Am.* ii. 222 (1818); Loudon, *Arb. et Frut. Brit.* iii. 1449 (1838).

Carya obcordata, Sweet, *Hort. Brit.* 97 (1827).

Carya glabra,¹ Spach, *Hist. Vég.* ii. 179 (1834).

Juglans glabra, Miller, *Dict.* ed. 8, No. 5 (1768).

Juglans squamosa, Poir., in Lamarck, *Dict.* iv. 504 (1797).

Juglans obcordata, Muehlenberg u. Willdenow, *Neue Schrift. Ges. Nat. Fr. Berlin*, iii. 392 (1801).

Juglans porcina, Michaux f., *Hist. Arb. Amer.* i. 206 (1810).

Hicoria glabra, Britton, *Bull. Torrey Bot. Club*, xv. 284 (1888); Sargent, *Silva N. Amer.* vii. 165,

tt. 352-355 (1895), and *Trees N. Amer.* 144 (1905).

Hicorius glaber, Sargent, *Garden and Forest*, ii. 460 (1889).

A tree attaining in America 90 feet in height and 12 feet in girth. Bark greyish, ultimately fissuring into narrow longitudinal ridges, occasionally on old trees breaking on the surface into loose thick scales. Terminal buds, $\frac{1}{4}$ to $\frac{1}{3}$ inch long, globose or ellipsoidal, with ten to twelve imbricated scales; outer scales usually deciduous in winter, keeled, acute, or pointed, glabrous, ciliate, often glandular; inner scales pubescent, enlarging to 2 inches long as the bud unfolds. Lateral buds small, ovoid, often glandular, with two scales visible externally. Branchlets glabrous, or rarely with a minute pubescence speedily disappearing. Leaves (Plate 203, Fig. 2) 8 to 12 inches long. Leaflets, five to seven, upper three obovate, lower one or two pairs oblong lanceolate, all acuminate; margin without cilia; upper surface glabrous, with numerous minute glands; lower surface glabrous, except for slight tufts of pubescence in the axils of the midrib and lateral nerves, covered with numerous glands; rachis glabrous.

¹ This is given as *Carya glabra*, Schneider, by Sargent in *Bot. Gazette*, xlv. 226 (1907).

Staminate catkins, scurfy-pubescent, pedunculate in threes at the base of the current year's shoot. Fruit, single or in pairs, very variable in size and shape; husk thin, reddish brown, glandular, opening only at the apex or splitting to the middle or to near the base; nut obscurely four-angled; seed small, light brown, poor in flavour.

Carya microcarpa, Nuttall¹ (*Hicoria microcarpa*, Britton²), appears to be only distinguished by the nuts, which are very small, compressed and globular. It is impossible to say whether it is in cultivation, as all the hickories in England produce smaller nuts than they do in America. This form is called by Sargent,³ var. *odorata*, a misleading name, as the tree has apparently no marked odour either in the foliage or in the fruit. (A. H.)

The pignut, which grows usually on dry ridges and hillsides, has a most extensive distribution, ranging from Southern Ontario and Southern Maine in the north to Florida and Mississippi in the south, and extending westward to Nebraska, Kansas, and Texas.

This species of hickory⁴ seems to succeed fairly well in England, though we know of very few trees. The best is at Kew, where there is a fine tree near the Temperate House (Plate 172), which is, however, becoming stag-headed. It measured, in 1907, 77 feet by 6 feet. It produces fruit abundantly, but the seed, so far as we have observed, is infertile.

Another tree is growing at Leny, near Callander, Perthshire. Though in a somewhat exposed situation and at an elevation of several hundred feet, it had a stem 3 feet 4 inches in girth and might have been 50 feet high before the leading shoot was broken. (H. J. E.)

CARYA SULCATA, BIG SHELLBARK, KINGNUT

Carya sulcata, Nuttall, *Gen. Am.* ii. 221 (1818); Loudon, *Arb. et Frut. Brit.* iii. 1448 (1838).

Carya pubescens, Sweet, *Hort. Brit.* 97 (1827).

Carya cordiformis, Koch, *Dendr.* i. 597 (1869).

Carya laciniosa, Schneider, ex Sargent in *Bot. Gazette*, xlv. 226 (1907).

Juglans laciniosa, Michaux f., *Hist. Arb. Amer.* i. 199 (1810).

Juglans sulcata, Pursh, *Fl. Am. Sept.* ii. 637 (1814).

Hicoria laciniosa, Sargent, *Silva N. Amer.* vii. 157, tt. 348, 349 (1895), and *Trees N. Amer.* 141 (1905).

A tree attaining in America 120 feet in height and 9 feet in girth. Bark grey, ultimately separating in plates, which sometimes remain for many years hanging on the trunk. Terminal buds, ovoid, obtuse, $\frac{3}{4}$ to 1 inch long, composed of ten to twelve imbricated scales; outer scales not deciduous in winter, dark brown, ovate, keeled, pointed, tomentose, with scattered glands; inner scales silky pubescent,

¹ *Gen. Am.* ii. 221 (1818).

² *Bull. Torrey Bot. Club*, xv. 283 (1888).

³ *Silva*, loc. cit. This varietal name is adopted by Sargent, as the tree appears to have been first described by Marshall, in *Arb. Am.* 68 (1785) as *Juglans alba odorata*.

⁴ The date of introduction is uncertain. Loudon states that in 1838 there were plants in the Hackney Arboretum.

becoming 2 to 3 inches long at the opening of the bud. Axillary buds, $\frac{1}{2}$ inch long, with four to five scales visible externally. Branchlets light reddish brown, glabrous towards the tip, covered below with a short dense pubescence. Leaves (Plate 203, Fig. 4) not fragrant, 15 to 22 inches long. Leaflets seven to nine, upper three or five obovate-oblong, lower one or two pairs lanceolate; margin ciliate, the cilia more numerous towards the base; upper surface glabrous, shining; lower surface with scattered short stellate tomentum; nerves in upper pair of leaflets more than twenty pairs; rachis with slight pubescence near the insertion of the leaflets, elsewhere glabrous.

Staminate catkins, glabrous, pedunculate in threes at the base of the current year's shoot. Fruit, solitary or in pairs, 2 inches long; husk downy or glabrous, hard and woody, $\frac{1}{4}$ to $\frac{1}{3}$ inch thick; nut compressed, four- to six-ridged, with a hard bony shell; seed light brown, sweet. (A. H.)

This species usually grows on deep rich alluvial soil, which is inundated for several weeks in the year, and is one of the commonest trees in the great river swamps of Central Missouri and of the Ohio basin. It is rare and local east of the Alleghany Mountains, being occasionally met with in New York, Pennsylvania, and North Carolina; and extends through the central states from South-Eastern Nebraska, Iowa, Illinois, and Indiana, southward to Kansas, Indian Territory, Arkansas, and Tennessee.

It is exceedingly rare in cultivation¹ in England, the largest tree we are acquainted with being one in Tortworth Churchyard, which bore a few nuts in 1905, when it was about 30 feet high by 1 foot 8 inches in girth. There are small plants growing at Hildenley Hall, Yorkshire, and at Grayswood, Haslemere.

(H. J. E.)

CARYA TOMENTOSA, MOCKERNUT

Carya tomentosa, Nuttall, *Gen. Am.* ii. 221 (1818); Loudon, *Arb. et Frut. Brit.* iii. 1444 (1838).

Carya alba, Koch, *Dendr.* i. 596 (1869); Sargent, *Bot. Gazette*, xlv. 226 (1907).

Juglans alba, Linnæus, *Sp. Pl.* 997 (in part) (1753).

Juglans rubra, Gaertner, *Fruct.* ii. 51 (1791).

Juglans tomentosa, Poiret, in Lamarck, *Dict.* iv. 504 (1797).

Hicoria alba, Britton, *Bull. Torrey Bot. Club*, xv. 283 (1888); Sargent, *Silva N. Amer.* vii. tt. 350, 351 (1895), and *Trees N. Amer.* 143 (1905).

Hicorius albus, Sargent, *Garden and Forest*, ii. 460 (1889).

A tree attaining in America 100 feet in height and 9 feet in girth, but usually much smaller. Bark grey, slightly ridged by shallow irregular interrupted fissures, and ultimately covered by closely appressed scales. Terminal buds broadly ovoid, $\frac{1}{2}$ to $\frac{3}{4}$ inch long, of 10 to 12 imbricated scales; outer scales, usually deciduous in winter, dark brown, keeled, apiculate, pubescent, glandular; inner scales silky

¹ Loudon states that it was introduced in 1804; but he appears to have been only acquainted in 1838 with small plants growing at the Horticultural Society's Garden, Loddiges' Nursery, and White Knights. None of these now survive.

pubescent, enlarging to 1 to $1\frac{1}{2}$ inch long, as the bud unfolds. Lateral buds much smaller, with 4 scales visible externally. Branchlets densely covered with stellate hairs and shining glands, without any definite ring of pubescence at the base of the shoot. Leaves (Plate 203, Fig. 3) very fragrant, eight to twenty inches long. Leaflets seven or nine, upper three obovate, lower pairs ovate; acuminate; margin regularly ciliate; upper surface glabrous, except for stellate hairs on the midrib, and with minute shining glands; lower surface covered with scattered stellate pubescence and numerous glands; nerves in the upper pair of lateral leaflets usually less than 20 pairs; rachis with stellate pubescence and shining glands.

Staminate catkins, pubescent, pedunculate in threes at the base of the current year's shoot. Fruit, single or in pairs, globose, 1 to 2 inches long; husk hard, thick, glandular, splitting to the middle or nearly to the base; nut four-ridged near the top, thick-shelled; seed small, dark brown, lustrous, sweet. (A. H.)

This species has a distribution similar to that of the shag-bark and bitternut; but is comparatively rare in the north, though it is found in Southern Ontario. It commonly grows on poor and sandy soil, and is the only hickory in the maritime pine-belt of the Southern States. It does not usually exceed 60 feet in height, except in the rich valleys of the Southern Alleghany Mountains and in Missouri and Arkansas. Ridgway records a tree in Southern Indiana 112 feet by $10\frac{1}{2}$ feet, and says it is a common species in upland woods, being known as the black- or white-heart hickory. Its name of mockernut is derived from the thickness of the shell and the smallness of the kernel of the fruit, which makes it hardly worth eating. The fruit and leaves have a strong fragrant resinous smell, not present in the other species.

Loudon states that this species was "introduced in ? 1766"; but he does not seem to have known of any trees in cultivation in 1838. This hickory is extremely rare, the finest specimen that we know of being one at Golden Grove, Carmarthen-shire, which is 50 feet high by 4 feet in girth. It is supposed to have been planted in 1865. Near the Azalea Garden at Kew there is a fine healthy young tree, procured in 1872 from Booth's Nursery, near Hamburg, and now 46 feet high by $2\frac{1}{2}$ feet in girth, remarkable for its fine large foliage, the fragrance of which is especially strong and can be perceived at a distance in the early morning. There are small trees growing at Tortworth and Hildenley. (H. J. E.)

CULTIVATION OF THE HICKORIES

Though so long introduced into cultivation, and at one time much more commonly planted than at present, no species of hickory has as yet established a reputation which justifies the hope that it may become a tree of real economic importance in this country. As ornamental trees the hickories are not equal either in size or in beauty to others which can be more easily grown, and though at least three of the species may be planted with good hopes of success, as an interesting addition to parks and pleasure grounds, yet their cultural peculiarities must be carefully studied before doing so.

Hickories though easily raised from imported nuts, require special treatment on account of their long thick tap-roots, which make them so difficult to transplant; and as they grow slowly for several years and do not ripen their wood when young, in most places, their ultimate success must always be to some extent a matter of chance. Though they are found in America, in places where the soil is not specially deep or good, they require a hotter summer than we get to enable them to ripen fruit, and when a tree will not ripen seed, it can hardly be called acclimatised.

I have made many experiments in raising them from seed, which at present have not given very good results, principally, I think, because of unfavourable local conditions; but believe that if the following points, which are based on those adopted in the Arnold Arboretum,¹ are attended to, the trouble will not be thrown away.

The nuts must be procured from America as soon as ripe; and if there is any influence in heredity, as I believe there is, from the Northern, rather than from the Southern or Western States; but it is only fair to say that the seed which I collected myself in Canada and near Boston, did not produce such strong seedlings the first season as those which I procured from Philadelphia.

The nuts should be sown at once in boxes of about 18 to 24 inches deep in rich sandy loam, about 2 inches apart, and covered with an inch or so of light soil. The boxes may be stored for the winter in a shed, and in spring brought into a frame or greenhouse to induce earlier germination. They should be kept under glass until all risk of spring frost has gone by, and perhaps are better kept in a frame the whole summer lightly shaded, and watered when necessary. The leaves will remain on throughout the autumn, when the box should be exposed to the full sun; and as soon as the shoot, which does not exceed 4 to 8 inches in height the first year, is ripe, may again be put away for the winter in a dry place covered with leaves, and protected from mice.

In the following May the seedlings may either be turned out and planted in a deep rich nursery bed, after cutting off the tap-root at about a foot, or if a warm sheltered spot can be found in a wood, where they can be cultivated and sheltered for some years, they may be planted out permanently without cutting the tap-root. But as the danger from vermin and early or late frosts will continue for some years, it may be better to keep them in the nursery till they are 3 to 5 feet high, provided that when transplanted a deep trench is first made on one side, so as to get up the whole of the root with as little injury as possible. Woods being their natural home they are more likely to grow into good trees when drawn up with others than when exposed in the open; but we cannot point to an instance in Great Britain where they have been so treated, though some of the best trees we know are in dense shrubberies.

As regards soil, it cannot be too deep, rich, or well drained, and a southern or western aspect is to be preferred. Under such conditions they may attain 50 to 60 feet in height in as many years, and in some parts of England even more. A certain amount of lime in the soil does not seem to be harmful.

The hickories are not either in America or in England very long-lived trees,

¹ Cf. *Garden and Forest*, x. 116 (1897).

and none of great age are recorded here. When cut down, or when killed to the ground by frost in their young state, they push shoots freely from the stool, though they do not produce suckers.

Dawson in *Garden and Forest*, ix. 77 (1896), gives an account of his method of grafting the cultivated varieties of hickory, and says that the best stock is the bitternut, which grows twice as fast at Boston as the common shagbark. He performs the operation under glass in the month of January, by side-grafting close to the collar of the stock, and plunging the pots into sphagnum moss up to the top bud of the graft.

TIMBER OF THE HICKORIES

The best account of the wood is given by Michaux and Emerson. The timber of the different species is so similar in appearance, that I doubt if any one could identify without the names, the six species illustrated by Hough; and as this author rarely mentions the age or origin of the trees from which his specimens were taken, or shows much personal knowledge of their peculiarities, his work is not of so much practical value as it might have been.

Michaux specially commends the timber of the shellbark and the pignut. Emerson does not say which is best, but says that the most valuable is that which has been grown most rapidly, and places the pignut and shellbark first for weight.

As fuel hickory is, or rather was in days when it was abundant, preferred to all other woods. But its greatest value is for carriage building, axe and tool handles, and especially for cask hoops, of which in Michaux's time large quantities were exported, as well as used at home. Now, however, it is superseded to a great extent for this purpose by iron.

An article on hickory by Mr. J. F. Brown in *Arboriculture*, vi. No. 4, states that the great demand for hoops in the apple-growing districts of Virginia, is rapidly exhausting the local supply of young trees, which is now being filled from Southern Indiana, and that in consequence the supply of second-growth timber fit for wheels and carriage work is likely to become diminished, and in well-settled regions is already exhausted. He states that when the trees are cut and put on the market, no discrimination is made between the different species, though second-growth hickory is always preferred to the timber of old trees, because it is more elastic, tougher, and stronger. He quotes a report of a meeting of over 200 representatives of the carriage-building industry at Chicago, at which it was stated that the hickory trees have recently been attacked by insects to such an extent, that unless some means can be taken to check their ravages, there will be no more hickory available in ten years; and though ash, maple, and other woods have been tried as a substitute, there is no other wood so suitable for this industry as hickory. It is imported to some extent to Europe, usually in the form of second-growth poles, which are produced from the stool and are used by carriage builders.

Cobbett,¹ with his usual enthusiasm for everything from America, urged that the hickory should be planted for coppice wood on account of the value of the hoops

¹ *Woodlands*, arts. 295, 296 (1825).

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which are made from it, and stated that he had a young tree at Kensington which was seven feet high when only five years old from the seed. Mayr also thinks that the hickory might have some economic value in the warmer parts of Germany, as it has stood the hardest frosts at Munich without injury. But so far as we know, none of the trials which have been made in France, where the tree was introduced on a large scale by Michaux 100 years ago, have been successful, and I could not hear that any of the trees which he planted near Paris are now alive. (H. J. E.)

PLATANUS

Platanus, Linnæus, *Gen. Pl.* 358 (1737); Bentham et Hooker, *Gen. Pl.* iii. 396 (1880); Jankó, in Engler, *Bot. Jahrb.* xi. 412 (1890); Usteri, *Mém. Herb. Boissier*, No. 20, p. 53 (1900); Schneider, *Laubholzkunde*, 435 (1905).

TREES belonging to the order Platanaceæ, which consists of the single genus *Platanus*. Bark, at the base of old trunks, dark-coloured and scaly; above on the stem and on the branches smooth, thin, light-grey or greenish, separating in large thin scales, which on falling expose large irregular surfaces of pale-yellow or whitish inner bark. Branchlets rounded, zigzag; the apex withering and falling off in summer (no true terminal bud being formed), leaving an elevated orbicular scar close to the uppermost axillary bud, which prolongs the shoot in the following year. Buds in summer concealed in the funnel-like base of the leaf-stalk, after the fall of the leaf surrounded at the base by an incomplete narrow ring-like scar, sinuous in margin and divided into five parts, each marked by a group of bundle dots; a line extending round the twig from the sides of the leaf-scar indicating where the connate stipule fell off. Buds all axillary, uniform in size, conic, covered by a scale in the form of a cap, which contains immediately within two similar scales, and more internally, several scales open at the apex and each with a young leaf at its base. Flower-buds similar, but larger. The three outer cap-like scales split longitudinally as the bud expands, the second and third continuing to grow after the bud is unfolded, ultimately falling and marking the base of the branchlet with ring-like scars.

Leaves deciduous, alternate, simple, stalked, palmately three- to seven-lobed; lobes entire or dentate with minute or coarsely sinuate teeth; venation pseudo-palmate, two strong lateral nerves diverging from the midrib a little above its base, and each often giving off on the outer side a basal nerve, thus forming with the midrib three to five main nerves, each of which ends in the apex of a lobe. Stipules two, lateral, united below into a tube embracing the branchlet above the insertion of the leaf, dilated above and more or less free, thin and scarious on flowering shoots, broad and leafy on vigorous barren branchlets, caducous or occasionally persistent.

Flowers monœcious, fertilised by the wind, appearing with the leaves, the females developing first, minute, densely aggregated in unisexual heads, which are solitary or several in spikes or racemes; the staminate heads on axillary peduncles, the pistillate heads on long terminal peduncles. Staminate flowers; sepals, three to six, scale-like, half as long as the scarious, cuneiform, acute, three to six petals; stamens, three to six, with very short filaments and clavate two-celled anthers,

crowned by a pilose capitate connective. Pistillate flowers; sepals, four (three to six), rounded, short; petals, four (three to six), long, acute; staminodes pilose at the apex; ovaries as numerous as the sepals, superior, sessile, surrounded at the base by long hairs, gradually narrowing above into long simple styles; ovules one, rarely two. Head of fruit composed of numerous elongated obpyramidate achenes, surmounted by the persistent style, surrounded at the base by long rigid hairs. Seed solitary, oblong, suspended, containing a thin fleshy albumen and an axile erect embryo. The fruiting heads remain hanging on the tree during winter, the component achenes being ultimately dispersed by the wind.

The dispersal of the pollen in the flowers of plane trees is effected by a peculiar mechanism, which bears some resemblance to that of the yew, and is well described by Kerner.¹

The planes are readily distinguished by the simple alternate palmately-lobed leaves, the base of the stalks enclosing and concealing the buds. In winter, the conical buds, all lateral, with stipule-lines around the twig and the peculiar narrow sinuous leaf-scars are diagnostic.

The genus is a very ancient one, fossil species² having been found in North America in Cretaceous, Eocene, and Oligocene strata. In the Miocene and Tertiary epochs numerous species were spread throughout all Europe, Northern Asia, and North America as far north as the Arctic Circle. In the glacial period those became extinct in the northern parts of their area, and the existing species are confined to Canada, the United States, and Mexico in the New World, and to the Eastern Mediterranean region in the Old World. Their entire absence from Eastern Asia is remarkable, as tertiary plants of circumpolar distribution, which have survived to the present time, are usually found existing both in Eastern North America and in China and Japan.

Six species³ are now living, which may be conveniently arranged as follows:—

I. Adult leaves glabrous or nearly so, conspicuously toothed in margin.

1. *Platanus orientalis*, Linnæus. Albania, Macedonia, Thrace, Greece, Crete, Cyprus, Rhodes, and Asia Minor.

Leaves distinctly lobed, the sinuses extending at least one-third the length of the leaf. Fruiting heads bristly, several on the peduncle. Achenes, with long hairs arising not only at the base, but along the body of the achene; apex pyramidal or conic, acute, passing gradually into the long style.

2. *Platanus occidentalis*, Linnæus. Eastern North America from Ontario to Texas.

Leaves indistinctly lobed, the sinuses not extending one-third the length of the leaf. Fruiting heads smooth, solitary, and terminal on the peduncle. Achenes with basal ring of long hairs, elsewhere glabrous; apex truncate or rounded, with a depression, from which arises a very short style.

¹ *Nat. Hist. Plants*, Eng. Transl. ii. 146 (1898).

² Cf. L. F. Ward, in *Proc. U.S. Nat. Museum*, 1888, p. 39, who states that a prominent characteristic of these archaic forms is the presence of basal lobes on the leaves. These basal lobes are occasionally met with on the young shoots of the species now living.

³ *Platanus glabrata*, Fernald, *Proc. Am. Acad.* xxxvi. 493 (1901), is an imperfectly known species from Coahuila in Mexico.

II. Adult leaves densely tomentose beneath, margin entire or minutely and remotely toothed.

* *Lobes elongated.*

3. *Platanus racemosa*, Nuttall, *Sylva*, i. 47 (1842). A tree, attaining 120 feet in height and 18 feet in girth, common on the banks of streams in California. Introduced on the Continent, unknown in cultivation in Britain.

Leaves three- to five-lobed to below the middle; lobes acuminate, tomentose on both surfaces; occasionally with remote minute teeth; base slightly cordate or truncate. Fruiting heads bristly, two to seven on the peduncle. Achenes with ring of basal hairs, elsewhere glabrous; apex pyramidal or rounded, without a central depression; style long.

4. *Platanus Wrightii*, Watson, *Proc. Am. Acad.* x. 349 (1875). A tree, attaining 80 feet in height and 15 feet in girth, common in mountain cañons up to 6000 feet altitude in Southern New Mexico and Southern Arizona in the United States; and in Sonora in Mexico. Not introduced.

Leaves three- to five-lobed to below the middle or near the centre; lobes acuminate, usually quite entire, tomentose on both surfaces, deeply cordate at the base. Fruiting heads smooth, two to four, racemose on the peduncle. Achenes with ring of basal hairs, elsewhere glabrous; apex rounded, with a central depression, from which arises a short style.

** *Lobes short and broadly triangular.*

5. *Platanus mexicana*, Moricand, *Bull. Ferr. Bot.* 79 (1830). A large tree in Mexico, in Nuevo Leon and the provinces to the south of it; frequently planted in the cities of North-Eastern Mexico; the handsomest of all the plane trees.¹ Not introduced.

Leaves three- to five-lobed, densely white tomentose beneath, base truncate or cuneate. Fruiting heads bristly, solitary. Achenes with ring of basal hairs; upper part of the body pubescent; apex pyramidal, continued directly into the long style.

6. *Platanus Lindeniana*, Martens et Galeotti, *Bull. Acad. Brux.* x. 2, p. 343 (1843). Tree, 100 to 150 feet in height. South Mexico, near Jalapa, at 4000 feet altitude. Not introduced.

Leaves with usually three very short lobes, ending in long bristle-like points, densely rusty tomentose beneath; base truncate. Fruiting heads bristly, several on the peduncle. Achenes as in *P. orientalis*.

¹ *Garden and Forest*, ix. 51 (1896).

PLATANUS ORIENTALIS, ORIENTAL PLANE

- Platanus orientalis*, Linnæus, *Sp. Pl.* 999 (1753); Loudon, *Arb. et Frut. Brit.* iv. 2033 (1838); Boissier, *Flora Orientalis*, iv. 1161 (1879); Gamble, *Manual Indian Timbers*, 661 (1902); Schneider, *Laubholzkunde*, 436 (1905).
Platanus palmata, Moench, *Meth.* 358 (1794).
Platanus cuneata, Willdenow, *Sp. Pl.* iv. 473 (1805).
Platanus acerifolia, Willdenow, *Sp. Pl.* iv. 474 (1805).
Platanus laciniata, Du Mont de Courset, *Bot. Cult.* vi. 436 (1811).
Platanus vulgaris, Spach, *Ann. Sci. Nat.* xv. 291 (excl. ϵ *angulosa*) (1841).
Platanus hispanica, Tenore, *Cat. Ort. Nap.* 1845, p. 91.
Platanus digitata, Gordon, *Garden*, 1872, p. 572.

A tree, with several forms distinct in foliage and habit, most of which appear to have arisen in cultivation. Bark scaling off in thin plates; furrowed and thick at the base of old trunks, variable in the different varieties.¹

Young branchlets at first densely stellate-pubescent, becoming green and glabrous in summer; brown in the second year. Leaves at first covered with dense loose white stellate pubescence on both surfaces, later nearly glabrous, the pubescence being only retained here and there, mainly on the veins and midrib of the lower surface, which is paler than the dark-green shining upper surface. Petioles at first densely stellate, white pubescent, ultimately glabrescent.

Fruiting heads several (two to seven) on the peduncle, bristly. Achenes with basal ring of rigid long hairs, similar hairs arising also along the body of the achene, the apex of which is more or less acute and ends in a long persistent style.

Seedling:² caulicle slender, about $\frac{1}{2}$ inch long, surmounted by two narrow spatulate cotyledons, obtuse at the apex, tapering to a very narrow base, sessile, one-nerved, entire, glabrous, dark-green, about $\frac{1}{3}$ inch long. First leaf resembling a petiole in shape, minute and glandular-pubescent. Second leaf spatulate-cuneate, with three teeth at the apex, alternately penninerved, two of the stronger nerves running into the teeth. Third leaf like the second, but larger. Succeeding leaves palmately five-lobed.

In summer, the oriental plane and its varieties are readily recognisable by the leaves, bark, and habit. In winter, the twigs are rounded, striate, glabrous, with numerous inconspicuous lenticels, the apex ending in a short stump, bearing an orbicular scar, marking where the tip of the branchlet fell off in summer. Leaf-scars, on prominent pulvini, almost but not completely surrounding the bud as a narrow ring, sinuous in margin, and with five groups of bundle-dots. Stipular line surrounding the twig at the level of each leaf-scar. Base of the shoot ringed with scars,

¹ Boissier states that the bark of the wild tree is rugose, and does not exfoliate, as is usually the case in cultivated trees, especially in var. *acerifolia*, of the origin of which he knew nothing. As there is considerable variation in the size of the scales of the bark on plane trees, it is probable that the difference noted by Boissier is individual and not varietal or specific. Var. *acerifolia* grows usually very fast, and scales off in much larger plates as a rule than is the case in the other varieties, which are slower in growth.

² Cf. Lubbock, *Seedlings*, ii. 505, f. 653 (1892).

marking the fall of the previous season's bud-scales. Buds distichous and alternate on the long shoots, arising at an angle of 45°, uniform in size, conical, smooth, lustrous, covered by a glabrous cap-like scale.

VARIETIES

1. Var. *typica*.—The form in cultivation, known generally as *P. orientalis*, slightly different in foliage from the wild form, known as var. *insularis*.

A tree, attaining enormous dimensions in South-Eastern Europe and Western Asia, with a short trunk, dividing into many wide-spreading branches. Leaves (Plate 204, Fig. 4) large, generally exceeding 6 inches broad by 5 inches long, usually five-lobed; lobes extending about half-way to the base of the blade, oblong-triangular with an acuminate apex, entire¹ in margin or with a few sinuate entire teeth; sinuses deep, variable in shape. Each of the two basal lobes often gives off a short lobe below, making the leaf seven-lobed. Base of the leaf truncate or widely cordate, but usually extending along the midrib $\frac{1}{8}$ to $\frac{1}{4}$ inch below where the two main lateral nerves are given off. Upper surface dark-green, glabrous, shining; lower surface paler, glabrous except along the nerves and midrib, and in their axils.

2. Var. *insularis*, DC. *Prod.* xvi. 2, p. 159 (1864). The wild form, occurring in Albania, Greece, Cyprus, Crete, Rhodes, and Asia Minor.

A tree, not reported to be very large in size, and said to have rough bark, with small scales, which fall off less readily than in the typical form. Leaves smaller than in the type, scarcely exceeding 5 inches broad and 4 $\frac{1}{2}$ inches long, very variable in shape, usually five-lobed; lobes oblong-triangular or triangular, coarsely three- to four-toothed, extending about halfway to the base of the blade, which is always cuneate, the lamina descending along the midrib $\frac{1}{8}$ to $\frac{1}{4}$ inch below the insertion of the first pair of main nerves; sinuses deep, variable in form.

Mouillefert² distinguishes two varieties of the wild form, one with narrowly lanceolate entire lobes and wide sinuses, the other with lanceolate sinuately-toothed lobes and very deep narrow sinuses. The range of variation in the shape of the leaf in the wild form is considerable.

3. Var. *cuneata*,³ Loudon, *Arb. et Frut. Brit.* iv. 2034 (1838).

Platanus cuneata, Willdenow, *Sp. Pl.* iv. 473 (1805).

A tree, moderate in size, with bark resembling that of var. *acerifolia*. Leaves (Plate 204, Fig. 3) usually about 5 inches wide by 4 $\frac{1}{2}$ inches long, occasionally 8 inches by 7 inches; three- to five-lobed, the lobes as in var. *typica*; base of the leaf broadly cuneate, the lamina extending along the petiole $\frac{1}{2}$ to $\frac{3}{4}$ inch below the insertion of the main lateral nerves; petioles short. This variety only differs from var. *typica* in the markedly cuneate base, and approaches in character var. *insularis*. As seen in cultivation it usually forms imperfect small fruiting heads.

¹ The form with entire lobes is sometimes distinguished as var. *liquidambarifolia*, Spach, *loc. cit.*

² *Essences Forestières*, 221 (1903).

³ Probably var. *undulata*, Aiton, *Hort. Kew*, iii. 364 (1789).

According to Koch,¹ this is a good species, growing as a shrub on the south-eastern slope of the Caucasus, and having a very short stem from which spring many upright branches. Koch, however, did not find it in flower or fruit; and as no plane has been observed growing wild in the Caucasus, it is probable that what he saw were stunted trees of ordinary *Pl. orientalis*, occurring as escapes from cultivation.

At Grayswood, Haslemere, there are two plants, 4 feet high, with a fastigiate habit, which Mr. Chambers raised eight years ago, from seed sent from Kashmir.

4. Var. *digitata*, Jankó, in Engler, *Bot. Jahrb.* xi. 412 (1890).

Platanus digitata, Gordon, *Garden*, 1872, p. 572.

This is a form of var. *typica*, in which the leaves are smaller than usual, with wider and deeper sinuses, the lobes extending three-fourths the depth of the blade and having large triangular toothed lobules.

Gordon supposed this form to be a native of the Caucasus, and says that it was introduced by Messrs. Loddiges in 1842. He describes the fruiting heads as only half the size of those of the type; but in the number and structure of the component achenes there is no difference.

5. Var. *acerifolia*, Aiton, *Hort. Kew*, iii. 304 (1799).

Platanus acerifolia, Willdenow, *Sp. Pl.* iv. 474 (1805). London Plane. Maple-leaved Plane.

A tree, with a tall upright stem, giving off shorter branches than the typical form. Leaves (Plate 204, Fig. 1) large, at least 8 inches wide by 7 inches long, with five short, broad, triangular lobes, separated by wide rounded or acute shallow sinuses, which only extend one-third the length of the blade; base truncate or widely cordate, the lamina often descending on the midrib a short distance below the insertion of the two main lateral nerves. Fruiting heads very variable in size and in number on the peduncle, often badly developed in English trees; achenes similar in structure to those of the typical form, and never resembling those of *P. occidentalis*.

Several forms of the London plane have been distinguished:—

Var. *pyramidalis*. Pyramidal in habit.

Var. *kelseyana*. Leaves variegated with yellow.

Var. *Suttneri*. Leaves creamy-white, more or less splashed or streaked with green, often very large, as much as 12 inches wide by 10 inches long. This is identical with var. *argenteo-variegata*, which was exhibited at the Royal Horticultural Society in July 1897, by Messrs. Russell of Richmond. It is one of the handsomest of variegated trees, the variegation usually lasting the whole season.²

A form with large leaves has been sent out under the misleading name of var. *californica*.

Though var. *acerifolia* exhibits a wide range of variation in the cutting of the leaf, it always shows very distinct lobes, and cannot be confused with *P. occidentalis*, in which the lobes are indistinctly marked.

¹ *Dendrologie*, II. Part i. p. 470 (1872).

² Cf. *Gard. Chron.* xxiv. 190 (1898).

DISTRIBUTION

The oriental plane has been in cultivation from very early times in the Mediterranean region; and the limits of its distribution in the wild state are difficult to determine accurately.

It occurs wild in woods and along torrents in the mountainous regions of Albania and Greece. It grows in chestnut groves and in mountain forests from sea-level to 2500 feet elevation in Macedonia, Thrace, and Bithynia. It is undoubtedly indigenous in the mountains of Crete, Cyprus, and Rhodes; and in Western and Southern Asia Minor up to 5000 feet, not ascending into the zone of the cedars, and also occurs in the Lebanon. M. Gadeceau, in *Rev. Hort.* 1907, p. 207, quotes a letter from a correspondent in Syria to the effect that the plane, known to the Arabs as *Dolbe*, does not grow in the forests, but only in valleys and along the banks of rivers; on Mt. Hermon it reaches 4000 to 5000 feet elevation.

Its occurrence in the wild state elsewhere is very doubtful, as all the specimens which I have seen from other localities were collected near villages. The great plane trees described by travellers as occurring in Persia, Afghanistan, Kashmir, etc., are evidently planted.

Radde,¹ who paid particular attention to the subject, denies its occurrence in the wild state in the Caucasus. Dr. Stapf only saw it cultivated in Persia, where it always grows near villages. In Afghanistan, according to Aitchison,² it is certainly not indigenous; but he found it naturalised in one district, where it had been originally planted in a valley and was gradually taking possession of the adjoining hill. According to Brandis,³ it is cultivated in the North-West Himalaya, particularly in the Kashmir valley, east of the Bias and Sulej, ascending to 8300 feet in Western Ladak. It grows well at Peshawar; and attains 75 feet in height in Kashmir and Chamba, the largest girth noted by Dr. Stewart at Srinagar being 28 feet. The Nasim Bagh, on the border of the great Kashmir lake, is a large grove planted by Akbar the Great, soon after he had taken Kashmir in 1588. Originally this grove contained 1200 trees, a large proportion of which are still standing. In 1838 Vigne found the average girth to be 13 feet, some of the trees growing near water being as large as 20 feet.

Tchihatcheff states that in Cyprus and Zante it is evergreen; but this statement is not confirmed by other travellers, although occasionally an evergreen variety occurs, as in the case of a tree at Lutraki in Crete, which was mentioned by Admiral Spratt.⁴ Mr. Sandwith wrote to Kew in 1884 that this tree had been cut down several years before, but that several vigorous shoots were springing from

¹ *Pflanzenverb. Kaukasuslând.* 170, 187, 189 (1899).

² *Journ. Linn. Soc. (Bot.)* xviii. 94 (1881).

³ *Forest Flora N.W. India*, 434 (1874).

⁴ *Travels and Researches in Crete*, ii. 40. Pliny mentioned the existence of an extraordinary evergreen plane tree which grew on the banks of the Lethæus. Tournefort searched for it without success; but its existence was made known to Captain Spratt by Mr. Agnew, an English merchant who owned property at Lutraki, where he showed him two young and branching plane trees growing by a rivulet, which retained their leaves all the winter. Mr. Agnew said that these were suckers from the roots of a very large tree of the same kind, which he had cut down, without knowing its rarity; and Spratt adds that he heard of two others growing near the village of Vourvalet on the banks of the Platanos river in the west of Crete. Spratt speaks, *op. cit.* p. 191, of a grove of large and beautiful plane trees, mixed with elm and oak, and covered with wild vines which climb to their very top.—(H. J. E.)

the stool, and cuttings from these had been grafted by a Cretan farmer on the ordinary plane tree and were preserving the evergreen habit. (A. H.)

The stellate tomentum, which covers the young leaves of the plane, is gradually cast off; and floating in the air, has been found in some parts of Europe to produce serious bronchial irritation. This was known to the ancient Greeks,¹ being mentioned by Galen and Dioscorides. In Alsace-Lorraine, the planting of plane trees is forbidden in the vicinity of schools; and workmen in nurseries on the Continent, where young trees are raised, are often affected.² We have, however, not heard of any complaint of this happening in England.

The young leaves and shoots of var. *acerifolia* are frequently affected by a disease,³ caused by the fungus known as *Gleosporium nervisequium*, Saccardo, which in early summer attacks the nerves first and soon causes them to wither. Small black spots appear on the dead parts, which are the conidia of the fungus. In England, it is remarkable that the true oriental plane appears to be practically immune from the attacks of this fungus, though its leaves are sometimes blotched between the veins. Mr. Massee informs us that after a thorough examination of dried and living material, he has failed to find the slightest evidence in support of the statement that *Gleosporium nervisequium* is parasitic on typical *P. orientalis*. The London plane is almost invariably affected, though less in London than in the country, where almost everywhere some of the leaves and young shoots become brown and wither; but the healthy growth of the tree is scarcely ever seriously interfered with. Some gardeners believe that this withering is due to cold winds and late frosts; but, though leaves may be injured by climatic conditions, this fungus is undoubtedly the principal cause. A plane tree, var. *cuneata*, in the Cambridge Botanic Garden, which had the habit of var. *acerifolia*, had the leaves badly attacked in June 1907. A tree, 30 feet high, of the same variety, at Grayswood, had the young wood seriously injured by a fungus, which Mr. Massee identifies with *Gleosporium*.

The fungus is apparently more severe in its attacks on the Continent; and at Ghent in 1891, all the plane trees lost their leaves.⁴ In the United States, the occidental plane⁵ is very liable to be attacked by this fungus, and as a street tree in New England is unsuccessful on that account, though *P. acerifolia* succeeds as well as it does in England.

Klebahn⁶ states that *Gleosporium nervisequium* occurs more especially on *P. occidentalis*, less frequently on *P. orientalis*. He believes that *G. nervisequium* is only a conidial form of a higher fungus, called *Gnomonia Veneta*, Klebahn.

(H. J. E.)

¹ Cf. *Gard. Chron.* iii. 370 (1888).

² Carrière, *Rev. Hort.* 1890, pp. 370, 435.

³ Cf. Massee, *Plant Diseases*, 284, f. 76 (1903).

⁴ Cf. *Gard. Chron.* x. 491 (1891).

⁵ Cf. *Garden and Forest*, 1891, p. 591, 1896, p. 51, and 1897, p. 257. In an article on Leaf-blight of the Plane Tree, by Murrill in *Journ. N. York Bot. Garden*, viii. 157 (1907), an account is given of an epidemic of the disease occurring this year in New York, believed to have been caused by the late and damp spring. Murrill observed the oriental plane to be attacked in Italy in 1906; and states that *P. racemosa* is also subject to the disease.

⁶ *Jahrb. Wissensch. Bot.* xli. 515 (1905).

HISTORY OF THE CULTIVATED PLANES

The oriental plane was introduced into Italy from Greece about 390 B.C.; and Hehn¹ gives a full account of the classical allusions to the tree.² It came into England³ some time before 1562. In Turner's *Herball*, published in that year, a figure is given, and the author states: "I have sene the leves of that Platanus that groweth in Italy and two very yong trees in England which were called there Playn trees, whose leves in all poyntes were lyke unto the leves of the Italian Playn tree. And it is doubtles that these two trees were either brought out of Italy or of som farr countrie beyond Italy where unto the freres monkes and chanones went a pilgrimage."

The American plane, *P. occidentalis*, was introduced into England by Tradescant,⁴ in whose garden two small plants were growing in 1636, when Johnson published his edition of Gerard's *Herball*. It was undoubtedly in cultivation in the eighteenth century, as a specimen from a tree cultivated at Kew in 1781 exists in the British Museum; but another specimen from the Chelsea Physic Garden, dated 1789 and labelled *P. occidentalis*, is undoubtedly *P. acerifolia*. The figure given in Evelyn's *Sylva* of *P. occidentalis* really represents *P. acerifolia*. Similarly Loudon's description and figure of the American plane are inaccurate, and in part refer to *P. acerifolia*. The confusion between these two forms is thus shown to have begun early, and has lasted until quite recently; and it is probable that most of the references to the occidental plane in this country and on the continent of Europe refer to *P. acerifolia*.

Platanus acerifolia was first distinguished by Tournefort⁵ in 1703. Miller,⁶ in 1731, gives an account of three kinds of plane: *P. orientalis vera*, *P. occidentalis*, and *P. aceris folio*; but he was unaware of the real distinctions between the two latter, attributing to *P. occidentalis* the property of being easily propagated by cuttings, whereas it is *P. acerifolia* of which this is true. He asserts that his *P. aceris folio* is only a seminal variety of *P. orientalis*.

Bolle⁷ states that Bourgeau found considerable forests of *P. acerifolia* in Lycia. This statement has not been confirmed, and there is no evidence of the occurrence anywhere of this form in the wild state. The difference between it and the wild form of *P. orientalis* (var. *insularis*) is mainly in habit, and taking into account the variability of the leaves on the wild tree, no two of which are alike in the specimens which I have examined, there is little doubt that *P. acerifolia* is a seedling variety of *P. orientalis*, which has been fixed in cultivation. Intermediate forms between it and the ordinary typical variety are not unusual. Bolle states that seedlings of *acerifolia* often exhibit the characters of typical *orientalis*. Further experiments on this point are desirable, as well as a thorough investigation of the range of variation

¹ *Kulturpflanzen*, ed. 6, p. 283.

² The Romans planted it in their gardens for shade: Ovid calls it *genialis*, and Horace *celebs* because it did not support the vine.

³ It was probably introduced into France in Provence about the same time. Cf. *Le Jardin*, 1896, pp. 116, 162.

⁴ Cf. Parkinson, *Theat. Bot.* 1427 (1640).

⁵ *Coroll.* 41 (1703).

⁶ *Gard. Dict.* ed. 1 (1731).

⁷ *Gard. Chron.* i. 564 (1876).

of the tree in the wild state in Greece and Asia Minor. At what time *acerifolia* came into cultivation is unknown; but the evidence points to its having become common in the eighteenth century. All the very old trees in the Levant of which we have specimens, are, however, of the typical form.

Considering the difficulty of distinguishing between *acerifolia* and *occidentalis*, in the absence of fruit, a character to which no attention was paid until 1856, when Sir W. J. Hooker¹ cleared up the confusion until then existing between them, it is probable that in the eighteenth century, as at the present time, the commonest plane in cultivation was *P. acerifolia*, and that *P. occidentalis* was very rare. The latter could never have been common, as it is quite unsuitable for our climate. It dies at Kew after a few years, and we know of no specimen, older than nursery plants, in England.

This we believe to be the true solution of the difficulty, namely, that *acerifolia* was always the common tree in cultivation in England, that it was perpetually confused with *occidentalis*, and often passed under that name, and that the American plane never reached adult size in this country.

The origin and date of the first cultivation of *acerifolia* must remain in doubt; but I see no grounds for assenting to Schneider's view that it is a possible hybrid between *occidentalis* and *orientalis*. It does not resemble the former in any way in the characters of the fruit; and the similarity in the shape of its leaves to those of the American plane is more apparent than real. (A. H.)

CULTIVATION

As the true oriental plane is now hardly to be procured in nurseries, where the maple-leaved or London plane has alone been propagated for many years, it is necessary either to sow seeds or make layers from the branch of an old tree. The seeds ripened in this country often (I think I may say usually) fail to germinate, probably on account of the insufficient heat of our autumn, yet I have raised a few seedlings from a tree at Fulham, which, however, soon died when planted out. As the fruiting heads hang on the tree till spring, it seems best not to sow them till then, and I have been successful in raising seedlings from seed gathered at Venice as late as May.

The seeds should be rubbed out with sand, covered very lightly with fine soil, and kept shaded in a greenhouse until they germinate, as they grow very slowly the first year. It is better not to transplant them to the open ground until they are two or three years old, as the young wood does not ripen well; and for these reasons it has been found by nurserymen much better to raise them by layering, or from cuttings, which Boutcher says should be about a foot long and torn asunder at the joints, with a knob of the old wood left on, and buried about eight inches deep. I have struck cuttings from the true oriental plane by this method.

The trees are easy to transplant even when of considerable size, and require a deep rich soil to make them grow well. Though often planted by the side of water

¹ *Gard. Chron.* 1856, p. 282.

they do not like cold wet soil or heavy clay; and a seedling which I brought in a bottle from the Temple of Diana at Ephesus in 1874, and planted out at Colesborne, has never been able to make good growth on account of the spring frosts, which cut it back in most seasons; and after thirty-three years' growth is only a stunted bushy tree 20 feet high.

The true oriental plane is always liable to be cut by frost at any age, and the branches and twigs assume a zigzag habit in consequence; but no tree succeeds better in the smoky air of towns than the maple-leaved or London plane, which is by far the largest tree in all the London squares, parks, and gardens, and seems likely to live to a very great age.

As regards hardiness, the plane seems, when of sufficient size, to endure the severest winter frosts, but requires a higher summer temperature than the north and west of England usually affords. In the south-east it is almost everywhere one of the finest exotic trees we have, but should not be planted on poor, stony land or in places exposed to cold winds.

The oriental plane is one of the very few trees that will grow on strongly alkaline soil, and has been successfully planted on the alkaline lands of the San Joaquin valley in California.¹

REMARKABLE TREES

Var. *typica*.

Perhaps the finest specimen in England of the oriental plane is one which was planted by Bishop Gunning in the palace gardens at Ely, of which he was bishop from 1674 to 1684. This tree seemed to be failing some years ago, probably owing to a succession of dry seasons, and on the advice of Sir W. Thiselton Dyer was liberally top-dressed with good soil; the result was so good that when I saw it in 1903 it was in good health, and measured 104 feet high by 20½ in girth. In 1896 it was found by the shadow to be about 100 feet high and 23 feet in girth at 3 feet from the ground. It forks at about 10 feet, where an immense limb comes off, and the branches almost touch the ground all round. It grows on a low hill 50 to 60 feet above the level of the fens, but is sheltered on the north and east by buildings. On 15th October 1903 (a very wet season), the leaves were still quite green, but there was no fruit. Plate 174 is selected from several photographs taken at different times, as giving the best representation of this noble tree.

In the garden of the Lady Margaret Professor of Divinity at Christ Church, Oxford, there is a very old plane, said to have been introduced by Dr. E. Pococke, who was Professor of Arabic in 1636. It is of no great height and throws out an immense limb close to the ground, where it measures 18 feet 10 inches in girth. When I saw it in September 1907, fruit of the last year was still hanging on it, together with full-grown fruit of the current year, and in some cases six or seven balls were borne on one peduncle.

At Hawsted Old Place, near Bury St. Edmunds, there are three very large

¹ Hilyard, *Soils*, 480 (1906).

oriental planes in a grass field near the farm, where an old manor-house formerly stood, and these, according to the Rev. L. Mercer, vicar of Hawsted, are said to have existed in Queen Elizabeth's time, and to be the oldest in England.¹ They are difficult to measure accurately on account of their broad round tops and the trunks being covered with shoots, but the two largest are 75 to 80 feet high and 17 to 18 feet in girth, and the third is not much smaller. When I saw them on 24th June 1905, they were still covered with last year's fruit, three to five on a peduncle, and new half-grown fruit was also growing on them. Their branches spread over a very wide area.

At Corsham Court, Wilts, the seat of General Lord Methuen, there is an oriental plane with very deeply-cut leaves whose branches spread over a larger area than those of any tree I have seen in England (Plate 175). It is 75 to 80 feet high and 18½ feet in girth. One of the branches, which is self-layered in several places, extends no less than 27 paces from the main bole, and the total circumference of the branches is 140 paces. Three of the principal stems grown from the layered branches are 6 feet 3 inches, 4 feet 10 inches, and 4 feet respectively in girth. Lord Methuen believes that this tree was planted soon after his ancestor built the house in 1757, and a cedar recently cut down, probably of the same age, showed about 133 rings and thus tends to confirm his opinion.

Another very large tree of great age is growing close to the banks of the Test, at Mottisfont Abbey, Hants, which has layered its branches in the damp alluvial soil. When I saw it some years ago it was in good health, and in 1898 measured 29 feet 8 inches at 4½ feet where it forks, the branches having a diameter of 129 feet.² At Bisterne Park near Ringwood, in the same county, there is a very fine old tree measuring, in 1906, 100 feet by 18 feet.

At Weston Hall, Staffordshire, the seat of the Earl of Bradford, there is a very fine plane which I have not seen myself, but which was measured³ in 1875 as 80 feet by 18½ feet with a bole 11 feet high, and twelve large limbs from 4 to 7 feet in girth.

At Blickling Hall, Norfolk, there are two very old trees growing close together, the largest of which was, in 1907, 11 feet in girth and almost 60 feet high, with remarkably spreading branches, covering a space of 140 feet in the largest diameter, and 127 paces in circumference. The lowermost branches lying upon the ground had taken root, and growing erect for a time had again bent down and taken root a second time.

At Chiswick House, London, there is another example of a large oriental plane with very spreading pendulous branches, many of which are lying upon the ground and one has taken root. This tree was, in 1903, 13½ feet in girth, 74 feet in height, and the diameter of the spread was 100 feet.

At Greycourt, Ham, in Surrey, the residence of Colonel Biddulph, there is a tree which measured, in 1906, 16 feet 11 inches in girth and 72 feet in height, and had a short bole of 7 feet dividing into three great limbs, the diameter of the spread of branches being 94 feet.

¹ Cf. *Woods and Forests*, 1884, p. 153.

² Cf. *Gard. Chron.* xxiii. 24, figs. 9, 10 (1898).

³ Geo. Berry, in *Garden*, xx. 370 (1881).

The well-known tree in Kew Gardens, near the Palace, is about 80 feet high, and measures 14 feet 8 inches in girth.

In Scotland, the oriental plane is rare; and seems to be much injured by late spring frosts. The Rev. D. Landsborough¹ speaks of one planted in 1864 in Kay Park, Kilmarnock, which was killed by the frost of 15th April 1903; others, however, in a sheltered position had not suffered. A large oriental plane at Kelso, which was a favourite tree of Sir Walter Scott's, was destroyed by the great frost of 1814. This was probably the tree referred to by Walker² in 1812, who states that the oriental plane grows at Mount Stewart, Bute, like a willow, and nowhere else so good in Scotland except at Kelso.

In Ireland the oriental plane is rather a rare tree. The finest specimen we know of is at Carton, the seat of the Duke of Leinster, which was, in 1904, 82 feet in height by 11 feet 9 inches in girth. Mr. W. E. Gumbleton has sent us specimens from a very fine tree growing in his grounds at Belgrove, near Queenstown in County Cork. Another good tree is reported to be growing at Curragh Chase, in Co. Limerick. There are smaller trees at Clonmannin, in Co. Wicklow.

The oriental plane attains an enormous size and great longevity in the eastern parts of Europe, Asia Minor, and Persia.

One of the most remarkable was a tree growing in the village of Vostiza, on the Gulf of Lepanto, in Greece, which measured,³ in 1842, 37 feet 4 inches in girth at 5 feet from the ground, and was estimated to be 130 to 140 feet in height. This tree is supposed to be the one referred to by Pausanias, who wrote in the second century A.D.; yet in 1842 the trunk appeared to be perfectly sound, though many of the larger branches have succumbed to age and storm. Sir F. Elliot, British Minister at Athens, was good enough to make enquiry about this tree from Mr. Wood, British Consul at Patras, who informed him that when he last saw the tree, only a few feet of hollow stump remained. There are two remarkable oriental planes at Cannosa, near Ragusa in Dalmatia, which measure at breast height 32 feet 1 inch and 30 feet in girth. They are about 120 feet high.⁴

The famous plane at Bujukdere on the Bosphorus is not a single trunk, but is formed of nine stems fused together. According to Ch. Martins,⁵ in September 1856, the height was 200 feet—evidently an exaggeration—with a spread of branches 373 feet in circumference. One trunk girthed 18 feet; two trunks united together for some distance girthed 36 feet, the remaining six trunks being in an ellipse of 76 feet. One of the stems was hollow and afforded stable room for two horses. This tree is typical *orientalis*.⁶ This tree is also sometimes called the "Seven Brothers" or the plane tree of Godfrey de Bouillon, as tradition states that he and his crusaders encamped in its vicinity in 1096.⁷ Sir N. O'Connor informed me in 1903 that it has suffered much within the last few years owing to some excavations made close to its roots, and is evidently declining rapidly. A sketch of it made for the late Mr. C. Ellis, is now in Lady Emlyn's possession.

¹ *Kilmarnock Glenfield Ramblers' Soc. Annals*, 1901-1904, p. 33.

² *Hebrides*, ii. 199 (1812).

³ D. H. in *Woods and Forests*, i. 174 (1884).

⁴ Beck v. Mannagetta, *Veget. Verhält. Illyrisch. Länd.* 185 (1901).

⁵ *Du Spitzberg au Sahara*, 474 (1866).

⁶ Bentham and Viscount Downe, in *Gard. Chron.* 1856, p. 118.

⁷ Mouillefert, *Essences Forestières*, 215 (1903); and *Garden and Forest*, ii. 349 (1889).

The tree of the Janissaries, the ancient plane, which stands in the Court of the Janissaries in the Old Seraglio at Constantinople, was 39 feet in girth at 3 feet from the ground in 1890; but the trunk was hollow, the branches and foliage, however, being sound and vigorous.¹

In the *British Medical Journal* of 21st June 1902, there is an excellent account, with illustrations, of a plane tree in the island of Cos, which from its appearance must be one of the oldest trees in the Mediterranean, if not so old as its somewhat mythical history alleges. Local tradition says that under this tree Hippocrates, the celebrated Greek physician, taught the art of healing no less than 2300 years ago. The tree grows near the landing-stage, between an ancient castle and a mosque, close to a drinking-fountain. Mr. von Holbach, who measured it, gives the girth of its hollow trunk as 18 metres; but all the upper part has decayed away, and the lower part of the tree now consists of immense branches which are supported on antique marble columns, over the tops of which their great weight has caused them to grow. Dr. Clapton, of 41 Eltham Road, Lee, procured a section of one of the branches of this tree, and has presented a photograph of it to the Hunterian Museum.

Bonvalot,² on his way from Samarcand to Amu, states that he halted at Sarijui, near the residence of the chief, under a plane tree, which was about 37 feet in diameter at 6 feet above the ground. In his book, a picture of the tree is given, and a great limb comes off low down, which evidently was included in the above measurement. The tree appears to be about 50 feet in girth at the base below where the limb comes off. Another enormous tree,³ 49 feet in girth, stands in the grounds of the mosque of Tajrish, a village in the Elburz Mountains, north of Teheran, in Persia.

Var. *acerifolia*.

The variety *acerifolia* seems to have generally replaced the cut-leaved form at some period above a hundred years ago, but we cannot find any certain evidence of this, because it was generally confused with the western plane.

All the planes that we have seen in the squares, parks, and gardens about London of less age than about 100 years are *acerifolia*, and the finest specimen that I know of is the one in the Ranelagh Gardens, which measured, in 1903, 105 feet high, with a girth of 20 feet 4 inches.

The planes in Berkeley Square are worth notice on account of their uniform burry trunks swelling at the base. They all appear to have been propagated from the same stool and to have retained this peculiarity throughout. They were planted by Mr. Edward Bouverie in 1789 and are probably the oldest plane trees in London.⁴ According to Mr. R. Birkbeck the two largest, in 1906, girthed at 5 feet, 13 feet 10 inches and 13 feet 4 inches, and were about 85 feet high. Tradition says that this area was a burial-ground during the Plague of London in 1665.

On the banks of the river Rother at Woolbeding Rectory, Sussex, in the garden

¹ *Garden and Forest*, iv. 85, fig. 19 (1891), where a full account and good picture of this remarkable tree are given.

² *Through the Heart of Asia*, i. 207, fig. on p. 209. Sarijui is a village 96 miles S.S.E. of Samarcand.

³ Figured in *Woods and Forests*, i. 375 (1884).

⁴ Hare, *Walks in London*, ii. 74 (1894).

of Archdeacon Elwes, are two of the largest planes in England, one of them, which is partly hollow at the base, but has been filled up with brickwork, being about 105 feet high by no less than 25 feet in girth. The other, a better-shaped and very vigorous tree, is 100 feet by 10 feet, with a bole 12 feet long. In Colonel Lascelles' grounds close by, there is another splendid plane, 110 feet high by 11 feet in girth, with a bole 30 feet long. At Cowdray, in the same neighbourhood, there are some fine old planes at the bottom of the park, two which I measured being about 80 feet high and over 15 feet in girth.

There is a very fine tree at Rickmansworth which, when measured by Henry in 1904, was 105 feet by 16 feet 3 inches. Another at the same place was 103 feet by 15 feet. Sir Hugh Beevor tells us of a fine tree at Shotesham, Norfolk, the seat of R. Fellowes, Esq., which, in 1904, was 100 feet by 17 feet 8 inches.

I measured a very tall and handsome tree, which appears to be growing fast, at Albury, in 1905, when it was at least 105 feet high by 11 feet 3 inches (Plate 178).

A tree which appears from its leaves to be more or less intermediate between the oriental and London planes is growing at Boconnoc in Cornwall, and is decaying, the climate being probably too damp for it, as I have seen no very large plane trees in the far west. In 1905 it was about 85 feet by 11 feet 2 inches.

At Hampton Court, Herefordshire, there is a fine tree on the lawn, which was measured in 1881 by Hogg, when it was 80 feet by only 8 feet 6 inches, and when I saw it in 1905 had increased to 95 feet by 14 feet 6 inches. I cannot help suspecting a mistake in the earlier measurement of girth, as an increase of 6 feet in twenty-four years seems extraordinary.

At Eastwell Park, Kent, there is a tree in a shrubbery drawn up by surrounding trees to a height of 105 feet, though the trunk is only 8 feet 6 inches in girth.

At Fawley Court, Oxfordshire, there is a row of four large trees about 100 feet high, and from 16 to 18 feet in girth, which are probably of no great age. In this damp alluvial soil they seem likely to become as large as any in England.

At Ashleigh College, on the east side of Mortlake, close to the Thames, a group of five trees form a conspicuous feature in the landscape. One of these is 110 feet in height and 10 feet in girth.

At Pains Hill, Cobham, Surrey, there are six or seven very large trees, one of which measured, in 1904, 100 feet high by 15 feet in girth.

At Chipleigh, near Minehead, a very fine plane, said to be an occidental plane, but undoubtedly a London plane, which was planted in 1760, is recorded by Mr. E. C. Batten¹ as being, in 1888, 105 feet high by 15½ in girth, with a spread of 120 feet.

At Heron Court, Ringwood, the seat of the Earl of Malmesbury, there is a London plane, which measures 90 feet by 11 feet 5 inches, and has a stone at the base with the date 1707 cut on it. A woodpecker's hole in the trunk, which is clean for about 35 feet, shows that this tree has begun to decay.

At Ribston Park,² Yorkshire, there is a tree which appears to be as old as any that I have seen. Tradition says that it was brought over by the Knights Templars,

¹ *Trans. Eng. Arb. Soc.* ii. p. 221.

² *Gard. Chron.* xxx. 34 (1901).

who had a preceptory here. It measured, in 1906, 72 feet high by 13 feet 9 inches in girth, but has the habit of *typica* rather than of *acerifolia*.

In Wales the finest plane that I have seen is a tall tree growing near the icehouse at Dynevor Castle. In 1906 it measured about 100 feet by 10½ feet with a clean trunk about 40 feet long.

In Scotland we have seen no plane remarkable for size, but there is one growing in the grounds at Benmore, Argyllshire, which has a curious resemblance in its foliage to the occidental plane.

In Ireland, the largest London plane, seen by Henry, is growing at Lismore Castle, and measures 12 feet 10 inches in girth, with an estimated height of about 90 feet. Mr. R. D. O'Brien informs us that a tree at Cooper Hill, near Limerick, is 10 feet 5 inches in girth, with a spread of 74 feet in diameter.

TIMBER

The wood of the plane is so little known in the timber trade of this country that it is not even mentioned by "Acorn," except as a name in use for sycamore, which is commonly called plane in Scotland; and in a recent letter in the *Timber Trade Journal*, what is known as lace-wood in the trade is spoken of as wood of the sycamore, imported from America, though it is really that of *Platanus occidentalis*. The ignorance which prevails among English timber merchants and builders about many of our useful woods is remarkable, and has led to many lawsuits, but there is no doubt that the wood of the oriental plane is one of much greater value than is supposed, both for ornamental work and for coach-building.

Mr. George Berry of Longleat¹ says that the timber of the plane tree is used almost exclusively by coach-builders and pianoforte-makers. No wood takes the paint and stands so well for the sides of large waggonettes as this. In the case of pianos, it was used exclusively for bridges, the toughness and hardness enabling the pins to be most securely held. He considers that plane timber exported from America is of very inferior value as compared with that of English growth.

Dr. Day sent me from the Lebanon a large board which shows a very beautiful and varied figure produced by the medullary rays, and I have seen in Prof. Sargent's house at Brookline, near Boston, very handsome panelling made of the wood of the western species. This wood is converted into veneer or three-ply, and sold as lace-wood, for covering the walls of rooms, and would make very pretty furniture if properly cut and seasoned. Gamble says that the wood is not valued in Kashmir, except to make boxes, trays, pencases, and similar articles, which are lacquered or painted. I have seen very ornamental boxes made from this wood in Russia.

(H. J. E.)

¹ *Garden*, xxii. 83 (1882).

PLATANUS OCCIDENTALIS, WESTERN PLANE, BUTTONWOOD

Platanus occidentalis, Linnæus, *Sp. Pl.* 999 (1753); Loudon, *Arb. et. Frut. Brit.* iv. 2043 (1838) (in part); Sargent, *Silva N. America*, vii. 102, tt. 326, 327 (1895), and *Trees N. Amer.* 344 (1905).

Platanus lobata, Moench, *Meth.* 358 (1794).

Platanus hybridus, Brotero, *Fl. Lusit.* ii. 487 (1804).

Platanus vulgaris, *ε. angulosa*, Spach, *Ann. Sci. Nat.* xv. 291 (1841).

A tree, attaining in America a height of 170 feet and a girth of 35 feet. Bark furrowed near the base of large trunks into broad rounded scaly ridges, higher on the tree separating in large thin scales, exposing irregular surfaces of pale-yellow or whitish inner bark. Branchlets and buds indistinguishable from those of *P. orientalis*.

Leaves (Plate 204, Fig. 2) large, about 8 inches broad by 7 inches long, broadly ovate, obsolete three- to five-lobed, the lobes much less marked than in *P. acerifolia*, not reaching to one-third the length of the blade, separated by very broad and very shallow sinuses, entire or with long acuminate teeth; base widely cordate or truncate, with often a slight cuneate part decurrent on the petiole.

Fruiting heads solitary¹ at the end of a glabrous stalk (3 to 6 inches in length), about an inch in diameter, not bristly, but smooth, the persistent styles being minute or obsolete. Achene truncate or rounded at the apex, which has a central depression bearing the short remains of the style, glabrous on the body, surrounded by a ring of long stiff hairs arising from the base only.

This species differs from all forms of *P. orientalis* in the solitary fruiting head, composed of glabrous achenes, with only a basal ring of long hairs. The foliage is nearest to *P. acerifolia*, but differs in the obsolete ill-defined lobes. (A. H.)

DISTRIBUTION

According to Sargent the western plane grows on the borders of streams and lakes in rich alluvial soil, and is widely distributed throughout the eastern half of the United States, crossing into Canada, where it is confined to the northern shores of Lake Ontario. In the United States it extends from South-Eastern New Hampshire and Northern Vermont southward to Northern Florida, Central Alabama, Mississippi, and Texas, as far as the valley of the Devil's River; and westward to Eastern Nebraska and Kansas. It attains its largest size in the bottom-lands of streams in the basins of the lower Ohio and Mississippi rivers.

The buttonwood, or sycamore, as it is often called in the United States, is the most massive, if not the tallest, deciduous tree of North America. The younger Michaux² states that his father measured, on an island in the Muskingum valley, a "palm-tree or *Platanus occidentalis*," 40 feet 4 inches in girth at 5 feet. The same

¹ Sargent in a letter to Kew, dated 1884, states that he had received from three different collectors specimens showing two heads on the peduncle; but this is rare and abnormal.

² *Travels in the Alleghanies*, 86 (1805).

tree had been measured twenty years earlier by Washington, when it was nearly the same size. Michaux measured one, 36 miles from Marietta on the road from Wheeling, on the Ohio, 47 feet in girth at 4 feet, which kept the same size for 15 to 20 feet, and then forked into several branches. This tree was hollow.

Ridgway records¹ a tree in Gibson County, Indiana, 160 feet high, 30 feet in girth at the smallest part of the trunk, with a spread of 134 feet by 112 feet; another in Wabash County 168 feet high, 25 feet in girth, and 68 feet to the first branch; another 83½ feet to the first branch, but only 9 feet in girth. He found the prostrate trunk of a tree near Mount Carmel, in Illinois, which was much larger than any of those above mentioned. The decayed base measured 60 feet in circumference; and at 20 feet from the ground, where the tree divided into three large limbs, it was still about 62 feet round. Each of the three limbs was about 70 feet long by 5 feet in diameter, so that the total cubic contents by quarter-girth measurement must have been over 8000 feet. None of these were quite so tall, but much larger in girth than, the largest Tulip tree on record, and I know of no broad-leaved tree in the northern hemisphere which equals these dimensions. The largest which I actually saw myself, shown me by Dr. Schneck near Mount Carmel, measured 150 feet by 25 feet, and was standing in a cornfield. In New England it does not attain anything approaching these dimensions, the largest mentioned by Emerson, near Lancaster, Mass., being 18 feet in girth at 6 feet, and holding its size for 20 feet, and with a broad head of great height.

CULTIVATION

This tree is unsuited to our climate, and though seedlings are frequently raised at Kew, they never live more than a few years, and suffer severely from frosts. One tree raised from Michigan seed attained a height of about 12 feet, but became badly attacked by disease, and was removed about a year ago. So far as we know, there is not a single tree of this species of any size now growing in Britain.

Thomas Rivers, in an interesting article,² states that in 1820 there were in his nursery stools of *P. occidentalis*, which had been planted by his grandfather in 1780. These stools gave shoots with enormous, almost circular slightly-lobed leaves; but the young shoots always died down. From 1830 to 1840 he imported seeds of the American tree, which gave plants like these stools, but never lived for any length of time. He quotes Sir W. J. Hooker's statement: "We often raise young plants of *P. occidentalis* from American seed; but the annual shoots are killed every winter."³ Rivers believed that the American plane had never existed in England so as to form large specimens, and that those mentioned as being large trees by Miller in 1759 and by Loudon in 1838 were not the true *occidentalis*.

The tree is equally rare on the Continent. M. Gadeceau, who wrote two papers⁴ on the differences between the occidental and oriental planes, knew of

¹ *Proc. U.S. Nat. Museum*, 1882, p. 288.

² *Gard. Chron.* 1856, p. 86, and 1860, p. 47.

³ But this is not always the case, as I planted out two seedlings of *P. occidentalis*, raised at Kew in the autumn of 1906, and they have remained healthy throughout the cold wet summer of 1907.

⁴ *Bull. Soc. Sc. Nat. Nantes*, iv. 105 (1894), and *Rev. Hort.*, 1907, p. 205.

the existence of only one true American plane in France, which is growing in the Jardin des Plantes at Angers; but I saw in the rich collection of M. Allard at La Maulevrie near Angers, a tree about 30 feet high which, though it bore no fruit, seemed quite healthy. M. L. Henry¹ says that another tree exists in the Botanic Garden at Nantes. There are three trees of this species, about 50 feet high, growing in the garden of Messrs. Simon Louis at Plantières-lès-Metz.² Schneider knows of no trees in Germany or Austria.

(H. J. E.)

¹ *Le Jardin*, 1903, p. 212.

² Schelle, *in litt.*

A C E R

Acer, Linnæus, *Sp. Pl.* 1054 (1753); Bentham et Hooker, *Gen. Pl.* i. 409 (1862); Pax, in Engler, *Pflanzenreich*, iv. 163, *Aceraceæ*, 6 (1902); Schneider, *Laubholzkunde*, ii. 192 (1907).
Negundo, Ludwig, *Gen. Pl.* 308 (1760); Bentham et Hooker, *loc. cit.*

TREES or shrubs, belonging to the natural order Aceraceæ, which is often considered to be a division of Sapindaceæ. Leaves usually deciduous, rarely evergreen, opposite, without stipules—simple, in which case they are undivided or palmately lobed—or compound with three to five leaflets. Buds covered by several scales arranged in decussate pairs, or protected by two valvate scales, sessile or occasionally stalked. Twigs with epidermis persisting for more than one year and remaining green in the second year; or becoming corky on the surface and changing colour in the first season. Inflorescence terminal on two- to four-leaved branchlets, or arising out of lateral buds without leaves, in racemes, corymbs, or fascicles. Flowers appearing at the same time as the leaves or earlier; regular, diœcious, or with male and perfect flowers on the same tree, or with male flowers on one tree and perfect flowers on another tree. Parts of the flowers in fours or fives or multiples of those numbers. Calyx with four, five, to twelve sepals, usually free, occasionally connate. Petals equal in number to the sepals, absent in some species. Disc secreting honey usually present, absent in a few species, annular, lobed, or reduced to small teeth. Stamens four to ten, usually eight, inserted either outside the disc, inside it, or upon it. Ovary, two-lobed, two-celled, each cell containing two ovules. Styles or stigmas two, free or connate at the base. Fruit of two samaræ, attached by their bases, with long and diverging wings. Seeds one or two in each samara, without albumen; cotyledons appearing above the ground on germination.

About 110 species of maple are known, occurring usually in mountainous regions; in Europe, south of lat. 62°, in Algeria, Asia Minor, the Caucasus, Persia, Turkestan, the Himalayas, China, Manchuria, Japan, Formosa, the Philippines, Java, Sumatra, Celebes, and in North America from Southern Canada and Oregon to Mexico and Guatemala. A large number have been introduced into cultivation, fifty-seven species being enumerated in the Kew Hand-List; but many of these are shrubs or small trees, the detailed treatment of which does not come within the scope of our work.

The genus is divided by natural characters into thirteen sections by Pax, whose monograph and that of Schneider should be consulted by cultivators of the

rarer species. The following synopsis, in which the species are arranged artificially according to the shape of the leaves, will help to distinguish most of the species in cultivation.

SYNOPSIS OF THE MAPLES IN CULTIVATION

I. Leaves simple, not lobed.

* *Leaves entire in margin.*

1. *Acer oblongum*, Wallich. Himalayas, China.

Leaves coriaceous, 3 to 6 inches long, narrowly elliptical, long acuminate, glabrous and glaucous beneath; nerves, eight to twelve pairs, not reaching the margin; stalks 2 to 3 inches long.

A tree, about 50 feet high. The Himalayan form was introduced in 1824, and has been long in cultivation in the temperate house at Kew; it is doubtfully hardy. The Chinese form, introduced by Wilson in 1901, is growing rapidly out-of-doors at Coombe Wood; but is slightly tender. The young leaves of the latter are bright-red in spring, and are slightly toothed with distinct serrations.

** *Leaves serrate.*

2. *Acer carpiniifolium*, Siebold et Zuccarini. Japan.

Leaves about 4 inches long, plicate, and resembling those of the Japanese hornbeam (*Carpinus japonica*), long acuminate, pubescent beneath, sharply bi-serrate; nerves, twenty pairs, extending to the margin; stalks $\frac{1}{4}$ to $\frac{1}{2}$ inch long.

A tree, attaining 50 feet in height. Introduced by Maries in 1881. Trees at Coombe Wood are about 15 feet high, and are remarkably distinct in foliage from the other species of maple.

3. *Acer distylum*,¹ Siebold et Zuccarini. Japan.

Leaves 5 inches long, 4 inches broad, ovate, long acuminate, finely serrate, pubescent on both surfaces when young, later glabrescent; nerves, eight to ten pairs, looping and not reaching the margin; petioles pubescent, about $1\frac{1}{2}$ inch long.

A tree, the height of which is not stated, introduced by Maries in 1881. At Coombe Wood, a specimen is about 25 feet high, and produces fruit, borne in erect racemes.

4. *Acer tataricum*, Linnæus. South-Eastern Europe, Southern Russia, Asia Minor, Caucasus.

Leaves (Plate 207, Fig. 33) 3 inches long, 2 to $2\frac{1}{2}$ inches wide, ovate, rounded or slightly cordate at the base, rounded or shortly acuminate at the apex, unequally bi-serrate, green and scattered pubescent beneath. The leaves, usually without lobes, show occasionally slight and irregular lobes.

Introduced in 1759. A shrub or small tree,² coming early into leaf.

¹ Figured in *Gard. Chron.* xv. 499, f. 93 (1881).

² At Arley Castle a good specimen is 29 feet high and 1 foot 9 inches in girth.

5. *Acer Fargesii*, Rehder.¹ Central China.

Leaves 3 to 4 inches long, $\frac{3}{4}$ to 1 inch broad, coriaceous, lanceolate, cuneate or rounded at the base, caudate or long acuminate at the apex, serrate on young plants, entire on old trees; nerves indistinct, about ten pairs, looping and not reaching the margin; green and glabrous on both sides, except for minute axil-tufts beneath, developed occasionally on leaves of old trees.

A small tree, introduced by Wilson in 1901; spring foliage and fruit bright crimson. Young plants at Coombe Wood are rather tender, and have only attained $1\frac{1}{2}$ foot high in six years.

6. *Acer Davidi*, Franchet.² Central China.

Leaves 3 to 4 inches long, $1\frac{1}{2}$ inch broad, ovate, cordate at the base, long acuminate, slightly lobulate and crenately bi-serrate; nerves prominent, about twelve pairs, looping before reaching the margin; upper surface dark-green, shining, glabrous; lower surface pale, glabrous, except for reddish-brown axil-tufts.³

A tree, 50 feet in height, introduced by Maries in 1879. Young plants raised from seed sent by Wilson in 1902 are 10 to 12 feet high and perfectly hardy at Coombe Wood. Bark green, striped with white.

6A. *Acer cratagifolium*. See No. 10.

Leaves of this species, without lobes, are distinguishable from *A. Davidi* by the absence of the conspicuous axil-tufts on the lower surface.

II. Leaves simple, three-lobed.

* *Leaves entire in margin.*

7. *Acer monspessulanum*, Linnæus. Southern Europe, North Africa, Asia Minor, Caucasus.

Leaves (Plate 207, Fig. 31) $1\frac{1}{4}$ inch long, $2\frac{1}{4}$ inches broad, coriaceous, greyish beneath; lobes ovate, obtuse. Petiole without latex. (See description, p. 665.)

** *Leaves minutely crenulate.*

8. *Acer creticum*, Linnæus. Greece, Crete, Lycia.

Leaves (Plate 207, Fig. 32) $\frac{3}{4}$ to $1\frac{1}{2}$ inch long, coriaceous, variously three-lobed, or with the lobes obsolete on some of the leaves, short-stalked, cuneate, or rounded at the base; margin non-ciliate; bright-green and glabrous beneath; petiole without latex. Fruit small, glabrous; wings parallel and not diverging.

A small tree, scarcely exceeding 30 feet in height, introduced in 1752. Old trees exist at Syon (mentioned by Loudon), Barton, and White Knights.

*** *Leaves irregularly toothed.*

9. *Acer trinerve*, Dippel. A juvenile form of the Chinese *Acer trifidum*, Hooker et Arnott, cultivated in Japan.

Leaves $2\frac{1}{2}$ inches long, 2 inches broad, variable in lobing; lobes acuminate;

¹ In Sargent, *Trees and Shrubs*, i. 180 (1905). Cf. *Acer levigatum*, Wallich, var. *Fargesii*, Rehder, in J. H. Veitch, *Journ. Roy. Hort. Soc.* xxix. 353, fig. 91 (1904).

² Cf. J. H. Veitch, *op. cit.* 348, figs. 86, 90.

³ These axil-tufts are partly covered by a small membrane at the junction of the lateral nerve and midrib.

three-nerved at the rounded base; under surface glaucous, glabrous, without axil-tufts. Petiole without latex. Young branchlets slightly pubescent.

A young tree is growing vigorously at Kew.

10. *Acer cratagifolium*, Siebold et Zuccarini. Japan.

Leaves 3 inches long, coriaceous, ovate, cordate at the base, acuminate at the apex, usually with two short lateral lobes, occasionally undivided, dark-green and shining above, pale and glabrous beneath. Petiole without latex. Bark striate.

A small tree, attaining about 20 feet in height, pyramidal in habit. Introduced by Maries in 1881. Var. *Veitchii* is variegated with irregular blotches of pink and white.

11. *Acer ginnala*, Maximowicz. Amurland, Southern Mongolia, China, Japan.

Leaves 3 inches long, $2\frac{1}{2}$ inches wide; terminal lobe elongated; under surface bright-green, scattered pubescent or glabrescent, without axil-tufts. Petiole without latex.

A small tree, with leaves assuming in autumn a brilliant red tint. Var. *Semenovii*, from Turkestan, has smaller leaves, occasionally five-lobed.

**** *Leaves regularly bi-serrate.*

12. *Acer pennsylvanicum*, Linnæus. North America.

Leaves (Plate 206, Fig. 13) 7 inches long, 6 inches wide; lobes arising from the upper part of the leaf, triangular, acuminate; under surface with scattered minute pubescence; petiole without latex. Young branchlets not glaucous.

Introduced in 1759, and remarkable for its striated bark, green branchlets, and fruit in drooping long racemes. It rarely attains a height of 40 feet.

13. *Acer rufinerve*, Siebold et Zuccarini. Japan.

Leaves $3\frac{1}{2}$ inches long, 3 inches wide, resembling in shape those of *A. pennsylvanicum*, but smaller, and with reddish pubescence along the sides of the primary nerves, forming axil-tufts. Racemes erect and reddish-tomentose. Young branchlets glaucous.

This is the representative in Japan of *A. pennsylvanicum*, which it resembles in bark, habit, and size. The type was introduced by Maries in 1881, and there are thriving small specimens at Kew. A variety, with the leaves white on the margin, was exhibited by Standish in 1869 at the Horticultural Society, and was figured in the *Botanical Magazine*, t. 5793.

14. *Acer capillipes*, Maximowicz. Japan.

This species strongly resembles the last, but differs in the glabrous leaves, and non-glaucous young branchlets; racemes glabrous, pedicels long.

A small tree or shrub, introduced by Sargent in 1892, and represented at Kew by a thriving young specimen. The autumn tint is purplish-brown, suffused with yellow along the nerves.

15. *Acer spicatum*, Lamarck. North America.

Leaves about $3\frac{1}{2}$ inches long and wide, broadly ovate, acuminate, ciliate in margin, glabrous above, pubescent beneath. Petioles and young branchlets pubescent.

A bushy tree, occasionally 30 feet high. According to Loudon,¹ introduced in 1750, and common in his day in ornamental plantations, one tree at Croome, Worcestershire, being reported as 40 feet high. This tree, which was probably incorrectly named, no longer exists. This maple² is extremely rare at the present day, and small specimens at Kew have a miserable appearance.

III. Leaves five-lobed, the basal lobes very small, obscure or obsolete in some of the leaves.

* *Leaves quite glabrous beneath.*

16. *Acer coriaceum*, Tausch. Hybrid between *A. Pseudoplatanus* and *A. monspessulanum*.

Leaves $2\frac{1}{2}$ inches long, 3 inches wide, coriaceous, pale beneath, often deeply cordate, slightly crenulate in margin; lobes broadly ovate, acute or obtuse.

A small tree, rarely seen except in botanical gardens.

17. *Acer glabrum*, Torrey. Western North America.

Leaves 3 inches long and wide, membranous, dark-green and shining above, pale beneath, bi-serrate; lobes acuminate; sinuses very acute at their base; petiole without latex.

A small tree, young specimens of which are thriving at Kew. In the wild state the leaves are extraordinarily variable, being often tri-partite or trifoliolate. It is readily distinguished by its perfectly glabrous thin leaves.

** *Leaves glabrous, except for slight pubescence on the nerves at the base.*

18. *Acer rotundilobum*, von Schwerin.³ Hybrid between *A. Opalus*, var. *obtusatum*, and *A. monspessulanum*.

Leaves $3\frac{1}{2}$ inches long and broad, pale beneath, slightly crenate in margin; lobes short, broadly ovate, cuspidate; sinuses rounded at their base; petiole without latex.

This species, which has leaves thinner in texture and much more glabrous than *Acer Opalus*, is represented at Kew by a fast-growing young specimen, obtained from Simon Louis of Metz.

19. *Acer hybridum*, Spach. Hybrid between *A. Pseudoplatanus* and *A. Opalus*.

Leaves $3\frac{1}{2}$ inches long, 4 inches broad, pale beneath, irregularly and slightly serrate; lobes broadly ovate, shortly acuminate; sinuses acute at their base; petiole with latex.

There are small trees in the collection at Kew.

*** *Leaves pubescent beneath.*

20. *Acer Opalus*, Miller, var. *obtusatum*. Southern Europe, Caucasus, North Africa.

Leaves (Plate 206, Fig. 16) $3\frac{1}{2}$ inches long, 4 inches wide; under surface pale with the pubescence densest on the nerves; lobes broadly ovate or

¹ *Arb. et Frut. Brit.* i. 407 (1838).

² Seedlings which I raised in 1905, from seed collected by me near Ottawa in 1904, have grown vigorously at Colesborne, and are now 3 to 4 feet high.—(H. J. E.)

³ In *Mitt. Deut. Dend. Gesell.* 1894, p. 76, von Schwerin considers the parents to be *A. Opalus*, var. *obtusatum*, and *A. Pseudoplatanus*.

rounded, short, obtuse or acute; margin with small irregular teeth; petiole without latex. In var. *neapolitanum*, the leaves (Plate 206, Fig. 15) are more obscurely lobed, with very dense long pubescence beneath. (See description, p. 663.)

21. *Acer grandidentatum*, Nuttall. Montana southwards to New Mexico.

Leaves (Plate 205, Fig. 4) 3 inches long, 4 inches broad, with three large oblong lobes, separated by sinuses extending half-way to the base of the blade; margin with a few large obtuse lobules, otherwise entire; under surface covered with pale dense pubescence; basal lobes represented by the lowest pair of the marginal lobules.

A small tree, rarely forty feet in height, representing the sugar maple in the West. There is a small specimen thriving in the Kew Collection.

22. *Acer rubrum*, Linnæus. North America.

Leaves (Plate 207, Fig. 27) averaging 3 inches long and broad, variable in shape; under surface silvery white with scattered pubescence; lobes usually triangular, acute or acuminate, sharply toothed or bi-serrate in margin; sinuses acute at the base, variable in depth; base of the leaf truncate or rounded, rarely cordate. (See description, p. 671.)

23. *Acer tetramerum*,¹ Pax. Central China.

Leaves 3 inches long, 2 inches broad, ovate, cordate at the base, indistinctly five-lobed; basal lobes obscure or obsolete; lateral lobes short, triangular, acute and sharply serrate; terminal lobe with two or three pairs of serrated teeth, and prolonged into a long narrow acuminate apex; margin ciliate; upper surface dark-green, scattered pubescent; lower surface pale, covered with white pubescence, densest in the axils; petiole without latex.

A small tree, introduced by Wilson in 1901. Young plants at Coombe Wood are perfectly hardy and free in growth, having already attained 16 feet in height.

IV. Leaves five-lobed; basal lobes well-developed; white or pale beneath; petiole without latex.

* *Leaves not serrate.*

24. *Acer Opalus*, Miller. Southern Europe.

Leaves (Plate 206, Fig. 14) $2\frac{1}{2}$ inches long, 3 inches wide; lobes short, acute, irregularly toothed; under surface with scattered pubescence, denser on the nerves and forming axil-tufts. (See description, p. 663.)

25. *Acer saccharum*, Marshall. North America.

Leaves (Plate 206, Fig. 12) 5 inches long, 6 inches wide; lobes triangular, acuminate, with one or two pairs of sinuate teeth; lower surface with axil-tufts of pubescence, elsewhere glabrous or more or less pubescent. (See description, p. 677.)

26. *Acer hyrcanum*, Fischer et Meyer. South-Eastern Europe, Crimea, Asia Minor, Caucasus.

¹ Cf. J. H. Veitch, *Journ. Roy. Hort. Soc.* xxix. 353, fig. 97 (1904).

Leaves (Plate 207, Fig. 22) $2\frac{1}{2}$ inches long, 3 inches wide; lobes oblong, acute or acuminate, with one to four small teeth; sinuses reaching half the length of the blade, usually rounded at the base; lower surface glabrous except for pubescence along the nerves and forming axil-tufts.

A small tree, representing *A. Opalus* in the Orient and Balkan Peninsula. There are good specimens in the collection at Kew.

27. *Acer Heldreichii*, Orphanides. Balkan Peninsula, Greece.

Leaves (Plate 206, Fig. 17)¹ 4 inches long, 5 inches broad, deeply five-lobed; the middle sinuses narrow, acute at the base, and reaching nearly to the base of the blade; lobes acuminate, with two or three pairs of triangular teeth; under surface with brown pubescence along the primary nerves, forming axil-tufts, glabrous elsewhere.

There is a small tree of this species in the Maple Collection at Kew.

28. *Acer Trautvetteri*, Medwedjeff. Caucasus.

Leaves (Plate 206, Fig. 19) averaging $5\frac{1}{2}$ inches long and 6 inches broad, deeply five-lobed; the middle sinuses acute at the base, reaching two-thirds the length of the blade; lobes long acuminate, with four or five pairs of irregular teeth; under surface glabrous except for conspicuous tufts of reddish-brown pubescence in the axils, at the base, and at the junctions of the primary and secondary nerves. (See description, p. 669.)

** *Leaves distinctly serrate.*

29. *Acer Pseudoplatanus*, Linnæus. Europe, Asia Minor, Caucasus, Northern Persia.

Leaves (Plate 206, Fig. 20) averaging 5 inches long and 6 inches wide; lobes acuminate, coarsely and irregularly serrate and lobulate; sinuses acute at the base, and extending half-way the length of the blade; under surface pubescent along the primary nerves. (See description, p. 641.)

30. *Acer insigne*, Boissier et Buhse. Caucasus, Northern Persia.

Leaves (Plate 206, Fig. 18) resembling those of the sycamore, but usually longer than broad, averaging 7 inches long and 6 inches wide; under surface with pubescence dense along the nerves, forming axil-tufts, and spreading over the leaf between the nerves. (See description, p. 667.)

31. *Acer Volxemi*, Masters. Central Caucasus.

Leaves considerably larger than in the preceding species, attaining 10 to 12 inches in width and length, glaucous beneath, with pubescence confined to the sides of the nerves. (See description, p. 668.)

32. *Acer dasycarpum*, Ehrhart. North America.

Leaves (Plate 207, Fig. 28) about 5 inches long and wide; sinuses rounded at the base, and concave on the sides, extending half-way the length of the blade; lobes long acuminate, with serrated triangular teeth or lobules; under surface silvery white, scattered pubescent, without axil-tufts. (See description, p. 674.)

¹ In the mountains of Greece, the leaves are smaller than is the case in trees growing in Southern Servia, Montenegro, Herzegovina, and Bulgaria, and average only 2 to 3 inches in diameter.

- V. Leaves simple, five-lobed; basal lobes well developed; green beneath; margin entire or with a few teeth and without cilia; petiole containing latex.

* *Margin entire.*

33. *Acer pictum*, Thunberg. Asia Minor to Japan.

Leaves (Plate 205, Fig. 9) about 4 inches long and $4\frac{1}{2}$ inches broad; lobes acuminate, bristle-pointed; basal lobes pointing outwards; glabrous beneath, except for pubescent tufts in the basal axils. Young branchlets green and not glaucous, turning grey in the second year in the type, remaining green in var. *colchicum*. (See description, p. 660.)

34. *Acer Lobelii*, Tenore. Italy.

Leaves (Plate 205, Fig. 8) 4 inches long, $4\frac{1}{2}$ inches wide; lobes acuminate, ending in long sharp points; basal lobes directed forwards; glabrous beneath, except for pubescent tufts in the axils of the primary and secondary nerves and at the base; young branchlets glaucous, remaining green in the second year. (See description, p. 659.)

35. *Acer truncatum*, Bunge. Northern China.

Leaves (Plate 205, Fig. 6) about $2\frac{1}{2}$ inches long and 3 inches wide, truncate or widely cordate at the base; lobes¹ acuminate, bristle-pointed; basal lobes directed outwards; glabrous beneath, except for a slight trace of pubescence at the base. Young branchlets not glaucous, becoming brown in their first winter.

A small tree, attaining 25 feet in height. Introduced some years ago by seeds received from Dr. Bretschneider, and thriving at Kew.

36. *Acer Dieckii*,² Pax. Hybrid between *A. platanoides* and *A. pictum*, var. *colchicum*.

Leaves (Plate 207, Fig. 30) 3 inches long, 4 inches broad; lobes five, shortly acuminate, not bristle-pointed; brown pubescent beneath at the base and in the axils of the primary and secondary nerves. Young branchlets not glaucous, becoming brown in their first winter.

** *Margin toothed.*

37. *Acer platanoides*, Linnæus. Europe, Asia Minor, Caucasus.

Leaves (Plate 206, Fig. 11) 5 inches long, 7 inches wide; lobes acuminate, bristle-pointed; sinuses wide, rounded and open; margin with a few sinuate pointed teeth; glabrous beneath, except for pubescence at the base and in the axils of the primary and secondary nerves. Young branchlets not glaucous, becoming brown in their first winter. (See description, p. 656.)

38. *Acer neglectum*, Lange.³ Hybrid between *A. campestre* and *A. pictum*, var. *colchicum*.

Leaves (Plate 205, Fig. 7) 4 inches long, 5 inches wide; lobes acuminate, not bristle-pointed, the upper three with one or two short teeth; glabrous beneath, except for pubescence along the nerves, densest at the base. Young branchlets not glaucous, pubescent, becoming brown in their first winter.

¹ The terminal lobe in leaves of young trees has often one or two sharp teeth.

² Sometimes known in cultivation as *Acer platanoides*, var. *integrilobum*, Zabel. There is a small tree at Kew, the bark of which is striped with white lines.

³ There are small trees in the Botanic Gardens at Kew and Edinburgh, the bark of which is striped with white lines.

VI. Leaves simple, five-lobed; basal lobes well developed; green beneath; margin serrate; petiole without latex.

39. *Acer Oliverianum*,¹ Pax. Central China.

Leaves $3\frac{1}{2}$ inches long, 4 inches broad; lobes long acuminate, finely and simply serrate; glabrous beneath, except for pubescent tufts at the base and in the axils of the primary and secondary nerves.

A small tree, 20 feet in height. Introduced by Wilson in 1901. Plants at Coombe Wood are thriving, and are about 12 feet high.

40. *Acer argutum*, Maximowicz. Japan.

Leaves about 3 inches long and broad; lobes triangular, acuminate, sharply bi-serrate; lower surface with scattered white pubescence, dense on the nerves and veinlets. Young branches densely pubescent.

A small tree, introduced by Maries in 1881. There are small specimens in the Kew Collection, and a good-sized one at Westonbirt.

40A. *Acer palmatum*, Thunberg. (See No. 46.)

VII. Leaves simple, five-lobed; basal lobes well developed; green beneath; margin with a few teeth or lobules, ciliate.

* *Petiole containing latex.*

41. *Acer campestre*, Linnæus. Europe, Caucasus, Northern Persia.

Leaves (Plate 207, Figs. 23, 24, 25) $2\frac{1}{2}$ inches long, 3 inches broad; margin irregularly and obtusely dentate; dark-green, and pubescent on the nerves above; light-green beneath with scattered pubescence, densest on the nerves, and tufted in the axils. (See description, p. 651.)

42. *Acer macrophyllum*, Pursh. Alaska to California.

Leaves (Plate 205, Fig. 3) about 9 inches long and broad; margin with large triangular lobules or teeth; upper surface dark-green, shining, scattered pubescent; lower surface light-green, glabrescent between the nerves, with tufts of white pubescence in the axils. (See description, p. 681.)

43. *Acer Miyabei*, Maximowicz. Yezo.

Leaves 5 inches long, 6 inches broad; lobes with long acuminate obtuse-tipped apex, and with one or two pairs of obtuse lobules; sinuses narrow, acute at the base; both surfaces pubescent, densest on the nerves; petiole and young branchlets pubescent.

A tree, attaining 40 feet in height. Introduced by Sargent, who obtained seeds from Miyabe in 1892. There are young trees at Kew and Coombe Wood; and one at Grayswood, near Haslemere, was about 18 feet high in 1906.

** *Petiole without latex.*

44. *Acer diabolicum*,² Blume. Japan.

Leaves (Plate 207, Fig. 26) 6 inches long, $6\frac{1}{2}$ inches wide; lobes short,

¹ *Acer* sp. in J. H. Veitch, *Journ. Roy. Hort. Soc.* xxix. 354, fig. 98 (1904).

² Specimens of reputed *Acer Francheti*, Pax, from Coombe Wood, introduced by Wilson in 1901, are indistinguishable from this species. Cf. *Journ. Roy. Hort. Soc.* 353, fig. 88 (1904).

ovate, with obtusely tipped acuminate apex, and one or two pairs of coarse teeth; upper surface dark-green, shining, with scattered pubescence densest on the nerves; lower surface pubescent, dense on the nerves, and forming axil-tufts; petioles and young branchlets pubescent.

A tree, 30 feet high, remarkable for the stinging hairs on the fruit-carpels. Introduced by Maries in 1881, and about 20 feet high at Coombe Wood.

45. *Acer villosum*, Wallich. North-Western Himalayas.

Leaves about 8 inches long and wide; lobes broadly ovate, caudate-acuminate, with a few crenate teeth; pubescent on the primary nerves above; lower surface, petioles, and young branchlets densely pubescent.

A large tree in its native home. A specimen, the only one seen in cultivation, at Grayswood, Haslemere, remains shrubby.

VIII. Leaves simple; lobes more than five, sharply bi-serrate; petiole without latex.

* *Petioles glabrous.*

46. *Acer palmatum*, Thunberg. Japan, Central China.

Leaves about 3 inches in length and breadth; lobes usually seven, occasionally five, long acuminate; sinuses extending half the length of the blade or to near the base; glabrous on both surfaces, except for minute axil-tufts of pubescence beneath. Young branchlets glabrous.

A tree, rarely attaining 50 feet in height. The type was introduced¹ in 1820, and in cultivation is a small tree, occasionally 25 feet high, with numerous small branches and extremely dense foliage. A very large number of horticultural varieties² have been produced in Japan, which are highly valued on account of the varied shape and colour of their leaves, and are commonly cultivated in Europe.

47. *Acer circinatum*, Pursh. British Columbia to California.

Leaves (Plate 205, Fig. 5) about 4 inches long and broad; lobes seven to nine, acute; sinuses reaching about one-third the length of the blade; scattered pubescent on both surfaces at first, ultimately glabrous except for minute traces of pubescence at the base on both sides. Young branchlets glabrous.

A shrub or small tree, rarely 40 feet high. Introduced in 1826, perfectly hardy, and producing fruit freely.

** *Petioles, with dense white long pubescence in spring, more or less persistent till autumn.*

48. *Acer japonicum*, Thunberg. Japan.

Leaves about 4 inches long and broad; lobes usually nine, acuminate; sinuses reaching one-third the length of the blade; both surfaces scattered pubescent, with a tuft at the junction of the blade and petiole above, and axil-tufts beneath. Young branches glabrous.

A small tree, attaining about 20 feet in height. Several varieties are

¹ Loudon, *Encycl. Trees*, 90. The largest specimen which we have seen is at Waterer's Nursery, Knaphill, Woking.

² Cf. J. H. Veitch, *Journ. Roy. Hort. Soc.* xxix. 338 (1904).

mentioned by Mr. J. H. Veitch, one of which, growing well at Mount Usher, Wicklow, Ireland, has deeply-cut leaves, figured on Plate 207, Fig. 29.

49. *Acer Sieboldianum*, Miquel. Japan.

Leaves about 2 inches in length and breadth; lobes usually nine, acuminate; sinuses reaching nearly half the length of the blade; glabrous above with a tuft of hairs at the base; pubescent beneath on the main nerves. Young branchlets covered with dense white pubescence.

A small tree or shrub, very rare in cultivation.

IX. Leaves compound; leaflets three or five.

A. *Leaflets entire in margin.*

50. *Acer Henryi*,¹ Pax. Central China.

Leaflets three, narrowly elliptical, acuminate; under surface green, pubescent on the midrib and lateral nerves, forming axil-tufts. Young branchlets pubescent.

A small tree, attaining about 30 feet in height. Introduced by Wilson in 1900. Young plants at Coombe Wood are now about 10 feet high, and are hardy and thriving.

B. *Leaflets serrate or toothed.*

* *Leaflets green beneath.*

51. *Acer Negundo*, Linnæus. North America.

Leaflets (Plate 205, Fig. 2) usually five, occasionally three; coarsely and irregularly toothed and serrate, sometimes three-lobed; under surface with scattered pubescence, dense on the primary and secondary nerves; petioles glabrous. Young branchlets glabrous, green or glaucous. (See description, p. 684.)

52. *Acer Negundo*, var. *californicum*, Wesmael. California.

Leaflets (Plate 205, Fig. 1) three or five, resembling those of the last species, but with coarser teeth and serrations; lower surface covered with a dense white pubescence. Petioles and young branchlets pubescent. (See description, p. 684.)

53. *Acer cissifolium*, Koch. Japan.

Leaflets three, obovate or oblong, with a long acuminate or cuspidate apex; margin ciliate with serrations ending in fine points; under surface glabrous, except for axil-tufts and slight pubescence along the midrib. Young branchlets pubescent.

A small tree, perfectly hardy, and fruiting freely in this country. A specimen of this species about 30 feet high, which Prof. Sargent says is as large as he saw it in Japan, is growing at Westonbirt.

¹ *Acer sutchuense*, Franchet, also from Central China, differs in the glabrous branchlets and serrate leaflets, which are pale beneath, and has not yet been introduced, the plants referred to this species in *Journ. Roy. Hort. Soc.* xxix. 353, figs. 93, 96, being *A. Henryi*, Pax. *Acer manschuricum*, Maximowicz, a native of Manchuria, which differs little from *Acer sutchuense* in foliage, is said to be in cultivation in Germany (*Mitt. Deutsche Dendrol. Ges.* 1906, p. 30).

** *Leaflets pale beneath.*

54. *Acer nikoense*, Maximowicz. Japan, Central China.

Leaflets three; terminal one about 4 inches long; lateral leaflets slightly smaller and unequal-sided; elliptical, acute; margin crenate, ciliate; under surface villous on the midrib and nerves, scattered pubescent between the nerves. Petioles stout, and like the young branchlets, densely woolly.

A tree, attaining 50 feet in height, with smooth, dark, slightly furrowed bark; leaves turning brilliant scarlet in autumn. Introduced by Maries in 1881. A tree at Coombe Wood is about 30 feet high.

55. *Acer griseum*, Pax. Central China.

Leaflets three; terminal leaflet about 2½ inches long; lateral leaflets smaller and unequal-sided; coarsely toothed and ciliate in margin; woolly pubescent on the midrib and nerves beneath. Petioles slender, and, like the young branchlets, pilose.

A tree, attaining 40 feet in height, with bark peeling off like a birch. Introduced by Wilson in 1901. Young plants at Coombe Wood are about 3 feet high. (A. H.)

ACER PSEUDOPLATANUS, SYCAMORE

Acer Pseudoplatanus, Linnæus, *Sp. Pl.* 1054 (1753); Loudon, *Arb. et Frut. Brit.* i. 414, 448, (1838); Willkomm, *Forstliche Flora*, 749 (1887); Mathieu, *Flore Forestière*, 37 (1897).

A large tree, attaining about 100 feet in height and 20 feet in girth. Bark¹ smooth and greyish on young trees, fissuring and scaling off in large strips on old trunks. Leaves (Plate 206, Fig. 20) 4 to 8 inches in length and width, cordate at the base; lobes five, ovate, acuminate, coarsely and irregularly serrate, lateral lobes larger than the basal ones; sinuses extending about half-way to the midrib, and very acute at the base; upper surface dark-green, shining, glabrous; lower surface paler green and glaucous or sometimes reddish, pubescent along the principal nerves; petiole without latex. The leaves usually turn brownish in autumn, and are often disfigured by black blotches, caused by the fungus known as *Rhytisma acerinum*, Fr., which, however, does little or no harm to the vitality of the tree.²

Flowers in long pendent racemes, composed of umbellate cymes of three flowers each, the central flower in the cyme usually perfect, the two lateral flowers staminate, with longer stamens and abortive ovaries; pedicels short; sepals five, deciduous, greenish-yellow; petals five, greenish-yellow, imbricate, inserted at the margin of a fleshy hypogynous disc. Stamens eight, inserted on the disc; filaments subulate; pubescent below, ovary tomentose. Fruit: keys divergent at a varying

¹ In the Edinburgh Botanic Garden there are trees about a foot in diameter, which have remarkably white bark, resembling that of a birch. The largest sycamore in the garden measured, in 1906, 78 feet in height, and 13 feet 7 inches in girth.

² Cf. *Board of Agriculture, Leaflet No.* 183.

angle, generally directed forwards, about $1\frac{1}{2}$ inch long; wings green, narrow below, scimitar-shaped. Seed obovate, without albumen; cotyledons narrow, long, either spirally coiled or plicate.

Seedling.¹—Cotyledons normally two, rarely three, carried above ground on germination, $1\frac{1}{2}$ to 2 inches long, oblong, sessile, obtuse, entire in margin, obscurely three-nerved, glabrous, pale-green. Caulicle, $\frac{1}{2}$ to 1 inch long, glabrous, ending in a tapering, flexuose, primary root, which gives off a few lateral fibres. Young stem terete, glabrous. First pair of leaves, ovate, cordate at the base, palmately five-nerved, acuminate, irregularly serrate. Second and third pairs similarly cordate and five-nerved, distinctly three-lobed; terminal lobe long, triangular-ovate; lateral lobes short, broad, with two indistinct lobules or teeth. Succeeding pairs resemble those of the adult plant.

Seedlings with three cotyledons, observed by Sir W. Thiselton Dyer,² bore leaves in whorls of threes in their first and second years; but in the third and following years they reverted to the ordinary type with opposite leaves.

IDENTIFICATION

In summer the sycamore is readily distinguishable by the shape of the leaves, and can only be confused with *A. insigne*, from which it differs markedly in the buds, as explained under the latter species.

In winter the twigs are shining, glabrous. Buds sessile, ovoid; terminal buds larger than the lateral buds, which arise from the twigs at an angle of 45° ; scales, six to eight visible externally, in opposite decussate pairs, green with dark edges, glabrous or slightly pubescent near the tip, ciliate in margin. Leaf-scars not joining around the twig, crescentic or V-shaped, three-dotted. The bud-scales are homologous with leaf-bases, and fall off when the bud opens, showing at this stage a minute three-lobed projection at the tip, which corresponds to a leaf-blade.

VARIETIES

The sycamore is remarkably constant in foliage in the wild state,³ only one well-marked geographical form being known:—

Var. *villosa*, Parlatores, *Fl. Ital.* v. 404 (1872). Leaves coriaceous; base widely cordate, margin coarsely toothed, lower surface pubescent throughout in early spring. Fruits usually tomentose, with very broad wings. This variety occurs in the mountains of Sicily, Calabria, and Dalmatia.

In the common wild form the leaves are scarcely coriaceous, and are only pubescent along the nerves beneath, while the fruit is glabrous. From the common form, numerous varieties have arisen in cultivation, as many as fifty being

¹ Cf. Lubbock, *Seedlings*, i. 360, f. 252 (1892).

² *Ann. of Botany*, xvi. 553, plate xxiv. (1902). In plate xxv. an abnormal seedling is figured, in which three cotyledons are followed by two leaves, one of which is bi-partite. Cf. Loudon, *op. cit.* p. 415.

³ On a tree growing in Tullymore Park, Co. Down, Ireland, many of the branchlets bore the leaves alternately and not in pairs. Specimens of this were sent to the Kew Herbarium in 1871.

enumerated by Pax and von Schwerin;¹ but many of these show only trifling variations, often inconstant in character; and only the most important varieties will be mentioned here:—

1. Var. *pyramidale*, Nicholson.² Pyramidal in habit with ordinary foliage; originated in a row of trees, close to the gate of Roger, M'Clelland and Co.'s Nursery, Newry.

2. Var. *erythrocarpum*, Carrière. Fruits red in colour and abundant, producing a fine effect in autumn. This variety is said to have originated in M. Ferrand's nursery at Cognac; but according to von Schwerin is of common occurrence in the wild state in the Bavarian Alps.

3. Var. *palmatifidum*,³ Duhamel. Leaves deeply cut, being five-partite.

4. Var. *ternatum*, von Schwerin. Leaves tri-partite to the base, so that they are ternate or nearly so.

5. Var. *vitifolium*, Tausch. Leaves large, deeply cordate at the base, with three broad rounded lobes, the basal lobes being very small or obsolete.

6. Var. *clausum*, von Schwerin. Leaves deeply cordate, with the sinus closed by the overlapping of the basal lobes.

7. Var. *crispum*, von Schwerin. Leaves wrinkled in margin. Forms also occur in which the leaves are rolled either backwards or inwards from the margin.

8. Var. *cruciatum*, von Schwerin. Leaves three-lobed, the lateral lobes being exactly at right angles to the median lobe.

9. Var. *jaspideum*, von Schwerin. Bark yellowish; leaves of the ordinary form.

10. Var. *euchlorum*, Nicholson.² Leaves deep-green above, normal in shape. This variety originated in Späth's nursery at Berlin.

11. Var. *splendens*, von Schwerin. Leaves red at the time of opening, afterwards becoming green. This includes var. *Rafinesquianum*, Nicholson, in which the young leaves are blood-red; var. *cupreum*, Behnsch, in which they are copper-red at the time of opening; and var. *metallicum*, von Schwerin, with the leaves at first yellowish, afterwards copper-coloured, and ultimately green.

12. Var. *albo-variegatum*, Loudon. Stripe-leaved sycamore. Leaves splashed and marked with white. This variety is mentioned in the *London Catalogue of Trees*, published in 1730, which states that it comes true from seed. It often grows to a large size, a tree at Highmore Hall, Oxfordshire, the seat of G. T. Inman, Esq., being 72 feet high by 9 feet in girth.

13. Var. *corstorphinense*, von Schwerin.⁴ Corstorphine or Golden Sycamore. Leaves often three-lobed, coming out yellow in spring, and in some places appearing about a fortnight earlier than those of the ordinary form. The colour is a fine golden one, and usually lasts till summer is advanced.

Loudon named this variety *flava-variegata*, variegated with yellow, which is

¹ *Gartenflora*, xlii. 258 (1893). Cf. also Nicholson, *Gard. Chron.* xv. 300 (1881).

² *Gard. Chron.* xv. 300 (1881).

³ This is var. *longifolium*, Loudon, *Trees and Shrubs*, 86 (1842).

⁴ *Gartenflora*, xlii. 263 (1893).

scarcely a happy designation, and states that the original tree grew in the grounds of Sir T. Dick Lauder in the parish of Corstorphine, near Edinburgh.

The Corstorphine sycamore is well illustrated and described by Sargent,¹ who quotes from a book, published locally by Mr. G. Upton Selway, called *A Midlothian Village*. The tree has a romantic history, as being the only survivor of an avenue which formerly led to an old manor-house belonging since 1376 to the Forrester family. James Baillie, second Lord Forrester, who took an active part against the Commonwealth, and became involved in difficulties on account of a heavy fine laid on him by Cromwell, is said to have quarrelled with his sister-in-law on August 26, 1679, and to have been murdered by her at the foot of this tree.

Mr. R. Galloway, Secretary of the Royal Scottish Arboricultural Society, informs us that this tree now stands in a garden attached to one of the houses in the village of Corstorphine, and measured in 1905, 61 feet in height and 11 feet in girth. A tree of this variety, which in 1904 measured 62 feet high by 5 feet 10 inches in girth, grows at Kilmarnock, and is believed by the Rev. Dr. Landsborough to be 112 years old. He says that this variety does not grow so fast or attain such a large size as the common sycamore, as owing to its early leafing, the golden sycamore is liable to suffer from spring frosts.

14. Var. *Worlei*, Rosenthal. Another form of the golden sycamore, with reddish leaf-stalks and bright-yellow leaves, which are orange-coloured at the time of opening.

15. Var. *aucubæfolium*, Nicholson. Leaves marked with yellow spots, similar in appearance to those on the leaves of the common *Aucuba japonica*. Originated as an accidental seedling in Little and Ballantyne's nursery at Carlisle.

16. Var. *Leopoldi*, Lemaire, *Illust. Horticole*, xi. t. 411 (1864). Leaves deep pink at the time of unfolding, afterwards variegated with pink and purple. This originated in the seed-bed in the nursery of M. Vervaene, at Ledeborg-les-Gand, by whom it was sold to Van Geert.

17. Var. *Webbianum*, Nicholson. Leaves with silvery streaks. This originated in the nursery of C. Lee and Son at Isleworth.

18. Var. *purpureum*, Loudon. Purple-leaved sycamore. Leaves purple beneath. The petiole and wings of the fruit are often also bright-red. This variety originated in 1828 in Sanders' nursery in Jersey.

Various sub-varieties are known as var. *atropurpureum*, Späth, under surface of the leaves very dark purple; var. *Nizeti*, von Schwerin, leaves purple beneath, spotted with yellow above; var. *Handjeryi*, Späth, vinous-purple beneath, upper surface with yellow minute spots; var. *purpureo-variegatum*, Nicholson, with rose-coloured or white stripes on a purple ground. The latter originated in Van Volxem's nursery at Perck, and is considered by Nicholson to be identical with var. *variegatum*, Carrière, *Rev. Hort.* 1877, p. 334, which originated as a branch sport from the ordinary purple-leaved variety in the Bois de Boulogne nurseries at Longchamps in 1874.

19. Var. *flavo-variegatum*, Hayne.² Leaves splashed and marked with yellow.

¹ *Garden and Forest*, vi. 202, f. 32 (1893).

² *Dendrol. Flora*, 212 (1822).

DISTRIBUTION

The exact limits of the distribution of the sycamore are difficult to define, as the tree has been extensively planted for centuries outside of its original home, which in Europe may be roughly described as the great central chain of the Pyrenees, Alps, and Carpathians, with the mountains and hilly districts radiating from them in all directions. It is truly wild in the Pyrenees, and reaches its western limit in the Iberian Peninsula in the Cantabrian Mountains, being absent from the greater part of Spain and all Portugal.¹ It occurs in all the mountainous and hilly districts of France except in the north-west; in the Alps generally; in the mountains of Germany, as far north as the Harz Mountains; in the Carpathians, Apennines, mountains of Sicily, Dalmatia, Bosnia, Servia, and in the mountains of Thessaly and Epirus in Greece.² In Russia it occurs in the provinces along the Black Sea, extending inland along the banks of the great rivers, and in the mountains of the Crimea. It is widely spread in the mountains of Asia Minor, Armenia, and the Caucasus,³ where it grows at all altitudes from sea-level to 4000 feet. Its extreme easterly point is near Astrabad, south-east of the Caspian Sea, about lat. 37°.

The tree is not a native of the British Isles, North-West France, Belgium, Holland, the North German plain, Denmark, Scandinavia, or the greater part of Russia. In these countries the sycamore, however, flourishes, and is extensively cultivated, reaching its northerly limit as a planted tree, according to Schübeler, in Norway and Sweden about lat. 64°.

It is usually met with, in the wild state, as an isolated tree or in small groups, being only known to form pure woods, and those of no great extent, in the Thuringian forests. It does not occur naturally on light soils, on heavy clay soils, or on wet ground; and apparently, in order to compete with other trees, must grow on a soil rich in mineral constituents, such as often occurs in valleys or ravines, or in pockets here and there in forests, where the soil is generally poor. It forms a part of the great beech and silver-fir forests; but reaches higher than either of these species on the mountains, where it dwindles to a sub-alpine shrub near the timber line. In the Bavarian forests it grows in the zone between 1000 and 4400 feet altitude, and a peculiar form occurs, with twisted curved branches, which Dr. Christ⁴ has not observed elsewhere. In Switzerland,⁴ it ascends to 5300 feet, and is most plentiful at Sernfthal above Elm. In France it ascends to about 5000 feet, and is most generally met with in the beech forests, its abundance and flourishing condition being considered a sure index of a fertile soil.

The sycamore has not been found in the fossil state in the British Isles. Clement Reid⁵ hazards the suggestion that it was perhaps introduced by the

¹ Willkomm, *Pflanzenverbreitung auf der Iberischen Halbinsel*, 94 (1896).

² Halácsy, *Consp. FL. Græca*, i. 285 (1900).

³ Radde, *Pflanzenverbreitung in den Kaukasusländern*, 175 (1899).

⁴ Christ, *Flore de la Suisse*, 278, 279 (1907).

⁵ *Origin British Flora*, 16 (1899).

Romans. Ray states, *Synopsis*, 230, published in 1690, that the sycamore was then planted in cemeteries and about the houses of the nobility, and that it was nowhere wild in England. It would appear from this that it was by no means a common tree in Britain in the seventeenth century. (A. H.)

CULTIVATION

The sycamore, or plane as it is commonly called in Scotland, is a tree which thrives in almost any dry soil, and seems to reach its greatest size or perfection in the colder hilly parts of England and Scotland, where nearly all the finest specimens we know of are to be found. In the Cotswold hills it is the only tree, except the wych-elm and the beech, which attains a maximum of size, and even here there are none quite equal to some trees in Scotland.

It is absolutely unaffected by the severest frosts¹ at any season, and is rarely attacked by insects or fungoid diseases, ripens seed profusely almost every year, and reproduces itself almost everywhere with such ease that in my own district I believe it might overrun the country if allowed to do so. It grows rapidly when young, and, though not usually planted as a forest tree, is well suited to produce timber in windy situations, where more valuable trees will only languish. Its foliage in spring and summer is very handsome, but assumes a dirty and ragged aspect in autumn, especially in smoky districts, and therefore it is not suitable for town planting. It does not grow so well, or live so long on sand, gravel, or on heavy clay as on limestone. Its branching habit makes careful pruning or close crowding necessary if clean tall stems are desired, and as its timber is most valuable in the form of clean boles of considerable girth, it must be looked on as of somewhat uncertain economic value as a forest tree. But I have found the sycamore a very useful tree for filling up blanks in thin woods, where, when once established, it grows on dry soil at least twice as fast as the ash, and four or five times as fast as the oak.

No tree can be raised from seed more cheaply and easily than the sycamore, and grafting or budding is only resorted to in the case of varieties. The seed falls in the late autumn and winter, and grows in abundance in gravel paths, so that when only a few are wanted, self-sown seedlings can usually be obtained. The seed germinates very early, often in February, though if kept dry it should not be sown before March. It is very liable to be smothered by grass in the first year, and is so easy to transplant that it will be found better to move self-sown seedlings at a year old to the nursery.

In the spring of 1900 I found great quantities of young plants recently germinated on the top of a bare hill pasture, where I wished to renew a clump of trees forming a conspicuous landmark, and had a fence put round them, in order to protect the seedlings from rabbits and cattle; but in the summer I found that every one had been suppressed by grass. In the following year I sowed sycamore seeds with many other tree seeds in lines in cultivated soil, where I

¹ According to Lord Leicester it is on the coast of Norfolk the hardest tree, except *Quercus Ilex*, which bears better the force of the gales from the sea.—(A. H.)

wished to establish a plantation by sowing, and they were the only species of which the plants showed up well in the lines the first summer. As they were much too thick in the rows, about 10,000 were transplanted the following winter, when 4 to 8 inches high, and these grew so fast in the nursery that in two years more I had trees 4 to 6 feet high, whilst those which were left where they were sown, after four years' growth had made very little progress, few exceeding 12 to 18 inches in height, and many remaining so stunted that they could hardly be recognised among the grass.

Though rabbits will not eat it so readily as beech or ash, yet where they are found, the sycamore is not safe from their attacks until it is a foot or more in diameter; after which I have not seen them touch it; and in a park, deer, however hungry, do not bark this tree, though they will peel the branches when cut. It shoots freely from the stool when treated as coppice wood, and on dry soil produces a much greater bulk of poles than ash or lime will do, but in this form is not so valuable as ash or oak, because the poles are neither strong nor durable, and are not used for hurdle-making.

REMARKABLE TREES

Among the many large sycamores which I have measured, it is hard to say which is the finest, but in England I think the palm must be awarded to a tree near the Marquess of Ripon's house at Studley Royal, Yorkshire. This tree is about 104 feet high, by 17½ feet in girth. It has a very large burr close to the ground, where it is 29½ feet round, and a clear bole of about 30 feet.

An almost equally fine tree, growing in front of the Earl of Darnley's house at Cobham Hall, Kent, was figured by Strutt, plate xxx. He gave its height as 94 feet, its girth at the ground 27 feet, and its cubic contents 450 feet. When I measured it in 1905, I found that it was about 105 feet by 17 feet 9 inches at 5 feet up, and still quite healthy. At Penshurst, in the same county, there is a fine tree 104 feet by 13 feet 10 inches.

The tree figured in Plate 179 grows on my own lawn, constantly in sight as I write, and though not quite so large as some others, is still a beautifully-shaped tree, 100 feet by 15 feet. Its top, I grieve to say, has been dying back for some years. At Lypiatt Park, near Stroud, there is a fine tree close below the house, of which Sir John Dorington has sent me a photograph. It measures about 90 feet by 18 feet, dividing near the base into three main stems.

At Essendon Place, Herts, Mr. H. Clinton Baker measured a tree in 1906 as 94 feet high by 9 feet 9 inches in girth. At Fawley Court, near Henley, close to the Thames, in a dense plantation, a tree, estimated by Henry in 1907 to be 100 feet or more in height, was 12 feet 8 inches in girth. At Shiplake House, also near Henley, there is a widespreading tree, 85 feet high and 10 feet 3 inches in girth.

At Lowther Castle, Westmoreland, the seat of the Earl of Lonsdale, there is an immense tree no less than 19 feet 9 inches in girth, but not so tall as,

some I have mentioned; and at this fine place I also remarked a large sycamore, with the bark scaling off in a very unusual way, so that it resembled the bark of an old hickory. I am indebted to Capt. Parkin for a good photograph of this curious tree.

At Mitford Castle, near Morpeth, Northumberland, the seat of Edward Mitford, Esq., Mr. W. H. Mason informs me that there is a very fine tree, about 100 feet in height, with a girth of $18\frac{1}{2}$ feet, and a spread of branches 102 yards in circumference.

In Wales there are many fine trees, the largest that I know being at Dynevor Park, where the Hon. Walter Rice has measured one 81 feet by 15 feet 3 inches in girth. At Gwydyr Castle, Carnarvonshire, a tree, dividing into two stems at ten feet from the ground, is 86 feet high by 14 feet 8 inches in girth.

In Scotland nearly every large place has fine sycamores, some of great age; but I have seen none to surpass in size, shape, and perfection the one which I figure (Plate 180) in front of Newbattle Abbey. This tree in 1904 was about 95 feet high by 16 feet 6 inches in girth at 5 feet, below which its roots spread out very widely. There are other large sycamores here, said by Loudon to have been planted before the Reformation, and one, which I could not identify, before 1530. Judging, however, from a beautiful photograph taken by Col. Thynne, the Newbattle tree is exceeded in height and equalled in girth by one (Plate 181) at Drumlanrig Castle, the seat of the Duke of Buccleuch, of which he gives the height as 105 feet and the girth 19 feet 6 inches. Henry, however, who measured the same tree in December 1904, made it 101 feet by 18 feet, with a bole 22 feet high dividing into two large stems.

At Castle Menzies, Perthshire, there are two magnificent trees, the largest of which is figured by Hunter.¹ I found it in April 1904 to be 92 feet high by 19 feet 2 inches in girth. Probably this is the same of which Hunter says that it contains upwards of 1000 feet of timber. I have a good photograph of it, but prefer to figure (Plate 182) another sycamore, also at Castle Menzies, which, though not so tall, is 20 feet 4 inches in girth, and is remarkable on account of its short trunk, covered with great burrs and excrescences.

The tallest tree of this species which we know in any country is one at Blair Drummond, Perthshire, the seat of H. S. Home Drummond, Esq., which is drawn up in a dense wood behind the house. It was measured by Henry in 1904 as no less than 108 feet in height, though only 10 feet in girth. In open ground on the same property there is another tree² of an entirely different character, which is $19\frac{1}{2}$ feet in girth with a short bole of 9 feet, dividing into two great limbs and forming a very widespreading crown. Its height is only 85 feet. Large variegated sycamores, one 70 feet high by 13 feet 10 inches in girth, also are growing at Blair Drummond.

At Kippenross, near Dunblane, the seat of Captain Stirling, there are the

¹ *Woods, Forests, and Estates of Perthshire*, 397 (1883).

² In Loudon, *Gard. Mag.* 1840, p. 505, there is a list of measurements of trees at Blair Drummond; and a sycamore, 80 feet high and 16 feet in girth in 1841, is probably this tree.

remains of an immense sycamore which was struck by lightning in 1860. It measured in 1821 as follows:—

	Feet.	Inches.
Height	100	0
Girth at smallest part of trunk	19	6
„ where branches separate	27	4
„ at ground	42	7
Extreme width of branches	114	0
Cubic contents	875	0

Captain Stirling informs me that its age, which can be determined from an entry in the records of the estate, is about 440 years. Hunter¹ says that this tree was known as the big tree of Kippenross in the time of Charles II., and in 1806 was described by Mr. Ramsay of Ochertyre, as “now much the greatest in this country.” He adds that in 1740 the late John Stirling of Keir was told by a woman over eighty, that though all the other trees had grown much in her recollection, she knew of no change in the great tree which many people came to see as a curiosity.

At Keir, Perthshire, there is a remarkable sycamore stool, with eleven stems, 85 feet in height and averaging in girth about 6 feet.

Sir Herbert Maxwell sends me the measurement of a sycamore behind the Birnam Hotel at Dunkeld, which Hunter figures on the frontispiece of *Woods and Forests of Perthshire*, and says² that it was supposed to be 1000 years old; this of course is without foundation, and the girth, 19 feet 8 inches, as taken by Sir H. Maxwell, is precisely the same as Hunter gave 25 years before.

In the parish of Cramond, county of Edinburgh, a tree of this species is stated in the *Old and Remarkable Trees of Scotland*, p. 198, to have attained 130 feet in height, but I must doubt the accuracy of this statement, of which I can obtain no confirmation.

Many large trees in the south-west of Scotland are recorded by Renwick,³ of which one at Erskine House, Renfrewshire, is 75 feet high and 19 feet 4 inches in girth, but this has only a short bole of 7 feet. Another at Logansraes, in the same county, is 80 feet high and 18 feet 3 inches in girth, with a spread of 95 feet. Strutt figures, on plate 3 of *Sylva Scotica*, a sycamore at Bishopton, in Renfrewshire, which was about 60 feet by 20 feet and contained 720 feet of timber.⁴

At Inveraray Castle, close to the big Scots pine, there is a fine sycamore about 100 feet high, with a bole of about 35 feet, but its girth in 1906 was only 12 feet 2 inches.

At Invergarry Castle there is an avenue of sycamores, said to date from 1689.

In Ireland, the sycamore is commonly planted and grows with great vigour, but Henry has seen no specimens rivalling those of Scotland in size. At

¹ *Woods, Forests, and Estates of Perthshire*, 286 (1883).

³ *Measurements of Notable Trees*, Glasgow, 1901.

⁴ Sir C. Renshaw informs me that this tree still survives, and that, according to local tradition, John Knox formerly preached under it, but that it is not so fine a tree as one at Erskine House, the property of W. A. Baird, Esq.

² *Ibid.* 73.

Kilmacurragh, Co. Wicklow, there is a fine tree, 15 feet in girth with an estimated height of 90 feet. This is supposed to be the tree referred to by Hayes,¹ as being in 1794 the largest then living in Wicklow; but if this is the case the tree must have remained stationary in growth for many years. At Powerscourt there is a fine widespreading tree 80 feet high by 14 feet in girth. At Carton, a sycamore, remarkable for its small leaves, which are only half the ordinary size, measured, in 1903, 87 feet in height and 11 feet in girth. At Woodstock, Co. Kilkenny, a tree was, in 1901, 73 feet high by 11½ feet in girth; and, according to the records kept here was 7 feet 10 inches in 1825, 8 feet 2 inches in 1830, and 8 feet 11 inches in 1846. At Cushendun, Co. Antrim, in a situation completely exposed to the blasts from the sea, in the garden of Miss M'Neil, a sycamore is 60 feet high by 13 feet in girth.

On the Continent the sycamore is not so often planted as in England, but in Switzerland and the Austrian Alps it attains a great size. Two are figured in the *Baum-Album der Schweiz*,² of which one, formerly growing at Truns in the Oberland at an elevation of 853 metres, close to the old chapel of St Anna, is interesting on account of its great age. Under this tree the Grey League, one of the three bodies which, when confederated in 1525, formed the canton of Grisons, were sworn in 1424; and though the last remnant of the veteran was torn up by a storm in 1870, it shows that the sycamore may attain an age of about 600 years. A figure of it, taken from a painting in the possession of M. Descurtins of Coire, is given in the work from which I quote. A young tree raised from its seed was planted in 1870 on the spot, and was in 1896 already over 30 feet high and 4 feet 4 inches in girth.

By the kindness of M. Coaz, Director of the Swiss Government Forests, I am able to reproduce a beautiful photograph (Plate 183) of an even finer tree, now standing on the land of the commune of Kerns, in Melchthal, canton of Unterwalden, at an elevation of 1350 metres, in deep loamy soil, on a formation described as *calcaire schrattique*. This immense tree measures 12.20 metres in circumference above the point where its trunk expands, and at 5 feet from the ground 8.85 metres, equal to about 29 feet, thus exceeding any tree of which we have a record in this country. At 12 feet from the ground a branch about 9 feet in girth is given off. The height is not stated, but the branches spread to a diameter of about 25 yards, and though the trunk is hollow and covered in places with a moss (*Leucodon sciaroides*), the tree still bears fruit. Its aspect reminds me strongly of many sycamores which grow on the Alps of the Vorarlberg in Austria, and especially of one, from the cover of whose trunk I shot my last chamois, a cunning old buck, which for four seasons I had hunted in vain.

TIMBER

The wood of the sycamore is of a white colour, close grain, and moderately hard; and when of large size is one of the most valuable woods we have, as it has been found the most suitable for making the large rollers, technically called

¹ *Practical Essay on Planting*, 121 (1794).

² Published by Schmid, Francke & Co., Bern, 1896.

"bowls," which are used in cotton-dyeing and washing machines. For this purpose it must be cut early in the winter, in order to preserve the purity of its colour, and removed as soon as possible, for if left standing till the sap begins to rise, which it does early in spring, or left lying exposed to the weather, it is soon depreciated in value. Butts of moderate age, free from branches or knots and over 18 or 20 inches quarter-girth, are worth from 3s. 6d. to 5s. per foot, or even more when near their best market, which is in Lancashire. The measuring of this timber presents a difficulty when, as often happens, the logs are not round or quite straight, as in conversion they have to be turned down to a true cylinder, and in trees grown in the open, as is usually the case, large buttresses and swellings often occur, for which allowance must be made.¹

Smaller and rougher trees are worth much less than large clean ones, and are converted into planks and smaller rollers, which are used by manufacturers of dairy utensils and mangles, brush-makers, toy-makers, and turners, for bobbins and many small articles. From 1s. to 2s. per foot is a fair price for such timber, but the price varies much, according to the locality. A certain quantity of sycamore is cut into veneers, and when the wood has a wavy grain, like that of the so-called fiddle-backed maple, it is very ornamental, and may be used with good effect for the interiors of cabins, railway carriages, and furniture. What is known in the furniture trade as "hare wood" is, I believe, nothing more than fine wavy sycamore, which by age or staining has taken a pinkish-brown colour.

(H. J. E.)

ACER CAMPESTRE, COMMON MAPLE

Acer campestre, Linnæus, *Sp. Pl.* 1055 (1753); Loudon, *Arb. et Frut. Brit.* i. 428 (1838); Willkomm, *Forstliche Flora*, 764 (1887); Mathieu, *Flore Forestière*, 42 (1897).

A tree, rarely attaining 70 feet in height, usually smaller. Bark, corky on young trees, ultimately becoming fissured and scaly. Young branchlets usually pubescent, in some forms glabrous, and not remaining green throughout the first year. Leaves variable in size, averaging 2½ inches long and 3 inches broad, cordate at the base, five-lobed, the two basal lobes occasionally obsolete; lobes shortly acuminate; margin plainly ciliate, usually with a few coarse obtuse teeth; upper surface dark-green, pubescent on the nerves; lower surface light-green, with scattered pubescence, dense on the nerves and tufted on the axils. Petiole with milky sap. Plate 207, Figs. 24 and 25, taken from adult trees growing in England, show considerable variation in the shape of the leaves and the amount of pubescence on the branchlets. Fig. 23 represents the foliage of a coppice shoot in a French forest.

Flowers, in corymbs, at first erect, afterwards pendent, opening with or soon after the leaves, green in colour, with pubescent pedicels and sepals; lateral flowers

¹ William Low, Esq., of Monifieth, Scotland, informs me that in his neighbourhood there is a large consumption of sycamore for making rollers used in the jute and flax-spinning industry. These are from 7 to 9 inches in diameter, and 1½ inch thick. They cost about 30s. per gross, and are preferred when made of hard and slowly grown Scotch timber, which is considered to be less liable to crack in drying, when cut in transverse sections.

staminate, others mixed; ovary in perfect flowers glabrous. Fruit¹ with horizontally spreading wings, glabrous or pubescent.

In summer it is distinguishable from all the other small-leaved maples by the leaves being ciliate in margin, with petioles containing milky sap. In winter the corky ridges on older twigs are characteristic; young branchlets are glabrous or pubescent towards the tip, with crescentic three-dotted leaf-scars, which join at their ends around the twigs. Terminal buds sessile, about $\frac{1}{5}$ inch long, with scales pubescent at the apex and fringed with white cilia. Lateral buds almost appressed to the twigs.

VARIETIES

Two varieties occur in the wild state both in England and on the Continent; var. *hebecarpum*, in which the carpels of the fruit are pubescent, and var. *leiocarpum*, with glabrous fruit. The leaves show considerable variation in shape and in the amount of pubescence on the lower surface; and six sub-varieties are distinguished by Schneider,² as follows:—

1. *subtrilobum*. Leaves three-lobed; fruit pubescent.
2. *lobatum*. Leaves with five obtuse, toothed lobes; fruit pubescent.
3. *acutilobum*. Leaves with five acute, almost entire lobes; fruit pubescent.
4. *pseudomarsicum*. Leaves three-lobed; fruit glabrous.
5. *normale*. Leaves with five obtuse, toothed lobes; fruit glabrous. Var. *collinum* is a form of this, with the leaves glabrous beneath.
6. *austriaca*. Leaves with five acute, almost entire lobes; fruit glabrous.

In var. *pulverulentum*, as cultivated at Kew, the leaves are spotted with white. This appears to be a very slow-growing tree. In var. *variegatum* the leaves are white in margin.

A hybrid² between this species and *A. monspessulanum* has been found wild in Herzegovina, and has been named *A. Bornmülleri*, Borb. *A. neglectum*, Lange, described above in the Synopsis, p. 637, is a hybrid between *A. campestre* and *A. pictum*, var. *colchicum*.

DISTRIBUTION

Acer campestre is spread generally throughout Europe, with the exception of the greater part of Scandinavia, Finland, Northern Russia, and the south of the Iberian Peninsula; and extends into Western Asia, where it is found in the Caucasus and in the province of Astrabad in Persia, where it reaches its most easterly and southernmost point.

In Norway, according to Schübeler, it is not indigenous; but it lives as far north as Trondhjem and grows as tall as 25 feet in the south. Its northern limit as a wild tree, beginning in the province of Scania in South Sweden, crosses into the province of West Prussia in Germany, where it grows at Thorn, and extends through Poland and Central Russia to Vladimir, where it reaches its northernmost

¹ A series of abnormal fruits, each with three to eight keys, instead of two, the normal number, is exhibited in the Kew Museum. Cf. Sir W. Thiselton-Dyer in *Ann. of Bot.* xvi. 556 (1902).

² Schneider, *Laubholzkunde*, ii. 230, 231 (1907).

and most easterly point in Russia. Its easterly limit extends from here through Voronej and Kharkof to the Crimea, where it grows in the mountains. It is also met with in the region of the steppes, growing on the banks of streams. The southern limit in Europe is not exactly known; but the tree occurs in the mountains of Turkey, Dalmatia, Italy, and Sicily, and in the Pyrenees and the mountainous parts of the northern provinces of Spain and Portugal.

Inside these limits, its distribution over the continent of Europe is not at all uniform, and is very scattered, as it is totally absent from many districts where the climate or the conditions of the soil are unfavourable. It is rather a tree of the plains, valleys, and hills, than of the mountains; and is especially met with in the broad-leaved forests, often growing as underwood in coppice with standards, and on the edges of woods, on the banks of streams, and in hedges. It ascends in Southern Bavaria to 2500 feet elevation. In France, it is scattered through coppice woods on the plains and low hills; but is rather rare in the Mediterranean region, and is not a native of Corsica. It has been found in Algeria in one or two restricted localities. It grows throughout the Caucasus¹ at elevations ranging from sea-level to 6000 feet.

Acer campestre is abundant as a wild tree in Southern England, and is recorded by Watson² from most of the counties of England and Wales, as far north as Durham. It is clearly native, according to Baker,³ in the denes of the magnesian limestone of Durham, but is doubtfully so north of the Tyne, though it may be indigenous in the woods of the steep banks of the Wansbeck about Morpeth and Mitford, where there are trees about 30 or 40 feet high; but in the Cheviot Hills it seems to have been introduced. Most of the English county records⁴ mention it as common in woods, hedges, and on the banks of streams; and in North Yorkshire⁵ it ascends to 300 feet and in West Yorkshire⁶ to 600 feet.

It is probably not indigenous in Scotland, though Woodforde⁷ records it in woods at Queensferry, near Edinburgh, and Gardiner⁸ says it grows in a wood at Mains of Hallerton in Forfarshire. In Ireland,⁹ though it grows in hedges and woods in many places, it is in all cases planted or derived from plantations.

It has been found in the fossil state¹⁰ in neolithic deposits at Crossness in Essex, and in preglacial deposits at Pakefield in Suffolk. (A. H.)

CULTIVATION

The maple is common in hedgerows in many parts of England, but can hardly be considered as a forest tree, though it forms a considerable part of the underwood in some woods in the Cotswold Hills, and attains considerable size even on

¹ Radde, *Pflanzenverh. Kaukasuslând.* 175 (1899).

² *Topographical Botany*, 104 (1873).

³ Baker and Tate, *New Flora of Northumberland and Durham*, 141 (1868).

⁴ Jones and Kingston, *Flora Devonensis*, 69 (1829); Ley, *Flora of Herefordshire*, 63 (1889); Bromfield, *Flora Vectensis*, 95 (1856); Hind, *Flora of Suffolk*, 93 (1889); Druce, *Flora of Oxfordshire*, 65 (1886); Leighton, *Flora of Shropshire*, 163 (1841).

⁵ Baker, *North Yorkshire*, 276 (1906).

⁶ Lees, *Flora of W. Yorkshire*, 187 (1888).

⁷ *Catalogue*, 23 (1824).

⁸ *Flora of Forfarshire*, 39 (1848).

⁹ *Cybele Hibernica*, 482 (1898).

¹⁰ Reid, *Origin British Flora*, 113 (1899).

poor soil. Though the autumn colour of the leaves is pretty, yet as an ornamental tree it is inferior to the Norway, American, and Japanese maples. It seeds itself freely in hedges, growing slowly and living to a great age. Lees¹ mentions a hollow tree at Powick which he estimated to be near 600 years old, and says that one almost as ancient stood near Hanley Castle.

It likes a dry, somewhat stony soil, and is most commonly seen in open sunny places in the form of a large shrub of very irregular growth. It is often pollarded, and in such cases becomes hollow, usually with a burry stem and spreading roots. So far as I have observed, the seeds germinate in the first year if sown when ripe, and are easy to raise. It bears pruning very well and is therefore suitable for hedges, which in France are often made of this tree.

According to Mouillefert,² it suffered much at Grignon in the severe winter of 1879-1880, when the thermometer fell to -27° Cent.; and is much less hardy than the sycamore, which sustained this low temperature without being injured in the least; but I have never seen it damaged by frost in this country.

REMARKABLE TREES

There are many good-sized trees of this species in England, of which one at Cobham Hall, Kent, is the tallest we have seen. This is a twin tree in a wood near the house, with two tall straight stems from the same root, which are 6 feet 4 inches and 6 feet respectively in girth, and about 75 feet high. Another tree, in the deer park here, is 70 feet high, with a trunk girthing, at three feet from the ground, 8 feet 11 inches, and dividing at 4 feet up into four stems. At Chilham Castle, Kent, the seat of C. S. Hardy, Esq., there is a splendid tree 55 feet high by 13 feet 8 inches in girth which covers an area 86 paces round, but the bole is only 7 feet high.

One of the best-shaped large trees that I have seen, grows in the park at the Mote near Maidstone: it measures 60 feet by 10 feet 3 inches. I lately discovered a magnificent tree past its prime at Langley Park, Norfolk, which, though only 45 feet high, girths 9 feet 5 inches and has branches which spread to a width of 24 paces.

At Hursley Park, Hants, the property of Sir G. Cooper, Bart., there is a tree which Sir Joseph Hooker told me was the finest that he had ever seen. Mr. J. Clayton, who was forester there, tells me that it has a short bole 9 feet 6 inches in girth, with ten large spreading limbs, and contains about 111 feet of measurable timber. The tree in Boldre Churchyard, figured by Strutt, and said by him to be the largest in England, was, however, only 45 feet by 7 feet 6 inches, but I cannot learn that it still exists.

In Cassiobury Park there is a very well shaped tree on the golf ground, which measured, in 1907, 60 feet by 9 feet 6 inches (Plate 184), being little less than the one at the Mote. At Moor Park, Herts, Sir Hugh Beevor found in 1902 a quite sound tree, which was 10 feet 3 inches in girth at 4 feet from the ground, and no less than 76 feet in height.

¹ *Botany of Worcester*, p. xxxviii (1867).

² *Essences Forestières*, 208 (1903).

At Casewick, Lincolnshire, the seat of Lord Kesteven, a maple measured, in 1907, 53 feet high by 9 feet 1 inch in girth, with a bole of 9 feet. At Arley Castle, near Bewdley, a slender tree measured, in 1906, 66 feet high by 4 feet 8 inches in girth. At Colesborne, just below the church, there is one about 60 feet high by 9 feet in girth; and this is the largest that I know in Gloucestershire.

None of the trees recorded by Loudon approach those mentioned above in size, and though the tree is so hardy in the south of England, it usually does not attain a considerable size in the north. I have myself seen no specimens in Scotland worth recording; and it is not mentioned either in the *Old and Remarkable Trees of Scotland* or in Hunter's *Woods and Forests of Perthshire*. Loudon records a tree at Hopetoun House, near Edinburgh, 46 feet high, and another at Blairlogie in Stirlingshire, said to have been 302 years old and no less than 55 feet high by 4 feet in diameter. The Hon. Vicary Gibbs, however, measured in 1905 a pollarded tree at Armadale Castle, in the Isle of Skye, 42 feet high by $7\frac{1}{2}$ feet in girth at $2\frac{1}{2}$ feet from the ground. Mr. Renwick also reports a large one at Ardgowan, Renfrewshire, which was, in 1904, 12 feet 2 inches in girth at 1 foot up, and another at Auchentorlie, Dumbartonshire, which was, in 1907, 41 feet high by 9 feet 5 inches in girth at 3 feet from the ground. Henry measured in 1905 a tree in the Edinburgh Botanic Garden, 54 feet high by 6 feet 2 inches in girth, dividing into two stems at 8 feet from the ground.

The common maple is often planted in Ireland; but Henry has seen no trees of great size. It thrives well at Castlewellan, where there is a young tree about 30 feet in height.

TIMBER

Though the wood is one of the best of its class, on account of its fine grain, close texture and hardness, and though it sometimes shows a most beautiful figure, which when polished is highly ornamental, this wood, formerly much sought after for turning, inlaying, and cabinetmaking, is now hardly known in commerce, and is not mentioned by most recent writers. Stevenson,¹ however, says that waved or mottled specimens when cut into veneer are little, if anything, inferior to American bird's-eye maple.

The so-called mazer bowls which in ancient times were carried by every pilgrim to drink from, just as they now are by the Tibetans,² were turned from the roots and burrs of the common maple, and when mounted in silver the few remaining specimens of these bowls are very highly valued by collectors. The colour of the wood is normally white, but in old trees it turns to a pinkish or brown colour, and so far as my experience goes it is a wood which shrinks and warps very little. For parquet flooring it would be admirable, and might be very well used for table legs. In *English Timber and its Economical Conversion* it is said to be subject to the attacks of worms, but I do not know whether this statement is based on experience.

(H. J. E.)

¹ *Trees of Commerce*, p. 112.

² Cf. p. 662, note 3.

ACER PLATANOIDES, NORWAY MAPLE

Acer platanoides, Linnæus, *Sp. Pl.* 1055 (1755); Loudon, *Arb. et Frut. Brit.* i. 408 (1838); Willkomm, *Forstliche Flora*, 757 (1887); Mathieu, *Flore Forestière*, 41 (1897).

A tree, attaining occasionally 90 feet in height, but usually smaller. Bark smooth on young trees, but ultimately becoming rough and fissured longitudinally. Young branchlets glabrous, not remaining green throughout the first year. Leaves (Plate 206, Fig. 11) averaging 5 inches long by 7 inches wide, five-lobed; lobes oblong with an acuminate bristle-pointed apex; sinuses wide, rounded and open, not reaching the middle of the leaf; base cordate; margin non-ciliate and with a few large sinuate pointed teeth; both surfaces shining, green, and glabrous, except for tufts of pubescence in the axils of the primary and secondary nerves beneath; petiole with milky sap.

Flowers, opening early before the leaves expand, in erect corymbs, yellowish-green; the earliest mostly staminate, those opening later perfect; stamens 8, as long as the sepals; pedicels, calyx, corolla, filaments, and ovary glabrous. Fruit pendulous, on long stalks, glabrous; keys about $1\frac{3}{4}$ inch long; wings widely divergent.

In summer the Norway maple is readily distinguishable by the leaves shining on both surfaces, with long pointed lobes and teeth, and by the milky sap in the petioles. In winter the twigs are shining, glabrous, with very narrow three-dotted leaf-scars, the opposite pairs of which are joined at the ends around the stem. Terminal buds $\frac{1}{2}$ inch long, sessile; scales shining, either green at the base and reddish-brown above, or reddish-brown throughout, glabrous, ciliate. Lateral buds appressed to the stem.

VARIETIES

A large number of varieties have appeared in cultivation, of which the most noteworthy are:—

1. Var. *laciniatum*, Aiton,¹ Eagle's Claw or Hawk's-foot Maple. Said by Loudon to have originated in the seed-bed. Leaves (Plate 205, Fig. 10) about half the size of the type, cuneate at the base; lobes acutely, deeply, and irregularly cut; margin rolled up. This variety usually attains to no great size, but Sir Hugh Beever tells us of a tree at Gelderstone Hall near Beccles, Suffolk, 50 feet high by 2 feet 8 inches in girth; and Renwick in 1907 measured one at Auchendrane, Ayrshire, 48 feet by 3 feet 2 inches.

2. Var. *dissectum*, Jacquin fil. (var. *palmatum*, Koch²) (*A. Lorbergi*, Van Houtte). Leaves (Plate 206, Fig. 21) deeply cut to near the base, which is cordate; lobes five, ending in long sharp points, the three upper lobes again divided into three lobules; margin with a few sharp-pointed teeth. First introduced from Belgium in 1845 by Knight of Chelsea, it grows to be a fair-sized tree, and is worth cultivating on account of its elegantly cut foliage.

¹ *Hort. Kew*, iii. 435 (1789).

² *Dendrologie*, i. 530 (1869).

3. Var. *heterophyllum*, Nicholson.¹ Leaves asymmetrical and irregularly cut.

4. Var. *Schwedleri*, Koch.² A tree, vigorous in growth, with large leaves, bright-red when young, changing to dark-green. A valuable ornamental tree.

5. Var. *Reitenbachii*, Nicholson.¹ Leaves pale-red when unfolding, turning a dark blood-red in late summer. This variety originated in Reitenbach's nursery at Plicken in Prussia, and was sent out by Van Houtte. It comes fairly true from seed, and grows at Colesborne as fast as the type.

6. Var. *rubrum*, Herder.³ Leaves green when young, but towards autumn assuming a fine red colour. This variety is cultivated in the Imperial Park at St. Petersburg, and in gardens and parks in Germany.

7. Var. *albo-variegatum*. Leaves irregularly blotched with white. In a form⁴ sent out by Messrs. Drummond of Stirling, the leaves are green in the centre, with a very deep edging of white. In var. *maculatum* the leaves are spotted with white, and are very pretty.

8. Var. *aureo-marginatum*.⁵ Leaves with a yellow margin.

9. Var. *cucullatum*. Leaves irregularly and shortly lobed, crimped, dark-green.

10. Var. *columnare*. Of erect columnar habit, with small leaves. Raised¹ by Simon Louis at Metz in 1855 and first sent out in 1879.

11. Var. *globosum*. With a dense, compact, rounded head of foliage.

12. *Acer Dieckii*, Pax, a supposed hybrid between this species and *A. pictum*, var. *colchicum*, has been described above in the Synopsis, No. 36, p. 637.

DISTRIBUTION

The Norway maple has a wide distribution, as it inhabits the greater part of Europe, and extends eastwards into the Caucasus and North Persia.

In Norway, where it is called *Lon* (in Swedish *Lönn*), it is indigenous, according to Schübeler, from the extreme south to Romsdal on the west coast and Elvedal in Osterdal, but has been planted and exists as a shrub as far north as Tromsö, lat. 69° 40'; and in Sweden it is met with growing wild as far north as lat. 63° 10' on the east coast. Elwes has never seen any large trees in Norway; but Schübeler figures one (his fig. 129) at Triset in Laurdal, which was 60 feet high by 9 feet 8 inches in girth, and had very much the appearance of a sycamore. He mentions a tree at Lid at 1000 feet elevation which was 120 years old; and says that the largest known to him were at Drobak on the Christiania fjord, 60 feet high by 14 feet in girth, and at Mollendorf near Drammen, a tree which was called the great Lon, and was 70 feet high by 11 feet in girth. In former times the peasants used to tap this maple, and make a sort of beer with the sap; and Loudon states that in Germany the sap has been found to contain more saccharine matter than that of the sugar maple.

¹ *Gard. Chron.* xv. 564 (1881).

² *Dendrologie*, i. 530 (1869). Koch could throw no light on the name of this variety, the origin of which is unknown.

³ *Gartenflora*, 163, t. 545 (1867).

⁴ *Gard. Chron.* xxxiv. 24 (1903).

⁵ Var. *aureo-variegatum*, a form in which the leaves are mottled green and white, is described in *Gard. Chron.* xiv. 241 (1880).

It grows wild in Finland as far north as 62° lat. on the west coast; and the northern limit of the species as a tree extends from Lake Ladoga, through Central Russia, where it is, with birch and aspen, the commonest deciduous tree, to Orenburg, where it reaches, but does not cross the Ural, in lat. 54°. To the north of this limit it is often met with as a shrub in the pine forests, and has been found even on the west coast of Onega Bay. Southward it grows in the Crimea, and is common in the Caucasus, at 2000 to 6000 feet altitude, extending into Armenia and North Persia.

It is common throughout Germany, especially in the north, where it grows mainly in the plains, valleys, and low hills; and extends southwards through Austria and the Balkan States to Epirus. It occurs in Northern Italy. In Switzerland¹ the tree is only met with in the lower part of the beech forests, ascending to about 3300 feet. In France it is spread throughout the forests of the low hills and mountains, as far south as the Cevennes, Auvergne, and the Central Pyrenees, where it crosses into Northern Spain.

The Norway maple is not a native of the British Isles, where it has not yet been found in the fossil state.

It always grows in company with other trees, never forming pure forest, and generally solitary or in small groups. It is often associated with the sycamore, and like it thrives best on soils rich in soluble mineral matter. It does not ascend in mountainous regions as high as the sycamore; but succeeds better than that species in wet situations. It bears a great degree of cold and is entirely unaffected by late frosts.

Mistletoe² is occasionally found on the Norway maple. (A. H.)

CULTIVATION

Though the tree has been known in England for a very long period—Loudon says it was introduced in 1683—and is one of the hardiest trees in cultivation, it is seldom seen of any size, and is not nearly so commonly planted as it deserves to be. It will grow on the driest and poorest soil, and on my own land there are many trees over 50 feet high by 6 to 7 feet in girth which have not been planted more than fifty years.

It ripens seed abundantly almost every year, and is as easy to raise as the sycamore, and though it does not attain nearly the size and age of that tree, is far more ornamental both in spring, when covered with pale-yellow flowers, before the leaves come out, and in autumn when they turn a brilliant red or yellow colour.

REMARKABLE TREES

The largest tree of this maple that we know of in England is not far from the stables at Cassiobury Park, the seat of the Earl of Essex, and measures over 90 feet, perhaps as much as 95 feet high, by 13 feet 9 inches in girth. But it is not

¹ Christ, *Flore de la Suisse*, 181 (1907).

² Cf. *Gard. Chron.* xxxix. 238 (1906).

so handsome or well-shaped a tree as the one figured (Plate 186), from a photograph for which I am indebted to Mr. W. M. Christy, who tells me that this tree, growing at Watergate, near Emsworth, Hants, is no less than 14 feet 4 inches in girth at 4½ feet from the ground, the branches spreading over an area about 102 to 105 paces round.

Another very fine tree grows in a wood at Park Place near Henley-on-Thames, by the side of the drive from Templecombe, on loamy soil overlying chalk, and this in 1905 measured 80 feet by 9 feet 9 inches, with a bole about 12 feet long (Plate 187).

At Syon there is a healthy vigorous tree, 68 feet by 7 feet 3 inches, with a bole 10 feet long. At Colesborne there are several of about this size, and some younger trees, one of which was photographed when covered with hoar-frost in winter, and shows the habit of branching which this tree sometimes assumes (Plate 188).

There are many handsome specimens in the park and woods at Highclere, which produce a beautiful effect when in flower. The largest that I measured is about 80 feet by 7 feet 2 inches, with a trunk 40 feet high.

At Arley Castle there is a tree, which in 1906 measured 70 feet high by 6½ feet in girth, dividing into two stems at 6 feet from the ground; and self-sown seedlings are growing near it. At Croome Court, Worcestershire, a tree in 1905 was 50 feet high by 4 feet 8 inches in girth. Sir Hugh Beevor measured in 1906 a tree at Newnham Paddox, Worcestershire, which was 63 feet high by 12½ feet in girth at two feet from the ground, dividing above into three stems, girthing each about 6 to 7 feet; and another at the Cranleigh Cottage Hospital, Surrey, 70 feet high by 8½ feet in girth.

At Pampisford Hall, Cambridgeshire, there is a group of four trees, the largest of which was in 1906 65 feet by 4½ feet; but the specimen at Kew, which in Loudon's time was 76 feet high at 70 years old, no longer exists.

In Scotland the largest record we have is of a tree at Bowhill, near Selkirk, one of the Duke of Buccleuch's properties, which Col. H. Thynne tells me is no less than 84 feet high by 7 feet in girth, having been drawn up by surrounding trees. At Smeaton-Hepburn, East Lothian, Henry saw in 1905 two more, one 58 feet by 6 feet, the other 50 feet by 7 feet 2 inches. Another in the Edinburgh Botanic Gardens measured in the same year 48 feet by 4 feet 11 inches.

In Ireland, Henry has seen no Norway Maples of considerable size; but Loudon mentions one at Charleville which was 78 feet high.

The timber of this species is very similar to that of the Sycamore and may be used for the same purposes. (H. J. E.)

ACER LOBELII

Acer Lobelii, Tenore, *Cat. Hort. Neap.* append. 2, p. 69 (1819), and *Fl. Nap.* v. 291 (1835).
Acer platanoides, Linnæus, var. *Lobelii*, Loudon, *Arb. et Frut. Brit.* i. 409 (1838).

A tree attaining about 50 feet in height, forming a narrow pyramid with ascending branches. Bark striped longitudinally. Young branchlets glaucous,

glabrous, remaining green throughout the first and second years. Leaves (Plate 205, Fig. 8) about 5 inches long by $5\frac{1}{2}$ inches wide; lobes five or three, with their apices pointing away from the base of the leaf and ending in long sharp points; margin repand, non-ciliate; upper surface dark green, shining, glabrous; lower surface light green, dull, glabrous except for pubescent tufts in the axils of the nerves; petiole with milky sap.

Flowers smaller than those of *A. platanoides*, in corymbs. Fruit, glabrous, with horizontally spreading wings, each key about an inch long.

A variety with deeply-cut leaves is described by Tenore; but it is not apparently in cultivation.

This species is readily distinguished by the pyramidal habit, striped bark, and glaucous shoots. It grows in woods in the mountains around the Bay of Naples, and according to Spach¹ is also found in the mountains of Calabria. (A. H.)

Acer Lobelii, which Loudon treats as a variety of the Norway maple, is so distinct in its habit of growth and in its bark that it is well worth cultivation. The largest we have seen in England is at Grayswood, a handsome tree with erect branches about 40 feet high. It is quite hardy as far north as Yorkshire, where Sir Charles Strickland has planted a good many which are now from 25 to 40 feet high and growing vigorously. They all have an erect, fastigate habit. There are two good specimens in Kew Gardens. A large tree was reported² to be growing in 1839 at Croome Court, near Worcester; but when this place was visited by us in 1905, it could not be found.

At Verrières, near Paris, in M. P. de Vilmorin's grounds, this tree has attained 55 feet in height by 5 feet in girth. (H. J. E.)

ACER PICTUM

Acer pictum, Thunberg, *Fl. Jap.* 162 (1784); Shirasawa, *Icon. Ess. Forest. Japon*, text 105, t. 65, ff 1-12 (1900); Brandis, *Forest Flora N.W. India*, 112 (1874), and *Indian Trees*, 183, 705 (1906).

Acer latum, C. A. Meyer, *Verz. Kaukas. Pflanz.* 206 (1831).

Acer cultratum, Wallich, *Pl. As. Rar.* ii. 4 (1831).

Acer colchicum, Booth, in Loudon, *Gard. Mag.* 1840, p. 632.

Acer Mono, Maximowicz, *Bull. Acad. St. Péters.* xv. 126 (1857), and *Prim. Fl. Annur.* 68 (1859).

Acer Mayri, von Schwerin, *Mitt. Deut. Dendr. Ges.* 1901, p. 58; Mayr, *Fremdländ. Wald- u. Parkbäume*, 460, f. 161 (1906).

A tree attaining 60 feet in height; bark smooth, usually striped with white lines or bands. Young branchlets green, glabrous, not glaucous except in one variety, remaining green and smooth in the second year in some varieties, becoming grey or brown with irregular fissures in others. Leaves (Plate 205, Fig. 9), averaging 4 inches long and $4\frac{1}{2}$ inches broad, cordate at the base, entire in margin; lobes long, cuspidate or caudate-acuminate, bristle-pointed, five or seven in number

¹ *Ann. Soc. Nat.* 2 sér. ii. 168 (1834). Cf. also Tenore, *Essai Géog. Roy. Naples*, 81 (1827).

² Loudon, *Gard. Mag.* 1840, p. 44.

in the latter case, with the two basal lobes very small and directed downwards; membranous; shining, green, and glabrous on both surfaces, except for pubescent tufts in the basal axils beneath; petiole containing latex.

Flowers in corymbs, appearing with the leaves, yellow or greenish-yellow, variable as regards the pubescence of the calyx and the relative length of the petals and sepals. Fruit, variable as regards the length and divergence of the wings.

Acer pictum is the representative in Asia of *A. platanoides*, and is very uniform in foliage, though it extends over a wide area. Owing, however, to the remarkable variation in the characters of the fruit, it has been usually divided into two species, which cannot be maintained,¹ as there are numerous connecting links; and the different forms are best treated as geographical varieties.

* *Branchlets remaining smooth and greenish in the second year. Wings of the fruit two to three times as long as the carpels.*

1. Var. *colchicum* (*A. latum*, C. A. Meyer). Asia Minor, Caucasus.

Leaves, five- to seven-lobed, light green in colour, thin in texture. Fruit-wings usually spreading at a wide angle. In the ordinary form of this variety, the leaves are green on opening. This was introduced² in 1838 by Messrs. Booth of Hamburg, plants being in cultivation in the London Horticultural Society's garden in 1840.

In var. *colchicum rubrum*, introduced³ in 1846, the young leaves and young branchlets are deep red in colour.

2. Var. *cultratum* (*A. cultratum*, Wallich). Persia, Himalayas, Central China.

Leaves thicker in texture than the last, usually five-lobed, more truncate at the base. Fruit usually with horizontally spreading wings.

This was introduced⁴ from China in 1901 by E. H. Wilson, and is in cultivation at Coombe Wood, where there are plants now 10 feet in height.

3. Var. *tricaudatum*, Rehder.⁵ Central China.

Leaves, three- to four-lobed; basal lobes small or obsolete. This is a peculiar form, with leaves smaller than in the type, scarcely exceeding two inches long by three inches wide; and was introduced⁶ by Wilson in 1901. Young plants at Coombe Wood are already 14 feet high and are growing very vigorously.

4. Var. *tomentosulum*, Rehder.⁵ Central China. A rare form with the young leaves covered beneath with dense whitish tomentum.

** *Branchlets⁷ becoming grey or brown and fissured in the second year. Wings of the fruit about $1\frac{1}{2}$ times as long as the carpels.*

5. Var. *eu-pictum* (*A. pictum*, Thunberg). Japan.

Leaves darker green and thicker in texture than in var. *colchicum*; lobes

¹ Cf. Rehder, in Sargent, *Trees and Shrubs*, i. 178 (1905).

² Cf. Loudon, *Gard. Mag.* 1840, p. 632.

³ Nicholson, *Gard. Chron.* xvi. 375 (1881).

⁴ *Journ. Roy. Hort. Soc.* xxix. 354, f. 101 (1904).

⁵ In Sargent, *Trees and Shrubs*, i. 178 (1905).

⁶ *Journ. Roy. Hort. Soc.* xxix. 354, ff. 100, 102 (1904).

⁷ Rehder, *loc. cit.*, points out that this character is inconstant, as he has found in several Japanese specimens the bark of the branchlets similar in colour to that of var. *colchicum*.

occasionally short and broad. Fruit-wings erect and parallel or diverging only at an acute angle. Introduced by Maries in 1881.

6. Var. *Mono* (*A. Mono*, Maximowicz). Japan, Saghalien, Amurland, Manchuria, Northern and Central China.

Differs from the last in the wings of the fruit diverging at about a right angle. Introduced¹ from Central China by Wilson in 1901. Plants at Coombe Wood are about 6 feet high.

*** *Young branchlets glaucous.*

7. Var. *Mayri* (*A. Mayri*, von Schwerin). Yezo. This differs from var. *eu-pictum* in the young branchlets being glaucous. Mayr, who discovered the tree in 1886, says that the bark is almost white in colour and hard and smooth. Apparently not yet introduced.

Acer pictum is widely distributed, occurring from Asia Minor through the Caucasus and the Himalayas to China, Manchuria, and Japan. In Asia Minor it is met with in the mountains near Trebizond, where, as in the Caucasus, it grows in mixed forests and beech woods, ascending from sea-level to 5600 feet. It has been collected in Armenia and in the Elburz Mountains of Northern Persia. According to Gamble,² it is the commonest maple in the Western Himalaya, but extends throughout the middle and outer ranges from the Indus to Assam, where it grows as a moderate-sized tree with thin grey bark at elevations ranging from 4000 to 9000 feet. The wood is used in India for construction, ploughs, bedsteads, and carrying-poles; and the Tibetan drinking cups are turned from the knotty excrescences which are often found on this tree.³ Further east the tree is spread throughout the mountains of Western China in the provinces of Yunnan, Szechwan, and Hupeh; and it is found northward in the province of Chihli and throughout Manchuria. It also grows in the island of Saghalien, and is the most common and largest species of maple in Japan, where, according to Sargent,⁴ it is one of the most abundant trees in Hokkaido, occasionally attaining a height of 50 feet and a girth of 5 feet. Elwes, however, saw none as large as this. The tree is beautiful in May, when the flowers are just opening, as the large lengthened inner scales of the winter buds are then bright orange-yellow, and very showy. The autumnal colour of the leaves is described as yellow and red.

This species is usually seen in England as a small tree in botanic gardens and public parks, var. *colchicum rubrum* appearing to be the commonest variety in cultivation, the form from Japan being very rare. The finest trees we have seen are two at Tortworth, one of which is 49 feet high, and 5½ feet in girth, with a very spreading top 45 to 50 paces round, and many suckers from the roots with reddish leaves. Another in the park, is grafted on *A. platanoides*, and has very

¹ *Journ. Roy. Hort. Soc.* xxix, 348, ff. 87, 89 (1904.)

² *Indian Timbers*, 202 (1902).

³ Hooker in *Himalayan Journals*, i. 132, 133, says that some of these cups are supposed to be antidotes against poison, and fetch a very high price. The knotty excrescences are produced on the roots of oaks, maples, and other mountain forest trees in the Himalaya by a parasitical plant known as *Balanophora*.

⁴ *Forest Flora of Japan*, 29 (1894).

handsome bark with purple and green streaks, smoother than that of the stock. At Park Place, Henley, there is a tree 51 feet high, and 4½ feet in girth at 4 feet from the ground, dividing above this into several stems. The bark is smooth and grey, and close to the trunk are several suckers about 4 feet high. (A. H.)

ACER OPALUS, ITALIAN MAPLE

Acer Opalus, Miller, *Dict.* ed. 8, No. 8 (1768); Aiton, *Hort. Kew.* iii. 436 (1789); Loudon, *Arb. et Frut. Brit.* i. 420 (1838).

Acer italum, Lauth, *De Acere*, 32 (1781); Willkomm, *Forstliche Flora*, 762 (1887).

Acer opulifolium, Villar, *Hist. Pl. Dauph.* i. 333 (1786); Loudon, *Arb. et Frut. Brit.* i. 421 (1838); Mathieu, *Flore Forestière*, 40 (1897).

Acer rotundifolium, Lamarck, *Encycl.* iii. 382 (1789).

A tree attaining about 50 feet in height, often met with in the wild state as a mere shrub. Bark smooth and grey on young trees, fissured and darker in colour on old trees. Young branchlets glabrous, becoming dark red in their first autumn. Leaves (Plate 206, Fig. 14), variable in size and shape, usually about 2½ inches long by 3 inches wide, cordate at the base, five-lobed; lobes short, ovate-triangular, acute at the apex, irregularly toothed; sinuses shallow, usually rounded at the base; upper surface dark green, shining; lower surface dull, pale, with scattered pubescence, denser on the nerves and forming axil-tufts, in some forms glabrescent; petiole without milky sap.

Flowers appearing very early, before the leaves, in sessile corymbs, yellow; pedicels long, glabrous or pubescent. Fruit, ripening in autumn, brown, glabrous; keys about an inch long; wings more or less divergent, only slightly narrowed at the base.

In winter the twigs are shining, glabrous. Buds conical, obtuse at the apex; outer scales about twelve, pubescent and ciliate. Lateral buds shortly stalked, arising from the twigs at an acute angle. Leaf-scars very slender, crescentic, three-dotted, and fringed on their upper margins with white hairs; opposite pairs of leaf-scars often joined around the stem.

VARIETIES

This species is very variable as regards the foliage. *A. hispanicum*, Pourret, which grows in Spain, and *Acer Martini*, Jordan, a rare tree in Savoy and Basses-Alpes in France, are connecting links between *A. Opalus* and *A. hyrcanum*.

1. Var. *obtusatum*.

Acer obtusatum, Kitaibel, in Willdenow, *Sp. Pl.* iv. 984 (1805); Loudon, *Arb. et Frut. Brit.* i. 420 (1838); Willkomm, *Forstliche Flora*, 763 (1887).

Leaves (Plate 206, Fig. 16) larger, 4 inches or more in width, more rounded in outline, more coriaceous, more densely pubescent beneath; lobes short, broad, slightly and crenately toothed; basal lobes very short.

This is kept up as a distinct species by Pax and Schneider; but intermediate forms are common, and there are no distinctive characters in the flowers or fruit.

2. Var. *neapolitanum*.

Acer neapolitanum, Tenore, *Fl. Napol.* ii. 372 (1820).

This variety differs from the last in the lobes being still shorter, with the basal lobes often obsolete; and the lower surface of the leaves (Plate 206, Fig. 15) is covered with dense whitish tomentum.

DISTRIBUTION

This species is widely distributed in Southern Europe, extends eastwards into the Caucasus, and also occurs in Algeria and Morocco. The typical form is found in the mountain forests of the south and south-east of France, ascending as high as the silver fir, and is recorded¹ from the Jura, Burgundy, Lyonnais, Dauphiné, Savoy, Alpes Maritimes, Provence, Aveyron, Pyrenees, and Corsica. It rarely attains a height of more than 30 feet, and is often only a bushy small tree. It also grows in South-western Switzerland, extending along the Jura as far north as Neuchâtel, and is also found in the Apennines of Northern and Central Italy.

Var. *neapolitanum* is found in wooded regions in the mountains around Naples, ascending as high as the beech, and attains, according to Tenore,² large dimensions in the Basilicata and Calabria.

Var. *obtusatum* is widely spread through Italy, as far south as Calabria and Sicily, and is common in the Balkan peninsula, extending from Croatia, through Istria, Dalmatia, Bosnia, Servia, and Herzegovina to Roumelia, reaching its most southerly point in the Pindus range. In the Caucasus, according to Radde,³ it is confined to the province of Talysch, where it grows at elevations between 1500 and 5000 feet. It is also found in Algeria and Morocco. (A. H.)

CULTIVATION

This species was introduced, according to Loudon, from Corsica in 1752, and though little known in general cultivation and rarely found in nurseries, has apparently a first-rate constitution, and is perfectly hardy. It ripens fruit in this country; and I have raised plants from seed sent me in 1901 by the Earl of Ducie, which grew the first season as fast as a sycamore, and are now about 10 feet high. It is one of the first of the maples to come into flower, early in March at Kew; and when in full flower the tree has a most handsome appearance. Its leaves colour nicely in autumn; and this maple is well worth a place in pleasure grounds, where it is not particular about soil, if this is well drained.

¹ Rouy et Foucaud, *Flore de la France*, iv. 150 (1897).

² *Essai Géog. Roy. Naples*, 81 (1827).

³ *Pflanzenverh. Kaukasusland*, 184 (1889).

REMARKABLE TREES

The only trees which we know to exceed 50 feet in height are two at Arley Castle, which Mr. Woodward measured in 1905—one 57 feet by 5 feet 1 inch at 5 feet from the ground, and the other 56 feet by 7 feet near the base, where it divides into two stems. The one which I figure (Plate 189) is growing in Sir Hugh Beevor's park at Hargham, Norfolk, and when I saw it in 1905 was 45 feet by 7½ feet with a bole of about 7 feet. There is a tree in Kew Gardens, not far from the Director's office, which is 45 feet high, by 5 feet 10 inches in girth at two feet from the ground, dividing at four feet up into four or five stems. Lord Ducie's tree at Tortworth, not more than forty or fifty years old, is 40 feet by 6 feet. There is a younger one almost as large at Grayswood.

In Scotland the only large one we know is at Smeaton-Hepburn, East Lothian, measured by Henry in 1905 as 45 feet high by 6 feet 3 inches in girth.

At Glasnevin, Dublin, a tree measures 46 feet by 7½ feet; and another at Glenstal, near Limerick, was 47 feet by 4 feet in 1905.

TIMBER

The wood is said by Mouillefert¹ to be like that of the sycamore, but pinkish or pale red in colour, closer in the grain, heavier, and more lustrous, and is esteemed in France by turners, cabinetmakers, and wheelwrights. (H. J. E.)

ACER MONSPESSULANUM, MONTPELLIER MAPLE

Acer monspessulanum, Linnæus, *Sp. Pl.* 1056 (1753); Loudon, *Arb. et Frut. Brit.* i. 427 (1838);

Willkomm, *Forstliche Flora*, 769 (1887); Mathieu, *Flore Forestière*, 43 (1897).

Acer trifolium, Duhamel, *Traité des Arbres*, i. t. 10 (1755).

Acer trilobatum, Lamarck, *Encycl.* ii. 382 (1786).

Acer trilobum, Moench, *Meth.* 56 (1794).

Acer rectangulum, Dulac, *Fl. Haut. Pyr.* 242 (1867).

A small tree, in the wild state rarely attaining 40 feet, and often only a shrub. Bark smooth on young trees, ultimately fissuring. Young branchlets glabrous, green, becoming dark brown in the first autumn. Leaves (Plate 207, Fig. 31) coriaceous, small, averaging 1½ inch long and 2¼ inches broad, cordate at the base, three lobed; lobes ovate, obtuse; sinuses wide, acute at the base; margin non-ciliate, usually entire, rarely toothed; upper surface dark green, shining, glabrous; lower surface pale or greyish, with tufts of pubescence in the axils at the base, elsewhere glabrous; petiole without milky sap.

Flowers, appearing before or with the leaves, in small corymbs, at first erect, afterwards pendulous, yellowish-green; pedicels long. Fruit, ripening in

¹ *Essences Forestières*, 206 (1903).

autumn; keys, $\frac{3}{4}$ inch long, erect, convergent; carpels glabrous; wings brownish or reddish.

The Montpellier maple in the wild state varies in the amount of pubescence on the leaf, the apex of which may be sharp or rounded; and the margin, usually entire, is occasionally toothed. The keys of the fruit are occasionally so convergent as to cross each other in their upper part (var. *rumelicum*, Grisb.).

A hybrid between this species and *A. Opalus*, known as *A. Peronai*, von Schwerin,¹ has been found in the Apennines at Vallombrosa. Another hybrid, *A. rotundilobum*, von Schwerin,² occurs between this species and *A. Opalus*, var. *obtusatum*, and is mentioned in the synopsis, p. 634.

The Montpellier maple is widely spread throughout Southern Europe, from Portugal to Turkey. It occurs also in the mountainous regions of Algeria and Morocco, and extends eastwards through Asia Minor to the Caucasus,³ where it grows at elevations between 3000 and 5000 feet, and to Turkestan. In France, it is common in the south in dry, rocky situations; and ascends on the west as far north as Poitiers and Niort, and on the east to Gap, Lyons, Grenoble, and Chambéry; and, according to Christ,⁴ grows at two spots near Bugey, in the southern Jura. It is found in Germany in the mountains of Rhineland, as far north as Coblenz and in the valleys of the Moselle and Nahe rivers; and also grows at Würzburg in Bavaria. In Switzerland, it is wild near Geneva, in the Jura, at Fort de l'Ecluse.⁵ In Austria, its northern limit extends from the Southern Tyrol, through Carinthia, Carniola, Istria, and Croatia to Banat; and the tree is spread southward through the Balkan peninsula to Greece.

This species has been found⁶ in the fossil state in England, in interglacial deposits at Stone, Hants, and Selsey, Sussex.

It was introduced into England, according to Loudon, in 1739, and in the southern counties thrives very well, ripening its fruit perfectly, and attaining a larger size than any wild trees recorded in Southern Europe.

There are two fine trees in Rickmansworth Park, Herts, growing in a good loamy soil overlying chalk, which, in 1904, measured 50 feet in height by 8 feet 3 inches (Plate 190) and 45 feet by 8 feet 1 inch. There are two good specimens in the grounds behind the Herbarium at Kew, which were covered with flowers on April 1, 1907. These are about 45 feet high, and girth respectively 5 feet 10 inches and 5 feet. There are also trees of a considerable size at Oxford, Fulham Palace, and Bicton. At Ewelme Rectory, Wallingford, there is a wide-spreading tree, which the Rev. Canon Cruttwell informs us is 36 feet high, and 9 feet in girth near the base. At Arley Castle, near Bewdley, there is a tree 35 feet high, by 6 feet 9 inches in girth at one foot from the ground, above which it divides into two limbs.

In the Edinburgh Botanic Garden a tree measures 34 feet by 4 feet 2 inches.

In the Jardin des Plantes at Paris there is a fine specimen, which I measured

¹ Mitt. D. D. Gesell. 1901, p. 59.

³ Radde, *Pflanzenverb. Kaukasusland*. 184 (1899).

⁵ Christ, *op. cit.* 466.

² *Ibid.* 1894, p. 50.

⁴ Christ, *Flore de la Suisse*, Suppl. 64, 65 (1907).

⁶ Reid, *Origin Brit. Flora*, 113 (1899).

in 1904 as 60 feet by 8 feet. At Grignon,¹ a tree resisted without injury the low temperature of -23° cent. in the winter of 1870-1871; and in 1879-1880, when the thermometer fell to -26° cent., it only lost a few of its branches. (A. H.)

ACER INSIGNE

Acer insigne, Boissier et Buhse, *Aufzähl. Transkaukas.*, 46 (1860); Boissier, *Flora Orientalis*, i. 947 (1867); Masters, *Gard. Chron.* x. 189, f. 24 (1891).

A large tree; bark of young stems dark grey, smooth, and marked with longitudinal whitish lines. Young branchlets glabrous, green, becoming dark reddish in autumn. Leaves (Plate 206, Fig. 18) resembling those of *A. Pseudoplatanus* in form and size, scarcely exceeding 6 inches wide and 7 inches long, but usually with somewhat shorter lobes, acute or acuminate; serrations and teeth more rounded than in the sycamore; under surface pale in colour, scarcely glaucous, with loose white or brown pubescence, dense along the sides of the primary and secondary nerves, forming tufts in the axils, and scattered over the surface between the nerves.

Flowers, very distinct from those of *A. Pseudoplatanus*, in erect many-flowered terminal corymbs, appearing with the leaves, small, greenish; bracteoles minute, about $\frac{1}{50}$ inch; filaments glabrous. Fruit, ripening in autumn; keys $1\frac{1}{2}$ to 2 inches long; carpels brown, pubescent on the upper side; wings broad, divergent at an angle of 45° .

In the absence of flowers or fruit, this species is best distinguishable from the sycamore by the buds, which are long and sharp-pointed, with eight to ten external scales, ciliate in margin and with a tuft of pubescence at the tip; lateral buds plainly stalked, arising from the twigs at an acute angle; opposite leaf-scars not joined round the twig, which is glabrous throughout.

Boissier considered that there were two forms of the species growing wild:—var. *velutina*, with leaves velvety pubescent beneath; and var. *glabrescens*, with glabrous leaves. Bornmüller,² who studied the tree, while collecting in Persia, is of opinion that these varieties are unstable, as the amount of pubescence is variable; and all the specimens in the Kew herbarium are more or less pubescent.

(A. H.)

Acer insigne was discovered by Buhse in the eastern Caucasus, in the mountains of Talysch, where, according to Radde,³ it is common in the forests from sea-level to 2000 feet altitude, and grows to a large size, developing a wide crown of foliage on good soil, and thriving best in moist situations. It is also recorded by Radde from the valley of the Alasan river in the central Caucasus. It grows

¹ Mouillefert, *Essences Forestières*, 214 (1903). Cf. also *Actes Premier Congrès Internat. Bot.* 385 (1900), where it is stated that this species sustained at Paris without injury the severe winters of 1879-1880 and 1890-1891.

² *Bull. Herb. Boissier*, v. 643 (1905). Bornmüller recognises three varieties, based on the shape of the leaf:—*typica*, Bornmüller, lobes of the leaf acute or acuminate; *obtusiloba*, Freyn et Sint., *Bull. Herb. Boissier*, iii. 843 (1902), lobes obtuse; and *longiloba*, Bornmüller, lobes three, elongated, acuminate.

³ *Pflanzenverb. Kaukasusland*. 184 (1899).

wild in woods in the provinces of Ghilan and Astrabad in Northern Persia, and is often planted along roads; and in Teheran is cultivated in gardens.

This species was introduced by van Volxem, at the same time as *A. Volxemi*. Dr. Masters received in 1877 from van Volxem three plants, one each of *A. insigne*, *A. Volxemi*, and *A. Trautvetteri*, which he planted in his garden at 9 Mount Avenue, Ealing. His specimen of *A. insigne* first flowered in 1889 and 1890, and is now a very fine tree, 43 feet high and 3 feet 7 inches in girth, as measured by Henry in October 1907. It has a good straight bole, with slender ascending branches, and produces fruit regularly. Two seedlings near it are about three feet high. There are two small trees of *A. insigne* in the collection at Kew, which are less striking in appearance than *A. Volxemi*; but are apparently growing as fast.

At Colesborne, plants raised from seed, received from Lagodechi in the central Caucasus, under the name of *A. Trautvetteri*, and sown in December 1902, are now about 5 feet high. (H. J. E.)

ACER VOLXEMI

Acer Volxemi, Masters, *Gard. Chron.* x. p. 18, figs. 1, 2, and p. 188 (1891).

Acer Van Volxemi, Masters, *Gard. Chron.* vii. 72, fig. 10 (1877).

Acer insigne, Boissier et Buhse, var. *Van Volxemi*, Pax, in Engler, *Jahrb.* xvi. 395 (1892).

This tree is referred by Schneider and von Schwerin to *A. insigne*, var. *glabrescens*, Boissier; but it differs considerably from *A. insigne*, and is either a distinct species or is possibly a hybrid between *A. insigne* and *A. Trautvetteri*, resembling the former more in the shape of the leaves and the latter in the structure of the flowers.

In this species, the leaves are extremely large, often 10 inches wide and 9 inches long, resembling those of the sycamore on a large scale, pale and glaucous beneath, with white pubescence along the sides of the primary and secondary nerves, forming axil-tufts, but not scattered over the surface. The buds resemble those of *A. insigne*; but the twigs differ in being pubescent at the nodes and on the upper edges of the leaf-scars. The flowers resemble those of *A. Trautvetteri*, having long bracts and bracteoles.

This tree is little known in the wild state, the only account¹ being that of van Volxem, who collected seed of it some years before 1877, in the valley² of a tributary of the Kura, above the military station of Lagodechi, on the southern slope of the central Caucasian chain. According to van Volxem, "it is a very large tree, very distinct from *A. Pseudoplatanus* in its larger size and its paler green colour, by which it is recognisable hundreds of yards away. The winged fruits are also smaller. It grows intermixed with *A. Pseudoplatanus* in the same forests, but with no intermediate forms, hence it is not a local form, nor would a mere variety remain distinct

¹ *Gard. Chron.* vii. 72 (1877). Van Volxem's specimens from the Caucasus, from which Dr. Masters drew up his description, cannot now be found; and the species has apparently not been collected by any one except van Volxem.

² Van Volxem names this tributary the Yora (or Jora); but this river lies much to the southward of Lagodechi, the Alasan river intervening.

in the wild state. It does not grow at so great a height on the Caucasus by at least 1000 or 1500 feet, so far as I was able to observe. The form of the tree is more columnar. The light green colour of the leaves makes the difference between the two conspicuous and remarkable. The colour of the bark and the shape of the buds are different." (A. H.)

Introduced from seeds collected by van Volxem in the locality mentioned above, a tree, sent to Dr. Masters in 1877 and planted in his garden at Ealing, grew very rapidly, producing splendid large foliage, silvery white on the lower surface. This tree is still living, but has been headed down, as there was no room for it to develop, and is now only about 15 feet high and 1 foot 10 inches in girth. It has not borne fruit. Dr. Masters told me that all efforts to propagate it by grafts, cuttings or layers failed, though tried by some of the leading nurserymen; and he considered this tree, which he watched from 1877, to be the fastest-growing and the noblest of the maples.

A. Volxemi flowered for the first time in 1891, in Belgium; and its distinctness from the sycamore was then clearly established. A small tree at Kew, now about 20 feet in height, has flowered several times and produced fruit. There are also healthy young trees at Frensham Hall, and in the garden of Mr. Chambers at Grayswood, both of which places are near Haslemere.

M. E. Louis, of Simon Louis Frères, the well-known nurserymen at Metz, informed me in a letter dated October 1902, that he cultivates the true *A. Volxemi*, which is sometimes erroneously called *A. Trautvetteri*.

In November 1902, through the kindness of the Grand Duke Nicholas Mikhailovitch of Russia, I obtained a quantity of fresh seed of this species, as well as of *A. insigne*, from Lagodechi, the original locality; and have raised a number of plants from them. These grow rapidly, but have not as yet ripened their autumnal growths well, and in consequence are rather bushy. The tree may, however, be considered perfectly hardy, and is well worth growing on account of its rapid growth and splendid foliage.

Acer insigne, var. *Wolff*, von Schwerin,¹ raised from seeds sent from the Caucasus by Herr Wolf of St. Petersburg, is apparently, from the description, a variety of *A. Volxemi*, distinguished by the very large leaves, perfectly glabrous and deep purple in colour beneath. (H. J. E.)

ACER TRAUTVETTERI

Acer Trautvetteri, Medwedjeff, ex Trautvetter, *Act. Hort. Petrop.* vii. 428 (1880); Wolf, *Gartenflora*, xl. 263, figs. 58-61 (1891).

Acer insigne, Nicholson, *Gard. Chron.* xvi. 75, f. 14 (1881), and J. D. Hooker, *Bot. Mag.* 6697 (1883). (Not Boissier and Buhse.)

A tree attaining, in the Caucasus, 50 feet in height and 6 feet in girth; bark grey, smooth. Young branchlets glabrous, green, becoming dark red in the first

¹ *Mitt. Deut. Dendr. Ges.* 1905, p. 210.

autumn or winter. Leaves (Plate 206, Fig. 19), about 6 inches long and 8 inches wide, cordate at the base, deeply five-lobed; lobes, oblong or ovate, acuminate at the apex, each with three or four small teeth on the margin, which is neither serrate nor ciliate; sinuses, reaching two-thirds the length of the leaf, acute at the base; upper surface dark green, shining, glabrous; lower surface light green, glabrous, except for conspicuous tufts of reddish-brown pubescence in the axils of the primary and secondary nerves; petioles without milky sap.

Flowers, appearing with the leaves, in erect, long-stalked corymbs; bracts and bracteoles conspicuous, $\frac{1}{8}$ inch long; filaments glabrous, ovary pubescent. Fruit, ripening in autumn; keys $1\frac{3}{4}$ inch long, narrowly divergent; carpels scurfy pubescent when young, glabrous when mature; wings broad.

The leaves are variable as regards the depth of the sinuses, being described by Medwedjeff as either five-lobed or five-partite; and the description above applies to the deeply-cut form, which is in cultivation.

The foliage resembles in size and shape some forms of the sycamore, but can be readily distinguished by the margin being simply dentate and not serrate. The buds are also different. In winter the terminal buds are ovoid, obtuse, with six outer scales, the lower pair of which are shining, dark red and glabrous, with the middle and upper parts ciliate; lateral buds distinctly stalked, arising at an acute angle; twigs polished, dark red, glabrous.

This species was discovered by Radde¹ in 1864 in the Caucasus at an elevation of 6000 feet, and was at first identified by Trautvetter with *A. platanoides*, which it resembles in no respect. It is allied to *A. insigne*, and has a more westerly distribution than that species, growing on both sides of the main chain of the Caucasus, but not extending into Talysch or Persia. It is a tree of high elevations, growing at 6000 to 8000 feet altitude in company with birch and subalpine shrubs, or mixed with *Abies Nordmanniana* on the edges of alpine meadows, and flowers in May. It ascends in many places to the timber line, and at lower levels is replaced in the forests by the Norway maple.² According to Wolf the tree attains 50 feet in height and 6 feet in girth; but Radde¹ gives the measurement of a tree, probably of this species, which was 120 years old and 62 cubic feet in volume.

This species was raised in van Volxem's nursery from seeds collected in 1866 by Balansa in Lazistan, and for a long time was confused with *A. insigne*,³ being described and figured under that name in the *Botanical Magazine*. Van Volxem informed Sir J. Hooker that it was the hardiest of the eighty species and varieties of maple cultivated by him, having withstood without injury the disastrous winters of 1879-80 and 1880-81; and being a late grower, it had never even been nipped by spring frosts. At Kew, where there are two healthy trees, it is one of the latest maples to come into leaf. The tree sent by van Volxem to Dr. Masters flowered

¹ *Pflanzenverh. Kaukasusland*, 108, 175, 225, 310 (1899).

² *Ibid.* 245. Radde speaks of *A. platanoides* and *A. Trautvetteri* growing together in impassable thickets, which are beaten down by the heavy snow.

³ *A. Trautvetteri* has also been confused with *A. Volxemi*, as in *Gard. Chron.* x. 188, note, and 189 (1891). Rehder, in *Cycl. Am. Hort.* 15 (1890), agrees with me that the tree, figured in *Bot. Mag.* 6697, is the true *A. Trautvetteri*, though it differs from wild specimens preserved in the Kew herbarium, in having the leaves more deeply cut.

at Ealing on May 23, 1882, but never throve, and has been dead for some years. This species is very rare in cultivation. I saw a young tree, about 20 feet high, in 1906, at Grignon in France, where it exceeds the sycamore in rate of growth.

(A. H.)

ACER RUBRUM, RED MAPLE

Acer rubrum, Linnæus, *Sp. Pl.* 1055 (1753); Loudon, *Arb. et Frut. Brit.* i. 424 (1838); Sargent,

Silva N. Amer. ii. 107, tt. 94, 95 (1892), and *Trees N. Amer.* 639 (1905).

Acer coccineum, Michaux f., *Hist. Arb. Am.* ii. 203 (1810).

Acer sanguineum, Spach, *Ann. Sc. Nat.* ser. 2, ii. 176 (1834).

A tree attaining in America 120 feet in height and 15 feet in girth; with ascending branches. Bark of young stems smooth and light grey, becoming on old trunks darker, ridged, and separating on the surface into plate-like scales. Young branchlets green or red, slightly pubescent towards the tip. Leaves (Plate 207, Fig. 27) very variable in size, averaging 3 inches long and broad; either five-lobed, with two very small basal lobes, or three-lobed, the middle lobe the longest; lobes short, triangular, acute or acuminate at the apex; sinuses very shallow, acute at the base; base of the leaf truncate, slightly cordate or shortly cuneate; margin non-ciliate, irregularly toothed, or doubly serrate; upper surface dark green, glabrous; lower surface silvery white, scattered pubescent, without axil-tufts; petioles without milky sap. The leaves turn scarlet or orange in autumn.

Flowers appearing early in spring before the leaves, in few-flowered, umbel-like clusters encircling the branchlets of the previous year; dioecious or monoecious; reddish; pedicels long; petals present; ovary glabrous. Fruit hanging on drooping stalks, ripening in June, and germinating as soon as it falls upon the ground; keys glabrous, about an inch long, at first convergent, afterwards divergent, brown or reddish in colour.

The red maple can only be confused with the silver maple, from which it differs in the ascending branches and in the shape of the leaves, which are usually only three-lobed, always have very shallow acute sinuses, and are less cordate (often truncate) at the base than in *A. dasycarpum*. In winter the twigs are glabrous, reddish; leaf scars very narrow, three-dotted, opposite pairs not united around the stem. Buds small, shortly stalked, reddish; external scales, six to eight, fringed with whitish cilia; lateral buds arising from the twigs at an angle of 45°.

VARIETIES

In addition to the typical form, above described, Sargent admits two well-marked varieties, occurring wild in America.

1. Var. *Drummondii*, Sargent. (*Acer Drummondii*, Hooker and Arnott, *Journ. Bot.* i. 200 (1834).) Leaves three-lobed, with short broad lobes, and covered on

the under surface, like the young branchlets and petioles, with hoary tomentum. Flowers and fruit bright scarlet. The variety is found in deep river swamps of Southern Arkansas, Eastern Texas and Western Louisiana.

2. Var. *tridens*, Wood.¹ Leaves three-lobed at the apex, rounded or cuneate at the base, thick and firm in texture, serrate except towards the base with remote incurved glandular teeth. Flowers sometimes yellow; fruit usually much smaller and rarely also yellow. This variety occurs in the coast region from Southern New Jersey to Southern Florida, and along the Gulf Coast to Eastern Texas.

A large number of varieties, based on trivial characters, are given by Pax and von Schwerin as occurring in cultivation, the most noteworthy of which is var. *sanguineum*, with the leaves deeper green above, bluish-white beneath, and turning a brilliant red in autumn. In cultivated trees in England there are marked differences in the size and shape of the leaves and in the amount of pubescence on their under surface; but these differences are not worth naming. Columnar and bushy rounded forms are known; and a pendulous form is also mentioned in the Kew Hand List, which seems, however, to be a form of *A. dasycarpum*.

(A. H.)

DISTRIBUTION

In America this tree is one of the commonest and most widely distributed, extending from about lat. 49° N. in Quebec and Ontario, south to Florida and west to Wisconsin, Iowa, and the Trinity river in Texas; abundant in the Mississippi valley, and attaining its largest size on the lower Ohio and in the Wabash valley, where Ridgway measured a tree 108 feet by 15 feet, with a clean bole 60 feet long, and says that larger trees could be found. In New England it grows abundantly in swamps and low ground, and is usually a tree of no great size, so far as I have seen. Emerson records no large trees, while Michaux says that he nowhere saw it larger than in the swamps of New Jersey and Pennsylvania, where it is often 70 feet high and 3 to 4 feet in diameter. It is the earliest tree in flower and was nearly over in the middle of May, near Boston, when the leaves were partly developed. Emerson says that they vary remarkably in size and shape, being sometimes broad and five-lobed, sometimes long and narrow, and are liable to become of a scarlet, crimson, or orange colour at all seasons, sometimes at midsummer, long before other trees have changed colour. He thinks that the frost has little to do with the autumnal coloration of leaves, and that the greater intensity of the light and transparency of the air is the reason why the leaves of trees usually turn so much more brilliant in colour in America than in Europe.

A fastigate tree of this species is illustrated in *Garden and Forest*, vii. 65 (1894), where it is erroneously² called a sugar maple. It grows in the grounds of Mrs. Leavitt at Flushing, New York, and is 80 feet high. Sargent adds that only two other American trees, the tulip tree and the Robinia, are known to have produced forms with fastigate branches.

¹ Cf. Rehder, in *Rhodora*, ix. 116 (1907).

² Mr. W. A. Stiles, in a letter to Kew, dated March 28, 1894, corrects this error.

CULTIVATION

This is the commonest in cultivation of all the American maples, except *A. Negundo*, and was the first to be introduced, having been cultivated by Tradescant as long ago as 1656. Miller says that a tree produced seed in his time from which plants were raised in the Bishop's garden at Fulham; and, according to Loudon, one of these in 1793 was 40 feet by 4 feet 3 inches, but was dead before 1809. It was often confused with the silver maple, and even Loudon says that they are only varieties of one species, though he treats them under separate names. No one, however, who has seen them in their native country could doubt their distinction, which was first established by Linnæus.

The red maple is perfectly hardy everywhere in Great Britain, but requires considerable summer heat and a good soil to bring it to any size. On dry sandy soils it is a stunted tree of no beauty. Its seed, like that of the silver maple, ripens early and must be sown at once, but Loudon says that in his time it was propagated by layers, which, coupled with insufficiency of moisture in the soil, may account for the rarity of fine specimens.

I have raised seedlings this year from seeds sent me from Arley by Mr. R. Woodward in July, when he found them germinating freely below the parent tree; and Mr. Knowles, gardener to H.R.H. the Duke of Connaught, tells me that he has found self-sown seedlings at Bagshot Park.

REMARKABLE TREES

At no place in England, so far as we know, are there so many fine red maples as at Bagshot Park, the seat of H.R.H. the Duke of Connaught. When I visited this place on May 22, 1907, the fruit was so abundant on trees in an open wood that it gave them quite a red appearance. The largest of these that I measured was 82 feet by 9½ feet, with a bole about 20 feet long (Plate 177). There is another on the bank of the lake at Claremont which measures about 75 feet by 9½ feet.

At Whitton, near Hounslow, there is a large tree, probably 150 years old, near the group of *Taxodium distichum*, in ground which has moisture beneath, and in 1904 it measured 80 feet by 8 feet 5 inches, but as this tree is not mentioned by Loudon, it may not be so old as we think, though decay has already commenced (Plate 192). At Walcot there is a tree which in March 1904 was in flower, and measured 68 feet by 6½ feet. At Arley Castle there is a fine tree with mistletoe growing on it, which produced seed freely in 1907, and measures about 60 feet by 7½ feet.

In a wood south of Virginia Water in Windsor Park, Henry measured, in 1906, a tree 80 feet by 6 feet 2 inches; and at South Lodge, Enfield Chase, there is a tree which was 50 feet by 6 feet 7 inches in 1904.

A variety under the name of *globosum*, which I saw growing in an ornamental

plantation in Silk Wood, Westonbirt, Gloucestershire, was conspicuous among all other trees for its brilliant scarlet leaves and upright habit, in October 1907.

In Scotland it grows well as far north as Brahan Castle, Ross-shire, the seat of Col. Stewart Mackenzie of Seaforth, where in 1907 I measured a tree about 50 feet by 12 feet 2 inches; and at Gordon Castle an old tree at the west end of the holly bank, was in the same year 55 feet by 6 feet 2 inches. There is also a good-sized tree close to the lodge at Moncreiffe House, near Perth, which I believe to be a red maple.

In Ireland Loudon mentions one at Woodstock, which at 60 years old was 50 feet high, but Henry could not find it now living. (H. J. E.)

ACER DASYCARPUM, SILVER MAPLE

Acer dasycarpum, Ehrhart, *Beit.* iv. 24 (1789).

Acer saccharinum,¹ Linnæus, *Sp. Pl.* 1055 (1753); Sargent, *Silva N. Amer.* ii. 103, t. 93 (1892), and *Trees N. Amer.* 638 (1905).

Acer eriocarpum, Michaux, *Fl. Bor. Am.* ii. 203 (1803); Loudon, *Arb. et Frut. Brit.* i. 423 (1838).

A tree attaining in America 120 feet in height and 12 feet in girth, the stem usually dividing at a short distance from the ground; ultimate branches pendulous, long, and slender. Bark of young trees smooth and grey, on old trunks dark in colour, ridged, and separating on the surface into thin loose scales. Young branchlets glabrous, green, becoming shining brown in the first autumn. Leaves (Plate 207, Fig. 28) about 5 inches long, 6 inches wide, usually cordate at the base, five-lobed; basal lobes well developed; lobes long acuminate at the apex, with serrated triangular teeth or lobules; sinuses rounded at the base and concave on the sides, extending halfway or more to the base of the blade; upper surface glabrous, shining green; lower surface silvery white, scattered pubescent, without axil-tufts; petiole without milky sap. The leaves turn yellow in autumn.

Flowers appearing before the leaves, earlier even than those of *A. rubrum*, greenish yellow, diœcious or monœcious, in crowded fascicles on the branchlets of the previous year; pedicels very short, petals absent, ovary pubescent. Fruit on slender drooping stalks, ripening in America in May or June, earlier than that of *A. rubrum*, and germinating as soon as it falls; keys woolly when young, ultimately glabrous, widely divergent, pale brown, $\frac{3}{4}$ to $1\frac{1}{2}$ inch long.

The silver maple can only be confused with the red maple, and the marks of distinction are given under the latter species. In winter, the twigs are indistinguishable from those of *A. rubrum*.

¹ This name, which was first given to the silver maple by Linnæus, was subsequently transferred to the sugar maple by Wangerheim and remained in universal use for the latter species during many years. In 1889, Sargent, in *Garden and Forest*, ii. 364, re-established it as the name for the silver maple, and he has been followed in this by most American botanists and foresters. The usage, however, of *A. saccharinum* for the silver maple, and of *A. saccharum* for the sugar maple, is confusing; and we have adopted *A. dasycarpum* for the former, as being a name long in use, and one which has never been applied to any other species.

VARIETIES

The most remarkable are:—var. *laciniatum*, leaves deeply divided into narrow lobes; and var. *tripartitum*, in which the division of the leaves is carried to the midrib. Various intermediate forms, as regards the shape of the leaf, have also received names, which are not worth recognition. Variegated forms are also known in cultivation. (A. H.)

DISTRIBUTION

The silver maple extends from New Brunswick through Southern Ontario to Eastern Dakota, Nebraska, Kansas, and Indian Territory on the west, and southward to Florida; but is rare near the Atlantic coast and on the higher Alleghany Mountains. Sargent gives an excellent article¹ on this species, with an illustration of a tree growing in the open near Boston, and says that it is an inhabitant of low sandy river banks, and grows to its greatest size on the tributaries of the lower Ohio, where it sometimes attains 120 feet in height and 9 to 12 feet in girth. Ridgway measured one in the lower Wabash Valley, which was 118 feet by 14 feet. Michaux says that near Pittsburg, trees of 12 to 15 feet in girth were common on the bank of the river, sometimes alone and sometimes mixed with the willow. Emerson states that in Massachusetts he measured a tree² $12\frac{1}{2}$ feet in girth in a meadow near Northampton, and that another near Lancaster was 16 feet 8 inches round at 6 feet from the ground.

In Canada, where I saw it on the sandy banks of the Gatineau River, near Ottawa, close to its northern limit, it was no larger than in England, but the colour of the leaves was more beautiful than it ever becomes in cultivated trees with us, as is usual in the case of deciduous trees in America. In the open situations which it usually frequents, it is a wide-spreading tree; and Michaux says that it forms a more spacious head than any other tree that he knew.

The fruit, if not destroyed by spring frost, which often happens, ripens in a few weeks after the time of flowering; and if it falls on moist open ground, germinates at once, and sometimes produces plants nearly a foot high before winter. Sargent suggests that this rapid ripening, which is peculiar to the red and silver maples, is a provision of nature for their preservation in situations where the seed, if it ripened in autumn, like other maples, would be water-logged by floods and lose its vitality.

Sargent considers it a valuable tree for ornamental planting, only in deep moist meadow land, or by the banks of streams, where it can spread its long and graceful branches and show its brilliant foliage. This is quite borne out by the specimens which I have seen in England. It is one of the favourite trees for planting in many of the northern cities of the United States.

¹ *Garden and Forest*, iv. 133 (1891).

² Fifty-two years later, in 1890, we learn from a note in *Garden and Forest*, iii. 36, that this tree was 17 feet 4 inches in girth at the same height, having made an annual increase in girth of more than an inch. Though the trunk was partly hollow and some of the branches were gone, the tree was still growing vigorously and might live for many years more.

CULTIVATION

This tree was introduced by Sir Charles Wager in 1725, and is still known in some catalogues and gardens as Wager's maple. It was formerly commoner in cultivation than now, and deserves a place in every garden where a suitable situation can be found; being perfectly hardy at least in the southern half of England, and one of the most beautiful-leaved trees we have both in spring and autumn. The seed is difficult to procure, as it ripens so early in the season—though Loudon says it ripens in England, I have never seen any,—and according to Dawson¹ should be sown directly it is ripe, and shaded and watered during the first summer. It is, however, easy to procure young trees by post from America in autumn, and such will I believe make better trees than the grafted ones which are usually sold in Europe.

Dr. Masters² says that this is one of the best and most elegant trees for planting in towns; but that he never saw a tree of the kind of such proportions as one on the ramparts at Ypres in Belgium.

REMARKABLE TREES

The tallest tree of this species I have seen in England is in a shrubbery at Cobham Hall, Kent, where, however, it has been too much crowded to develop its natural habit and beauty. It is about 77 feet by 9 feet, with a clean bole of nearly 30 feet. There are some trees on Ashampstead Common, Berks, of which the largest is about 65 feet by 8 feet.

At Rickmansworth Park, I measured a tree 60 feet by 12 feet which grows on the banks of the stream and spreads to a diameter of 30 paces. At Barton, Suffolk, there is a very spreading tree on a lawn, forked close to the ground, and 68 feet high, with two main stems 9 feet 3 inches and 6 feet 3 inches in girth. At Hampton Court, Herefordshire, there is an old tree in the lower park on rich alluvial soil, which, when measured by Mr. Hogg in 1881, was 65 feet by 11 feet 5 inches. When I saw it in 1905 it had lost its top and was decaying, though it had increased in girth to 12 feet 3 inches. At Woburn, in rich damp soil near a pond, there is a handsome spreading tree, with a short bole, 53 feet high by 9 feet 5 inches; and at Syon a tall slender tree, 58 feet high and only 3 feet 3 inches round, has smooth bark like that of a beech. At Arley Castle there is a fine tree 61 feet by 4 feet which, according to Mr. R. Woodward, was only planted in 1877. Smaller and younger trees are found in many gardens; but in the North and West of England we have seen none worthy of record, and Loudon mentions no trees equal to those above mentioned.

In Scotland, Mr. W. Middleton Campbell has measured a tree at Camis Eskin, near Helensburgh, which is 58 feet by 11 feet 1 inch.

In Ireland, Henry has seen no large silver maples, and one at Glasnevin, 45 feet high by 6½ feet in girth, is badly shaped and not thriving.

¹ *Trans. Mass. Hort. Soc.* 1885, p. 153.

² *Gard. Chron.* xxxvi. 267 (1904).

TIMBER

All accounts agree in stating that the timber is softer, lighter, and weaker than that of the red or sugar maples, and in consequence is only used as an inferior substitute for these or other similar woods.

The sap of the silver maple is sometimes used to produce sugar in places where the sugar maple is not found, and Michaux says that though the quantity is only half as much, yet the unrefined sugar is whiter and more agreeable to the taste than common maple sugar. (H. J. E.)

ACER SACCHARUM, SUGAR MAPLE

Acer saccharum,¹ Marshall, *Arbust. Am.* 4 (1785); Sargent, *Trees N. Amer.* 632 (1905); Trelease, *Missouri Bot. Garden Report*, v. 88 (1894).
Acer saccharinum, Wangenheim, *Nordam. Holz.* 26 (1787) (Not Linnæus); Loudon, *Arb. et Frut. Brit.* i. 411 (1838).
Acer barbatum, Michaux, *Fl. Bor. Am.* ii. 252 (1803); Sargent, *Silva N. Amer.* ii. 97, t. 90 (1892).

A tree attaining in America 120 feet in height and 12 feet in girth. Bark grey and smooth on young stems, deeply furrowed on old trunks. Young branchlets glabrous, becoming brown in their first summer. Leaves (Plate 206, Fig. 12), about 5 inches long by 6 inches wide, usually five-, rarely three-lobed, cordate at the base; lobes triangular, acuminate, with one or two pairs of sinuate teeth; sinuses rounded and shallow, reaching about one-third the length of the blade; margin non-ciliate; upper surface dark green, glabrous; lower surface pale, dull, with pubescent tufts in the primary and secondary axils, elsewhere either glabrous or more or less pubescent; petiole without milky sap. Leafy stipules,² with bases adnate to the petiole, are occasionally developed in var. *nigra* of this species.

Flowers, monœcious or diœcious, appearing with the leaves, arising from terminal leaf-buds and from lateral leafless buds, in nearly sessile corymbs, greenish-yellow; pedicels long, thread-like, pubescent; petals absent; ovary with long scattered hairs. Fruit, ripening in autumn, glabrous; keys about an inch long; wings broad, thin, usually divergent.

This species in the form of the foliage somewhat resembles the Norway maple; but is readily distinguishable by the pale colour of the leaves beneath, and the absence of milky sap in the petioles. In winter, the buds are conical, sharp-pointed, and pubescent, showing externally 8 to 14 scales; lateral buds shortly stalked; opposite pairs of leaf-scars not united around the stem, their upper margins fringed with yellowish hairs.

¹ This is the name now adopted by Sargent, by Sudworth, *Check List of Forest Trees of U.S.* 91 (1898), and by other American botanists and foresters. *Acer saccharinum*, Wangenheim, is a later name, and must be dropped, especially as *Acer saccharinum*, Linnæus, is now commonly used in America for another species, the silver maple.

² Gray, *Amer. Naturalist*, vi. 767 (1872), and vii. 422 (1873); and Sargent, *Garden and Forest*, iv. 148 f. 27 (1891).

VARIETIES

The sugar maple is very variable in the wild state, and certain varieties of it are now recognised as distinct species by Sargent in his latest book on American trees. Two of these—*Acer floridanum*, Pax, a moderate-sized tree, growing in the Southern States and in Texas and Mexico, and *Acer leucoderme*, Small, a low tree ranging from North Carolina to Arkansas—would probably not be hardy if introduced, and need not be further mentioned by us. *Acer nigrum*, Michaux, now considered by Sargent to be a distinct species, is best treated as a variety of *A. saccharum*, and is to be carefully distinguished from var. *Rugelii*, with which it has been confused.

1. Var. *nigrum*, Britton, *Trans. N.Y. Acad. Sci.* ix. 10 (1889).

Acer nigrum, Michaux f. *Hist. Arb. Am.* ii. 238, t. 16 (1810); Sargent, *Garden and Forest*, 1891, p. 148, f. 27, and *Trees N. Amer.* 634 (1905).

Leaves green beneath, cordate at the base, with the basal sinus closed by the approximation or overlapping of the lobes; sides of the blade drooping; lobes usually three, occasionally five; acute, entire or obtusely toothed. Bark of old trees deeply furrowed, sometimes almost black. Young branchlets orange-coloured.

This variety, according to Sargent, is widely distributed, extending from Ontario and the valley of the St. Lawrence, near Montreal, southward to Virginia and Kentucky, and westward through Michigan, Indiana, Illinois, Iowa, and Missouri to South Dakota and Kansas. It is comparatively rare near Montreal and Vermont, becoming more abundant farther west, almost replacing the type in Iowa, and the only form in South Dakota. It was first noticed by the younger Michaux on the banks of the Genesee River in New York, where it still forms a forest of considerable size.

Loudon states that the black sugar maple was introduced in 1812; but it is now very rare in cultivation. Var. *monumentale*, Temple, a tree of upright columnar habit, occasionally seen in botanic gardens, is a form of var. *nigrum*.

2. Var. *Rugelii*, Rehder, in Sargent, *Trees N. Amer.* 633 (1905).

Acer barbatum, Michaux, *Pl. Bor. Am.* ii. 252 (1803).

Acer barbatum, var. *nigrum*, Sargent, *Silva N. Amer.* ii. 99, t. 91 (1892).

Acer Rugelii, Pax, in Engler, *Bot. Jahrb.* vii. 243 (1886).

Leaves pale beneath, papery in texture, three-lobed, entire or with short obtuse teeth. This is the common and frequently the only form of the sugar maple in the region from North Carolina and Georgia to Missouri; and is occasionally met with as far north as Michigan and Prince Edward's Island, leaves of this form sometimes appearing on the upper branches of trees, which bear on their lower branches typical leaves of the ordinary form of the species. This variety does not appear to be in cultivation in England. (A. H.)

DISTRIBUTION

The sugar maple is one of the most widely and generally distributed trees in Eastern North America. The northern limit of its range on the Atlantic coast is Southern Newfoundland. It extends through Canada and the Northern States southwards along the Alleghany Mountains to Northern Georgia and West Florida, and westward along the valleys of the St. Lawrence and the Saguenay, by the shores of Lake St. John and the northern borders of the Great Lakes to the Lake of the Woods, and in the United States to Minnesota, Nebraska, Eastern Kansas, and Eastern Texas. It is common in all these regions, growing especially on rich uplands mixed with ashes and hickories, white oak, wild cherry, black birch, yellow birch, and hemlock, and often in the north forming the principal part of extensive forests. The undergrowth in some of the forests near the northern border of the United States is often composed almost entirely of young sugar maples, which grow readily under the dense shade of other trees. The type is more prevalent in the north—var. *Rugelii* and var. *nigra* in the central States, while var. *leucoderme* and var. *floridanum* appear to be the only forms found in the south.

Much of the splendour of the northern forest in early autumn is due to the abundance of the sugar maple, which is then unsurpassed by any other tree in brilliancy of colouring, the foliage turning to shades of deep red, scarlet, orange, or clear yellow.

A figure of an unusually large tree, showing the habit which it assumes when in the open, is given in *Garden and Forest*, v. 380 (1892). It grows on the farm of Mr. L. Parker, forty-five miles east of Cleveland, Ohio, and measures 13½ feet in girth at 2 feet from the ground, with very large limbs spreading over an area 100 feet in diameter. It has been tapped annually without any apparent ill-effects, and yields each year three gallons of syrup. Another illustration in *Garden and Forest*, iii. 167 (1890), of a tree exposed on a stony hillside in New Hampshire is of a very different type, and shows the habit of an adult tree which has lost the narrow upright form of growth it usually has when young.¹

REMARKABLE TREES

Though introduced at a very early period (the date is given by Loudon as 1735, on whose authority we know not), the sugar maple has rarely thriven in England, or, so far as we know, in Europe. The reasons for its failure to grow in this country are as mysterious as in the case of the white oak, the American beech, and other trees of the Eastern States; but it seems a short-lived tree, and seldom attains any considerable size. Loudon mentions several trees of no great age 20 to 40 feet high, and one at Purser's Cross which was 45 feet. But none of these, so far as we can learn, are now living, and some maples which have been reported under this name turn out to belong to other species. We know,

¹ The fastigate tree, supposed to be of this species, is really *A. rubrum*. Cf. p. 672.

however, of several worthy of mention, of which the largest is growing at Park Place, near Henley-on-Thames, in the grounds of Mrs. Noble. This tree is in a thick wood on loamy soil overlying chalk, and if upright would be probably over 60 feet high. It leans, however, very much to one side, where the branches extend as much as twenty paces from the trunk. It has a short bole of 8 feet, which girthed 9 feet 2 inches when I measured it in 1905. There were a few fruits on it, which, however, seemed unlikely to ripen. (Plate 191.)

Sir Hugh Beevor has lately discovered a tree in the grounds of Sir Robert Dashwood at West Wycombe, which is 83 feet high by 5 feet 11 inches in girth. It is nearly dead, being probably killed by mistletoe, as many of the branches show large spindle-shaped swellings, caused by this parasite.

At Arley Castle there is a tree which measured, in 1907, 64 feet high by 4 feet 8 inches in girth. At Dropmore one in a wood is 45 feet by 4 feet 10 inches. There are also small trees at Cornbury Park and at Tortworth. There is a healthy specimen at Syon 55 feet by 5 feet 1 inch, which had some seed in 1905. At Barton, Suffolk, there is an ill-shaped tree much crowded by others, which measures about 50 feet by 4 feet 6 inches.

Mr. Bartlett reports that there are five trees of this species at Pencarrow, and that another at Tredethy, Cornwall, is 50 feet high by 3 feet 5 inches in girth.

The Hon. Vicary Gibbs informs us that at Tyntesfield, Somersetshire, a number of sugar maples are growing, which are about fifty years old. The soil being shallow they have made low heads with very stout lateral branches. He has raised some seedlings from them at Aldenham. Young trees, which I raised from seed gathered near Boston in September 1904, have grown fairly well at Colesborne, and are now about 3 feet high.

TIMBER

The wood of the sugar maple has been well known in commerce for a long period, and at one time the variety of it which is known as bird's-eye maple was very fashionable for furniture and cabinet-making, though it is now little used for first-class work in England.

The best account I know of the varieties of maple wood is in Hough's *American Woods*, i. 50-51, where he says that there are peculiar freaks in the growth of timber as yet unexplained, but of which this is one of the most important from a commercial point of view, as well as one of the most beautiful. They are known as "blister," "bird's-eye"¹ or "pin," and "curly" figures. The first two are almost peculiar to the "hard" or sugar maple. The last is found even more commonly in the red and silver or "soft" maples as they are called in the United States and Canada. The three varieties of figure are often found more or less mixed in the same tree, and it requires much experience to detect their presence in the growing tree.

The blister variety, which is much the rarest, usually has a massive trunk in

¹ In bird's-eye maple there is a succession of elevations and depressions in the annual layers of the wood, and Hopkins considers that this is probably due to punctures made in the bark by woodpeckers. Cf. *Garden and Forest*, vii. 373 (1894).

proportion to its top, and on removing a piece of bark the surface of the wood is found to be covered with wart-like swellings. The figure is best on the outside, falling off as the heart is approached. In order to show it, the log is cut on a lathe, which slices off a thin shaving all round, producing what is called a knife-cut veneer. The bird's-eye variety may be detected by small pits in the bark, usually inconspicuous, which correspond to small pits all over the wood, and, like the other, has a head usually small as compared with the trunk.

Maple wood also shows when cut radially a very fine silver grain, which to my eye is almost as beautiful as the other figures. The colour is normally white, but when the trees are old assumes a pink or reddish tint. It is also very much used in its plain form for shipbuilding, flooring, and all purposes where strength, durability, and close texture are required, and is largely imported in the form of prepared blocks, which, when properly fitted and laid, make a durable good floor.

Maple sugar, usually, though not always, the produce of *Acer saccharum*, is derived, by boiling, from the sap which flows from the tree in spring. Though it is in the opinion of most people one of the best kinds of sugar known, and, especially in the form of syrup eaten with buckwheat cakes, is one of the most favourite of American table delicacies; it is so little known to English readers that we do not think it necessary to describe the process of manufacture, which has been given at length by Loudon, Michaux, and other writers on American trees.¹ An article on this subject was published in *Kew Bull.*, 1895, p. 127; and an interesting letter on the domestic uses of maple sugar and maple syrup, by Miss Boyle of Maywood, New Jersey, appeared in *The Garden*, lxxv. 152 (1904). (H. J. E.)

ACER MACROPHYLLUM, OREGON MAPLE

Acer macrophyllum, Pursh, *Fl. Amer. Sept.* i. 267 (1814); Loudon, *Arb. et Frut. Brit.* i. 408 (1838); Sargent, *Silva N. Amer.* ii. 89, tt. 86, 87 (1892), and *Trees N. Amer.* 628 (1905).

A tree attaining in America 130 feet in height and 15 feet in girth. Bark of old trees thick, rough, deeply furrowed, and broken on the surface into small plate-like scales. Young branchlets glabrous, green, remaining green or becoming dark red in their first winter. Leaves (Plate 205, Fig. 3) very large, averaging 9 inches in breadth and length, deeply and usually narrowly cordate at the base; lobes five, with acute or acuminate apex, and large triangular lobules or teeth; sinuses deep, extending more than half-way the length of the blade, rounded at the base; margin ciliate; upper surface dark green, shining, scattered pubescent; lower surface light green, glabrescent between the nerves, with tufts of white pubescence in the axils; petiole with milky sap.

¹ The most complete account is given in *U.S. Dept. Agric., Forestry Bulletin No. 59; The Maple Sugar Industry*, by Fox and Hubbard, Washington, 1905. Cf. also *U.S. Dept. Agric., Forest Service, Circular 95* (1907), which gives notes on the cultivation and economic uses of the sugar maple.

Flowers, staminate and pistillate together, in pendulous racemes, appearing when the leaves are fully grown, bright yellow, fragrant; pedicels slender, pubescent, often branched; stamens nine or ten, filaments pubescent; ovary tomentose. Fruit, ripening in autumn, brown, the carpels covered with long, pale hairs, which extend along the thickened edge of the wing; keys slightly divergent, about 2 inches long.

(A. H.)

DISTRIBUTION

This species, which is the largest of the American maples, is confined to the Pacific coast, where it extends from about 55° N. in Alaska to the San Bernardino Mountains of Southern California, but never, according to Sargent, far from the coast or ascending the mountains higher than about 2000 feet. It is the largest deciduous tree in Vancouver Island except *Populus trichocarpa*, and I believe also in Washington and Oregon, though surpassed by some of the oaks in California. It attains its maximum size in the wet and mild climate of Puget Sound, especially in the Olympic Mountains, and grows with the luxuriance of a tropical tree covered with ferns, moss, and climbing plants. The beautiful photograph (Plate 193), for which I am indebted to Mrs. Browne of Tacoma, was taken near Lake Cushman in the Olympic Mountains. I cannot give exact measurements of these trees, but the height was estimated at 130 feet.¹ On Capt. Barkley's farm, north of Duncans, Vancouver Island, I measured several trees of 110 to 120 feet high, and on Swallowfield farm two trees on the banks of a river, of about the same height, one being 12 feet, the other 13 feet in girth. A gigantic spreading tree on the same farm had a swelling butt, no less than 15 paces round at the ground, but of no great height. It grows as a rule in flat meadows with Douglas fir, *Abies grandis*, and *Thuja plicata*, and likes a fairly damp soil. Farther south in the drier country of Oregon, it is smaller; Sheldon says 50 to 90 feet high by 6 to 15 feet in girth. In the dry country of Northern California about Lake Tahoe it becomes a low crooked tree only 8 to 20 inches in diameter. Its large keys are produced very abundantly, and when ripe add to the ornamental appearance of the tree.

CULTIVATION

Discovered by Menzies during Vancouver's voyage to British Columbia, it was introduced into England in 1812. Douglas sent home seeds to the Royal Horticultural Society about 1827, from which we believe the oldest trees in England have grown. But though very easy to raise and a very rapid grower when young, it does not ripen its young wood when quite young, this being often killed back by the frosts of winter, sometimes to the ground; but as the trees get older this failing decreases. Though the tree is hardy, at least as far north as East Lothian,

¹ Mr. F. R. S. Balfour of Dawick tells me that in the deep alluvial soil of the valley above Lake Cushman, this tree attains an immense size, being well sheltered by the steep mountains around. The maples grow here mixed with *Abies oregona*, *Populus trichocarpa*, and *Thuja plicata*; and though overtopped by the last two, he estimated the maples at over 150 feet high. He also saw it of great size in the Puyallup Valley, and at the mouth of the Nisqually River in Washington; and adds that it is being extensively planted as a shade tree in the towns of the Pacific coast.

it has never become common, and is not often to be had from nurserymen. It is well worth cultivation on account of its large and beautiful foliage, and should be planted in deep moist soil in a warm aspect where it is sheltered by other trees at first. It ripens seeds in England, and I have raised plants from some sent me by the Earl of Ducie in 1900, which are now over 8 feet high.

It does fairly well as a planted tree in the lighter alkali lands of the San Joaquin valley in California, where only a few species will thrive, owing to the nature of the soil.¹

REMARKABLE TREES

The largest specimen I know of the Oregon Maple is one at Boynton, Yorkshire, which Sir Charles Strickland to the best of his recollection planted himself about sixty years ago. It is not a well-shaped tree, as it is rather crowded, but measures 70 feet high by 6 feet in girth. There is another at Hildenley, probably of the same age, which measures 50 feet by 5 feet and bears fruit. There are several trees in Kew Gardens, the largest of which, near the entrance to the nursery, is 49 feet high by 3 feet 8 inches in girth. At Tortworth there is a tree in a rather exposed situation which is 45 feet by 5 feet 6 inches. At Syon a grafted tree is 50 feet high but only 3 feet in girth, and bore some fruit in 1905. In the Royal Avenue at Bath there is a tree 50 feet by 6 feet 2 inches, but it is not in a thriving condition, the soil being too dry to suit it. At Bicton, now the property of Lord Clinton, one of the most thriving young trees which I have seen grows near the house; and was in 1906 about 50 feet high but only 2 feet 9 inches in girth.

At Smeaton-Hepburn, East Lothian, there is a wide-spreading tree, with a bole of 6 feet, which Henry measured in 1905 as 50 feet high by 7 feet in girth.

At Glasnevin, Dublin, there is a fine tree, which in 1907 measured 51 feet high by 5 feet 4 inches in girth. There are two others about 40 feet high, with wide-spreading branches, growing in the quadrangle inside the main gate of Trinity College, Dublin.

TIMBER

This wood, though unknown in Europe, is equal in beauty, and similar in character to that of the eastern maples, and is more valued than any other native hardwood in British Columbia and Washington. In old trees it is often very well figured, though the figure is larger, bolder, and less regular than in the sugar maple, and the colour not so uniform; some parts of the heartwood being of a rich red brown. Some of the best houses in Victoria are decorated with this wood, that of the Hon. J. Dunsmuir, Lieutenant-Governor of British Columbia, being a good example. If carefully selected and well seasoned it is fit for the finest cabinet-maker's work. I had a bedstead made from it by Messrs. Weiler of Victoria which shows the beauty of the wood very well; and it could be procured in fair quantity if desired, as there are many large trees still standing in accessible places.

(H. J. E.)

¹ Hilyard, *Soils*, 481 (1906).

ACER NEGUNDO, ASH-LEAVED MAPLE, BOX ELDER

Acer Negundo, Linnæus, *Sp. Pl.* 1056 (1753); Sargent, *Silva N. Amer.* ii. 111, t. 96 (1892), and *Trees N. Amer.* 641 (1905).
Negundo aceroides, Moench, *Meth.* 334 (1794).
Negundo fraxinifolium, Nuttall, *Gen. Amer.* i. 253 (1818); Loudon, *Arb. et Frut. Brit.* i. 460 (1838).

A tree attaining in America 70 feet in height and 12 feet in girth; bark deeply fissured into broad rounded ridges. Young branchlets green or glaucous, glabrous. Leaves (Plate 205, Fig. 2) pinnate, turning yellow in autumn. Leaflets, three or five, stalked, ovate or oval, rounded or cuneate at the base, acuminate at the apex, serrate or toothed above the middle, often three-lobed; upper surface bright green and glabrous; lower surface pale green and with slight pubescence on the midrib and nerves; rachis glabrous.

Flowers dioecious, without petals, appearing with the leaves, from buds in the axils of the leaf-scars of the previous season, staminate flowers in fascicles, pistillate in narrow pendulous racemes. Fruit, with narrow acute nutlets, diverging at an acute angle, and thin reticulate, straight or falcate wings.

In winter, the terminal buds are about $\frac{1}{8}$ inch long, acute, with four tomentose ciliate external scales; lateral buds appressed to the twigs, with two outer visible scales; opposite leaf-scars united around the twig, narrowly crescentic, three-dotted, fringed with hairs on the margin.

VARIETIES

The species, extending over a vast territory, varies considerably in the wild state, the typical form described above occurring in the eastern part of its distribution. Farther west, in Colorado, Utah, and New Mexico, the branchlets and leaves become pubescent; and in California, an extreme form is met with, which is often considered to be a distinct species:—

1. Var. *californicum*, Wesmael, *Bull. Bot. Soc. Belg.* 43 (1890); Sargent, *Garden and Forest*, iv. 481 (1891), *Silva N. Amer.* ii. 112, t. 97 (1892), and *Trees N. Amer.* 643 (1905).

Acer californicum, Dietrich, *Syn.* ii. 1283 (1840).
Negundo californicum, Torrey and Gray, *Fl. N. Amer.* i. 250, 684 (1838).

This is distinguished, according to Sargent, by its darker-coloured bark; buds covered with dense tomentum; short pale persistent pubescence on the branchlets and ripe fruit; leaflets three, larger, more coarsely serrate, and more frequently lobed than in the type, and coated beneath with pale pubescence. As seen in cultivation at Kew, the leaflets are usually five and not three; and in the wild state, 5-foliolate leaves are occasionally met with, as in a specimen in the Kew herbarium collected by Lobb in California. The pubescence on the leaflets beneath is most strongly marked on the midrib and nerves, is whitish in colour, and forms prominent

axil-tufts. Cf. Plate 205, Fig. 1. There are specimens of this variety at Kew; and a tree at Grayswood, near Haselmere, was about 30 feet high in 1906, and appeared to be very vigorous and thriving.

A considerable number of horticultural varieties are known:—

2. Var. *variegatum*.¹ Leaves with broad white margin. One of the most popular and most largely grown of all variegated trees. It originated as a chance branch sport in the nursery of M. Fromant at Toulouse in 1845; but remained almost unknown, till 1853, when it was awarded, at a horticultural show at Toulouse, a medal given by the Empress Eugenie.

3. Several other coloured forms are known, as var. *aureo-maculatum*, leaves spotted with yellow; var. *aureo-marginatum*, leaves with yellow margin; and var. *auratum*, leaves yellow.

4. Var. *violaceum*.² Young branchlets covered with a glaucous violet bloom.

5. Var. *crispum*.³ Leaves variously cut and curled. According to Nicholson, this is not nearly so vigorous a grower as the type. (A. H.)

DISTRIBUTION

This species is the most widely distributed of North American maples, extending in its typical form from Western Vermont and Central New York, southward to Northern Florida, and westward to the Rocky Mountains. According to Sargent, it is rare east of the Alleghany Mountains, and is commonest in the basin of the Mississippi, attaining its largest size in the valley of the lower Ohio. The biggest recorded, so far as we know, is one measured by Ridgway in the Wabash Valley, which was 60 feet high by 12 feet in girth. It is one of the few eastern trees, which is quite at home in the dry prairie region, and is found on most of the rivers of the great plains, and on the foot-hills of the Rocky Mountains, where it is usually a stunted and ill-shaped tree or bush, and rarely has a clean or straight stem. Slightly modified, as regards the amount of pubescence on the leaves and branchlets, it occurs in Utah, Colorado, New Mexico, and Eastern Arizona. Var. *californicum* is met with in California in the valley of the lower Sacramento river, in the interior valleys of the coast ranges from San Francisco Bay to about lat. 35°, and in the high cañons of the San Bernardino Mountains; and has been planted, with successful results, on the alkaline lands of the San Joaquin valley.⁴

In Western America it is largely planted for shelter belts.⁵ Mr. W. T. Macoun states in a recent number of the *Canadian Forestry Journal*, p. 80 (1907), that in the prairie provinces it is used largely in plantations. It grows rapidly during the first twenty years, and produces a very dense cover, which makes it a bad neighbour for slow-growing trees, but a good nurse for those which, like birch, ash, and American elm, can hold their own in its company.

¹ *Gard. Chron.* 1871, p. 1202, f. 275. Cf. also *Rev. Hort.* 1861, p. 268; *Gard. Chron.* 1861, p. 867; *Flore des Serres*, vii. 117 (1867). ² *Negundo aceroides*, var. *violaceum*, Kirchner, *Arb. Musc.* 190 (1864).

³ G. Don, in Loudon, *Arb. et Frut. Brit.* i. 460 (1838).

⁴ Hilyard, *Soils*, 481 (1906).

⁵ Cf. *U.S. Dept. Agric. Forest Service, Circular* 86 (1907), which gives an elaborate account of the economic uses of this tree in the United States, with notes on its propagation and cultivation.

CULTIVATION

Acer Negundo was very early introduced into England, being cultivated in the garden at Fulham by Bishop Compton in 1688. According to Loudon, this tree was about 45 feet high and 7 feet 1 inch in girth in 1835.

It is by far the commonest of American maples in cultivation, the variegated form being grown in every nursery and planted extensively in shrubberies and town gardens for the sake of its colour. It grows from seed with extraordinary rapidity, attaining 5 or 6 feet high in 3 years, is apparently at home in every kind of soil, and resists all the extremes of our climate without injury. Though Loudon says that the seed must be sown in autumn, I have found that it will germinate readily when sown as late as June. Trees which came up in a bed of American ash in my nursery in June 1901, are already 15 feet high, and bearing seed freely when only seven years old.

REMARKABLE TREES

Though not often seen as a tree, yet on good soil it seems to attain almost as great size in England as in America. Loudon mentions a tree at Kenwood which was 47 feet high, 35 years after being planted. A tree at Botley, Hants, probably planted by Cobbett, was recorded¹ in 1884 as being 70 feet high by 6 feet 4 inches, but I did not find this when I visited Botley in 1906. The largest, however, that we have seen is at the Mote, near Maidstone, which I found in 1902 to be 53 feet high by 8 feet 4 inches. Henry measured one at Shiplake House, near Henley, 50 feet by 6 feet 3 inches, with a clean bole 16 feet long; and there is a large wide-spreading tree in Kew Gardens near the Director's Office which is about 40 feet high, and measures 6 feet 8 inches in girth. Another in the Oxford Botanic Garden is 4 feet in girth; and a very old tree, with a short trunk and wide-spreading branches, in Mortlock's Garden, behind the Corn Exchange at Cambridge, probably on the site of the old Botanic Garden, is about 30 feet in height and 5 feet 8 inches in girth. Miss Woolward, in 1905, measured a tree in the grounds of the Knowle Hotel at Sidmouth, 38 feet in height and 3 feet 10 inches in girth.

TIMBER

Its timber is very unlike that of other maples, for though in young trees it is whitish, the heartwood of old trees is of a most peculiar colour, purplish red with dark veins.² I have never seen it of sufficient size to be useful, though Michaux says it was in his time sometimes used by cabinetmakers in the west; and Sargent states that it is sometimes used for the interior finish of houses, wooden-ware, cooperage, and paper pulp. Small quantities of maple sugar are occasionally made from this tree.

(H. J. E.)

¹ *Woods and Forests*, 1884, p. 316.

² I made this note from specimens shown as "Box Elder" at the St. Louis Exhibition, but do not find any confirmation of this in Sargent's or Hough's works.

SEQUOIA

Sequoia, Endlicher, *Syn. Conif.* 197 (1847); Bentham et Hooker, *Gen. Pl.* iii. 429 (1880); Masters, *Journ. Linn. Soc. (Bot.)* xxx. 22 (1892).
Wellingtonia, Lindley, *Gard. Chron.* 1853, p. 823.
Washingtonia, Winslow, *Calif. Farmer*, 1854, ex Hooker, *Kew Journ.* vii. 29 (1855).
Gigantabies, Nelson (*Senilis*), *Pinaceæ*, 77 (1886).
Athrotaxis, Baillon, *Hist. Pl.* xii. 39 (1892).
Steinhauera, Kuntze, *Lexic. Gen. Phan.* 533 (1904).

TALL evergreen trees, belonging to the tribe Taxodineæ of the order Coniferae. Bark thick, of two layers, the outer thick, spongy and fibrous, the inner thin, close, and firm. Branches short and stout; lateral branchlets slender, terete, and deciduous. Buds and leaves different in the two species, the leaves having an undivided fibro-vascular bundle, with a single resin canal beneath it.

Flowers monœcious, solitary, minute, appearing in early spring from buds formed in the previous autumn. Male flowers terminal or in the axils of the uppermost leaves, surrounded at the base by imbricated, ovate, acute, apiculate, involucre bracts; stamens numerous, spirally arranged on an axis; filaments short, dilated into ovate incurved sub-peltate connectives, which bear on their inner surface two to five (usually three) pendulous globose two-valved anther-cells, opening below on the back; pollen simple. Female flowers terminal, the leaves gradually passing into the bracts, which are numerous, spirally imbricated, ovate, keeled on the back, acuminate with either long or short points, and adnate to short thick rounded ovuliferous scales which bear five to seven ovules, at first erect, ultimately becoming inverted.

Cones pendulous, persistent after the fall of the seeds. Scales, formed by the enlargement of the united bracts and ovuliferous scales of the flowers, woody, with deciduous resin-glands, spirally arranged, wedge-shaped at the base, widening at the apex into oblong wrinkled discs, showing a transverse median depression, sometimes tipped by a small spine. Seeds, 5 to 7 under each scale, pendulous, oblong-ovate, compressed, with two lateral wings. Seedlings with four to six cotyledons; primary leaves linear-lanceolate, short-pointed, thin, spreading.

Several fossil species of *Sequoia* are known, occurring earliest in the Cretaceous period in the holarctic region, becoming very widely spread over Europe, Northern Asia, and North America in Tertiary times. Two living species, inhabiting California, are distinguished.

1. *Sequoia sempervirens*, Endlicher. Coast range of California, and crossing

the boundary line into Oregon. Buds scaly. Leaves on lateral branches linear and in two ranks in one plane. Bracts of pistillate flowers about twenty, usually with short points. Cones ripening in the first season; scales abruptly enlarged into terminal discs.

2. *Sequoia gigantea*, Decaisne. Western slopes of the Sierra Nevada in California. Buds without scales. Leaves all radially arranged, spreading or slightly appressed, ovate or lanceolate. Bracts of pistillate flowers 25 to 30, with long points. Cones ripening in the second year; scales gradually thickening from the base to the apex.

SEQUOIA SEMPERVIRENS, REDWOOD

Sequoia sempervirens, Endlicher, *Syn. Conif.* 198 (1847); Lawson, *Pinet. Brit.* iii. t. 52 (1884); Sargent, *Silva N. Amer.* x. 141, t. 535 (1896), and *Trees N. Amer.* 68 (1905); Masters, *Gard. Chron.* xix. 556, f. 86 (1896); Kent, Veitch's *Man. Coniferae*, 270 (1900).

Sequoia gigantea, Endlicher, *Syn. Conif.* 198 (1847).

Sequoia religiosa, Presl, *Epimel. Bot.* 237 (1849).

Taxodium sempervirens, Lambert, *Pinus*, ii. 24 t. 7 (1824); Loudon, *Arb. et Frut. Brit.* iv. 2487 (1838).

Abies religiosa, Hooker and Arnott, *Bot. Voy. Beechey*, 160 (1841). (Not Lindley.)

Schubertia sempervirens, Spach, *Hist. Vég.* xi. 353 (1842).

A tree attaining 340 feet in height, with a slightly tapering and irregularly lobed trunk, occasionally 50 to 75 feet in girth above the enlarged and buttressed base. Bark six to twelve inches thick, divided into rounded ridges two or three feet in width, separating on the surface into long narrow fibrous scales, which on falling display the reddish-brown soft spongy fibro-cellular middle bark. Young trees pyramidal, with slender branches to near the base. Older trees in the forest with stems clean to 75 or 100 feet, the stout horizontal branches above forming an irregular narrow crown. Branchlets slender, green in the first year, gradually becoming afterwards brownish with a thin scaly bark, spreading in two ranks more or less in one plane. Buds solitary, both terminal and in the axils of two or three of the uppermost leaves, surrounded by loosely imbricated ovate acute scales, which remain persistent, dry, and brown at the base of the branchlets.

Leaves of two kinds: (1) on normal lateral branchlets, spreading in one plane in two ranks by a twist on their bases, $\frac{1}{4}$ to $\frac{3}{4}$ inch long, linear or lanceolate, ending in short cartilaginous points, slightly thickened on the revolute margins, narrowed at the base, where they become decurrent on the branchlets; upper surface dark green, with a median furrow; lower surface with a green midrib and two conspicuous whitish stomatic bands: (2) on leading branchlets, radially arranged in several ranks, appressed or spreading, about $\frac{1}{2}$ inch long, ovate or ovate-oblong, with incurved cartilaginous points; upper surface concave with a prominent green midrib and two whitish stomatic bands; lower surface rounded, indistinctly stomatiferous. Lateral branchlets with leaves of the latter kind may exceptionally occur on any part of the tree, and usually cover entire branches at the summit of

large trees; while in the case of trees growing at high altitudes they are sometimes spread over the whole of the branches.

Male flowers, $\frac{1}{16}$ inch long, with rounded connectives. Female flowers with about twenty broadly ovate bracts, tipped usually with short points. Cones ellipsoidal, $\frac{3}{4}$ to 1 inch long, $\frac{1}{2}$ inch broad; scales with slender stalks, which enlarge abruptly into discs $\frac{1}{3}$ inch in breadth. Seeds light brown, $\frac{1}{16}$ inch long; wings narrower than in *S. gigantea*.

The cones ripen at the end of the first season, and are freely produced in most parts of the South of England and in Ireland, the first recorded¹ being in 1862 on a tree at Barton, Suffolk, which had been planted in 1847. Fertile seed, however, is very rare, the only instance known to us being on a large tree at Huntley Manor, Gloucestershire, from which Prof. Somerville raised seedlings in 1904. Proliferous cones² occur occasionally; and a cone³ with the upper part ovulate and the lower part staminate has been observed.

The tree suckers from the root,⁴ and sends up, when cut, numerous shoots⁵ from the stool. Fasciation⁶ has been observed in the suckers in the redwood forest in California. Dr. Masters⁷ described and figured the peculiar woody excrescences, which are sometimes formed at the base of the stem of young trees, which have been raised from cuttings.

VARIETIES

In the wild state there is some variation, as noticed above, in the occasional occurrence of lateral branches with foliage like that of the leading shoots. Several varieties have been obtained in cultivation:—

1. Var. *albospica* (var. *adpressa*). Tips of young shoots creamy white in colour. Leaves small and dense upon the twigs, resembling those of *Taxus baccata adpressa*.
 2. Var. *glauca*. Leaves linear, acute, $\frac{1}{4}$ inch long, glaucous, loosely imbricated, appressed or spreading.
 3. Var. *taxifolia*. Leaves broader than in the type.
- A tree, pendulous in habit, is growing at Dropmore.

DISTRIBUTION

The redwood occurs on the western slopes, valleys, and alluvial flats of the coast range, from the Chetco river in Oregon to Salmon Creek Cañon, twelve miles south of Punta Gorda in Monterey county, California, and ascends from sea-level to 2000 or rarely 3000 feet. It occupies a narrow strip of country along the sea coast, about 500 miles in length from north to south, and is not found inland beyond

¹ Bunbury, *Arboretum Notes*, 166 (1889).

² *Bot. Gazette*, xxxviii. 2 (1904).

³ Two suckers are growing beside a tree, 60 feet high, at Shiplake House, near Henley.

⁴ In *Journ. Roy. Hort. Soc.* xix. 432 (1896), it is stated that redwood coppice shoots are believed to have been used for producing hop-poles in Kent; but this must have been an experiment on a small scale, and without any practical value. At Arley, shoots from the stool of a tree, which was felled, made a growth of 4 feet in their first year.

⁵ Pierce, in *Proc. Calif. Acad. Sc.* ii. 83 (1901), who also gives an account of peculiar white-coloured suckers, which are often seen in California.

⁶ *Gard. Chron.* xi. 372, fig. 53 (1879).

the influence of the sea fogs. A large portion of the area, originally covered by the tree, has of late years been destroyed by fires and by felling for lumber. In ancient times the redwood grew considerably to the southward of its present limit, as is proved by logs being found by well-borers in various parts of the coast range, where it does not now exist, as far south as Los Angeles and San Diego.

In Oregon there are only about 2000 acres of redwood, in two small forests, on the Chetco river, six miles from its mouth, and on the Winchuck river. The redwood belt, properly so called, which is a continuous forest of the species, begins on the northern boundary of California, and ends in Mendocino county, where it attains its maximum width, about thirty-five miles. Farther north the belt narrows, being only ten miles broad in Del Norte county. South of Mendocino county the redwood is only met with in small isolated forests.

In Monterey county¹ the groves are small, the most southerly forest of any importance being in the Santa Cruz Mountains, where the tree is common. The State of California appropriated in 1901 \$250,000 for the purchase of the redwood forest of the Big Basin in Santa Cruz county, and this is now known as the California Redwood Park.² Prof. Jepson tells me that the area of the park is about 3800 acres, 2500 acres of which are covered with timber, consisting of Redwood mixed with Tan Oak, Madroña, and Douglas Fir. A fine grove, known as the Santa Cruz "Big Trees," is famous. A small grove, now practically destroyed, existed fifty years ago on the east side of the bay of San Francisco in Alameda county. At present the tree grows in the Mount Diablo range in only one limited locality, Redwood Peak, in the Oakland Hills, directly opposite the Golden Gate. In Napa valley the tree is rather common; and crossing over the summit of Howell Mountain it descends the slope towards Pope valley. This is the point where the redwood grows farthest from the ocean, and the only locality where it is found to the east of the divide of the coast range. In Marin county there are only a few isolated groves, mainly used as picnic grounds; and in Sonoma county a few scattered claims still remain uncut.

The redwood belt, which I visited in 1906, near its northern limit at Crescent City, is the most impressive of all forests, being remarkable not only for the immense size³ of the trees, but also for their extraordinary density upon the ground. A single acre has yielded 100,000 cubic feet of merchantable timber. The favourable conditions of the soil and climate account in great measure for this extreme productivity; but I am inclined to think that the mode of reproduction by suckers and by coppice shoots, explains in part the density with which the trunks stand upon the ground. A large proportion of the old trees are sprouts from ancient

¹ Cf. Jepson, *Flora W. Mid. California*, 24 (1901); and C. H. Shinn, *Cycl. Am. Hort.* iv. 1660 (1902).

² Prof. Jepson in a recent letter says that there is practically no Redwood in the National Forest Reserves; but a few groves in private hands are as safe as if under State or National control, namely:—Redwood Cañon by Mount Tamalpais, near San Francisco; Bohemian Club Grove in Sonoma county; and Armstrong Grove in the same county. These comprise 500 to 1000 acres each.

³ Mr. J. H. Maiden, Director of the Sydney Botanic Garden, in an article in the *Sydney Morning Herald*, quoted in the *London Pharmaceutical Journal*, April 30, 1904, states that the excessive heights claimed for eucalyptus trees in Australia are unreliable, and considers that the redwood, accurately measured by Sargent as 340 feet, is the tallest tree in the world. Von Mueller, in *Eucalyptographia*, Decade 5 (1879-1884), gives, on the authority of Mr. D. Boyle, the measurement of a fallen *Eucalyptus amygdalina* as 420 feet, and states that Mr. G. Robinson, a competent surveyor, measured another tree of this species as 471 feet; and it is unknown to me on what grounds Mr. Maiden has questioned these measurements.

trees, as is readily seen by the way in which one-sided stems are often grouped around a hollow, from which the old stump has rotted away. At the present day reproduction is mainly effected by suckers, the proportion of these to seedlings being as 100 to 1. Seeds do not germinate except in open places, and young seedlings, requiring plenty of light to grow, are usually suppressed by the shade of the suckers, which, being well nourished by the roots of the parent tree, grow fast in dense shade.

The habit of the tree perpetuating itself by suckers seems to have impaired the vitality of the seed, as only 15 to 25 per cent of it proved fertile in experiments made by Mr. P. Rock of Golden Gate Park.

The topography of the redwood belt is uneven, and the character of the forest in consequence is very varied. The mountains of the coast range rise to altitudes of 1000 to 2000 feet, and consist of two or three ridges parallel to the coast, through which rivers and streams have cut deep valleys in some places, and formed wide alluvial flats in others. On the steep slopes and at the higher elevations, where the soil is shallow and dry, the redwood is always mixed with Douglas, hemlock, *Abies grandis*, and two or three other species, and is comparatively small in size and less dense upon the ground. It is only at low altitudes, in the deep soil of alluvial flats and in ravines, where the water-supply is great, that the redwood grows as practically pure forest, and attains a great size and density; but even here a few trees of Sitka spruce and hemlock are usually associated with it. Absolutely pure stands, however, occur on flat tracts near streams, and in these the shade is so great that nothing grows upon the ground but *Oxalis* and a few tufts of *Aspidium munitum*. I saw a stand of this kind close to the Smith River, where the trees were of enormous size and of incredible density upon the ground. One tree measured 51 feet in girth. The river bank was fringed with *Alnus oregona* 50 to 60 feet high, behind which were two or three rows of taller *Umbellularia*; and a single Lawson cypress, 200 feet high, had taken refuge on the river bank. Behind this screen there were only redwoods towering far above the other trees. On the slopes the ground cover was dense and impenetrable, consisting mainly of *Aspidium* attaining an immense size, *Acer circinatum*, *Rhamnus Purshiana*, *Gaultheria Shallon*, *Rubus*, etc. According to R. T. Fisher, of the U.S. Forestry Service, of whose paper¹ I have made use in this account, the redwood slopes, where the tree is mixed in varying proportions, cover fifty times as large an area as the redwood flats, where the tree is pure or nearly so.

Near Crescent City the flat which extends for about three miles in width from the ocean to the first hill of the coast range was originally covered with a mixture of redwood, Sitka spruce, and hemlock, most of which is now cut away. On the bluffs of the sea-shore a few small trees of *Pinus contorta* take refuge, while behind them and inland there are scattered groves of second-growth spruce, about 50 feet high. The first slope, exposed to the south-west and rising to 500 feet, is a dense stand of virgin spruce and hemlock, the trees attaining 200 feet high by 15 feet in girth. Crossing the hill to the north-east slope the first redwoods are seen, and from here inland for about eight miles over rolling country the redwood is the dominant tree, enormous in size and thick upon the ground. Afterwards, ascending the gorge of

¹ "The Redwood": *U.S. Forestry Bulletin*, No. 38 (1903).

the Smith River, Douglas fir begins to prevail, the redwoods becoming gradually fewer and smaller; and the last ones were seen twelve miles inland at about 1000 feet elevation.

The prevailing formation in the redwood belt is sandstone; and the tree attains its maximum either on deep sandy loam or on gravel full of moisture. The climate is remarkably even and moderate, with warm days, cool nights, and scarcely any frost even in winter; while the air is charged with humidity, and the annual rainfall amounts to from 60 to 80 inches. The following observations, taken in 1900 at Crescent City, show the nature of the climate in which the redwood thrives:—

	Rainfall in Inches.	Temperature, Fahrenheit.	
		Maximum.	Minimum.
January	11	64°	32°
February	10	61°	33°
March	6	63°	36°
April	6	70°	32°
May	5	63°	39°
June	2	67°	41°
July . . . . .	...	67°	40°
August	0.3	71°	40°
September	0.6	76°	41°
October	11	70°	37°
November	6	72°	33°
December	8	61°	27°
Total rainfall	65.9		

The tree is not found in the interior valleys to the east of the coast range, where the summer is comparatively hot and dry, and only a moderate amount of rain falls in winter.

Dr. Mayr,¹ reproduces a sketch of the largest redwood he saw in December 1885 near Santa Cruz. The mean of three measurements made it 308 feet high by 46 feet in girth at 6½ feet from the ground, above the swollen base. The first large green branches were at 230 feet up. This tree was still standing in 1903. He also gives an excellent illustration² of the appearance of a redwood forest after lumbering and fire have devastated it, which reminds me strongly of similar scenes in the Douglas fir forests of Oregon and Washington.

Fisher gives several tables showing the composition of the species and the size of the trees in the redwood belt. At Scotia, on an alluvial flat, there are 100 redwoods to the acre, no other species being present, and of these thirty-six were over 20 inches, and averaged 76 inches in diameter. Mayr² gives the following figures for the best pure stand which he measured:—57 trees to the acre, averaging 275 feet in timber height and 23 feet in girth; total cubic contents, exclusive of branches, 199,000 cubic feet per acre. The tallest redwood recorded³ was measured in 1896 by Professor Sargent. This tree grew on the Eel River, and was 662

¹ *Fremdländ. Wald- u. Parkbäume*, tt. 19, 20 (1906); cf. also *Waldungen*, p. 268 and frontispiece.
² *Waldungen von Nordamerika*, 267 (1900). ³ *Garden and Forest*, 1897, p. 42.

years old, 340 feet in total height, 230 feet to the first branch, and 10 feet 5 inches in diameter at 6 feet from the ground. I found it impossible to obtain in the dense forests accurate heights; but I saw lying on the ground a tree blown down many years ago which measured 240 feet, the top having been broken off at a point where the stem was still 3 feet in diameter. In the logging camp near Crescent City a tree which had just been felled measured 45 feet in girth at 6 feet from the base, and 24 feet in girth at 144 feet up; the top, knotty and full of branches, had smashed in the fall, and was rejected as being useless as timber.

Most of the trees cut are from 400 to 800 years old. After 500 years it usually begins to die at the top and to fall off in growth. The oldest redwood found by Fisher was 1373 years of age.

Isolated trees are occasionally blown down by the wind; but no considerable tracts are ever overthrown. There is no tap-root; but the lateral roots, numerous and stout, strike downwards, usually at a sharp angle, and form a compact mass, in shape like an inverted funnel. Such roots both anchor the tree securely and provide it with a large supply of moisture.

Fires are of rare occurrence in the damp northern part of the redwood belt; but farther south, where the climate is drier, they are frequent in August and September. Usually, however, only young trees and undergrowth are burned, the larger trees remaining unharmed. Injuries by fire or by the fracture of the branches by the wind, which involve the sapwood, are supposed to be the cause of the curious burrs and protuberances which are found on many trees.

Where the forests have been cut down, the better land has been permanently put under fruit, grain, or pasture; but on the worse lands the tree will survive and is in no danger of extinction, owing to its astonishing power of reproduction by sprouts. There are many fine stands of second-growth redwood; as in Mendocino county, where young trees, only 45 years old, are nearly 100 feet high and 20 to 30 inches in diameter. In Sonoma county, second-growth timber is being cut commercially, and though sappy, makes good boards for boxes.

The Spaniards, near San Francisco Bay, were the first to cut the redwood forests; but their operations were on a very small scale. Regular felling only began in 1850, and at first, as redwood timber was little valued, only Douglas fir and Sitka spruce were taken out of the redwood belt. Of late years, redwood timber has greatly increased in value, and the introduction of machinery has made lumbering more easy and profitable. Only big companies, however, can work with profit, as the outfit is very expensive, consisting of sawmills, many miles of railroad in the forest, locomotives of a special type for ascending steep gradients, waggons, donkey-engines, and logging camps, with a large staff of workmen.

No cutting is being done at the present time in the southern counties. The largest sawmills are in Mendocino county; and they had cleared, by the year 1900, 150,000 acres, or a quarter of the total acreage, including the largest and best stands. In the same year the mills had cleared in Humboldt county 65,000 acres and in Del Norte county 2000 acres. Since that year cutting has been going on at an accelerated pace, and the quantity now felled annually is enormous. (A. H.)

INTRODUCTION

It is stated by Kent in Veitch's *Coniferae* that Hartweg, who collected in California and Mexico for the Royal Horticultural Society in 1846 and 1847, was the introducer, but there is no evidence to confirm this statement, either in Hartweg's letters, which are printed in the Journal of the Society, or in Gordon's account of the conifers of which he sent home seeds.

The first mention I can find of the tree in the *Gardeners' Chronicle* is on March 17, 1849, when James Duncan, gardener at Basing Park, wrote that he had planted out in July 1847 a plant 9 inches high, which had stood two winters without protection. In the same journal for 1851, p. 246, it is stated that in 1845 there was a plant 2 feet 7 inches high at Holker, near Ulverston;¹ and on the authority of Mr. Frost that a grafted tree planted at Dropmore in 1845 was 18 feet high in 1851. It is evident that all of these must have been raised earlier than 1848, when Hartweg returned to England, and in his letter, received by the Society on November 4, 1846,² though he speaks of having seen the tree on the mountains of Santa Cruz, he says nothing about having collected or sent home seeds.

In *A Synopsis of the Coniferous Plants grown in Great Britain and Sold by Knight and Perry, at Chelsea*, published by Longmans, London, without date, but probably about 1850, it is stated on pp. 45, 46, that the redwood was introduced in 1843, when plants were sent to Knight and Perry by Dr. Fischer of St. Petersburg, who received seeds of it from America. I have inquired of M. Fischer de Waldheim, Director of the Botanic Gardens at St. Petersburg, whether he knew who was the actual collector, but he replies that there is nothing in the archives which will give this information.

CULTIVATION

I have never seen a plant raised from seed grown in this country, though I believe it will ripen in the south-west. Imported seed, so far as I have tried it, germinates badly, and the seedlings are tender at first, and should not be planted without protection till they are two or three years old, as the young growth will usually suffer from frost.

I am inclined to think that many of the plants sold by nurserymen are raised from cuttings, and purchased plants certainly seem hardier than the seedlings I have raised, most of which were killed to the ground in 1905 and 1907, though they shot up many suckers the following year. I have no evidence to show whether trees raised from cuttings will grow into tall, straight trees, as in the case of *Cryptomeria*.

According to a note³ by Mr. Frost in 1851, the first plants sent out by Knight and Perry were grafted, but this seems very unlikely, as there is no stock except that of the *Wellingtonia* which would seem at all suitable.

¹ Mr. Fenner tells me that this tree is now only 65 feet high by 6 feet in girth, and has been damaged by wind at the top. Suckers are growing from roots two feet from the main stem.

² *Journ. Hort. Soc.* ii. 124 (1847).

³ *Gard. Chron.* 1851, p. 246.

Though in this country the tree has proved fairly hardy in most localities, it is certainly more susceptible to frost in spring and autumn, especially when young, than *Wellingtonia*, and cannot be looked on as a really hardy tree except in well-drained soils, and in situations where it is well sheltered from dry frosty winds. All the really fine specimens I have seen are in unusually favourable places, and I should not recommend the tree for planting largely except in the south-west and west of England and Scotland, though in Ireland it seems to be more generally flourishing.

It does not dislike lime in the soil, and though the top is always killed back in hard winters, grows fast even at Colesborne, a tree planted on the site of the old house here about 1855, being now no less than 11 feet in girth though only about 55 feet high. Another planted later on thin dry soil is only about 35 feet by 4 feet.

Its long feathering branches, which droop to the ground and sometimes take root, make it a very ornamental tree, but as a timber tree its value remains doubtful. Whilst young it is very liable to be barked at the ground by mice, which have destroyed more than half of those which I have planted, and Sir W. Thiselton-Dyer tells me that squirrels¹ attack the bark at Kew.

Specimens of its timber grown in England are very inferior to the imported wood, on account of the rapid increase in girth which the tree makes unless crowded; and the only places I have seen where it seemed at all likely to be profitable are at Whitfield and Penllergare, though in Ireland there may be better hopes of its economic value, in favourable situations.

The following opinions, taken from the reports² published by the Conifer Conference, express very well the condition of this tree in twenty selected places:—

ENGLAND

Pampisford, Cambridge	Often injured by frost.
Golden Grove, Caermarthen	Leader sometimes frosted.
Scorrier, Cornwall	Requires shelter from wind.
Tortworth, Gloucester	In a shady place.
Linton, Kent	Lost 3 feet of top last winter.
Howick, Northumberland	Not thriving well.

SCOTLAND

Inveraray, Argyllshire	Often loses its leader.
Whittinghame, East Lothian	Vigorous; well sheltered.
Fordell, Fife	Very fine specimens.
Murthly, Perth	Fine in damp places.
Scone, Perth	In fine health; grows well.
The Cairnies, Perth	Doing well in shelter.
Castle Leod, Ross	Fine specimen.

¹ Squirrels are fond of making their nests out of the bark, but do no injury to trees, which have attained a considerable size. Cf. *Gard. Chron.* 1866, p. 413.

² *Journ. Roy. Hort. Soc.* xiv. pp. 483 seq. (1892). Cf. also *Gard. Chron.* 1866, p. 1043, where an abstract is given of Mr. Palmer's statistics of the effects of the severe winter of 1860-1861 on this tree, planted in 113 different places in England, Scotland, and Ireland.

IRELAND

Shane's Castle, Antrim	Grows rapidly here.
Fota, Cork	Free-growing, fine tree.
Woodstock, Kilkenny	A handsome tree.
Birr Castle, King's County . .	Thriving well.
Adare Manor, Limerick	Thriving; gales break leader.
Baron's Court, Tyrone	Fine rapid grower.
Coollattin, Wicklow	Very fine specimen.

REMARKABLE TREES

Among the great number of large redwoods I have seen at various places in England, I think the finest is one at Claremont, growing near the borders of the lake in a very sheltered position (Plate 194), which in 1903 measured 95 feet by 12 feet and in 1907 98 feet by 12 feet 9 inches. At Melbury there is a tree not so tall but thicker, which in 1906 was 85 feet by 15 feet 1 inch. At Fonthill Abbey there is a remarkable twin tree which grows in a damp hollow, dividing at the ground into two trunks which are 98 to 100 feet high by 10 feet and 9 feet 3 inches in girth respectively. At Boconnoc in Cornwall there is a tree which in 1851 was already 16 feet high, and in 1891 was reported as measuring 75 feet by 13 feet, but when I measured it in 1905 it had lost its top, and was then only 68 feet by 14½ feet. At Dropmore, Buckinghamshire, a tree,¹ remarkable for its pendulous branches and branchlets, is 94 feet high and 11 feet in girth. Three years ago, according to Mr. Page, the gardener, it was 10 feet 6 inches in girth, so that it is still making rapid growth. This tree was planted in 1845, when it was a foot high, having been bought for five guineas at Knight and Perry's nursery. It is bearing this year an immense number of cones; but no attempt has ever been made to raise seedlings.

In a sheltered dell known as the Wilderness, at Cuffnells, near Lyndhurst, the seat of R. Hargreaves, Esq., are three splendid redwoods, which were planted about the year 1855 by his father. These measure 102 feet by 10 feet 8 inches, 98 feet by 15 feet, and 105 feet by 10 feet 10 inches respectively, the last being equal or superior to the one at Claremont, and growing close to a magnificent tree of *Pinus insignis*, which will be figured in our next volume.

At Beauport, Sussex, there is a tree with very pendulous branches bearing cones on the ends of the twigs, 73 feet by 9 feet 6 inches, and a larger one of the ordinary form, 85 feet by 11 feet 5 inches; and at Hemstead in Kent there is a tree not quite so tall as the *Cryptomeria* growing by its side (see Plate 42), and of about the same age. In the eastern counties the best we have seen are at Hardwicke House, Suffolk, where a tree in 1905 was 74 feet by 11 feet 10 inches, and at Barton, where in an exposed situation on the lawn there is one of 71 feet by 8 feet. This seems to be the only survivor of four which Sir Charles J. F. Bunbury²

¹ Erroneously reported to have been 114 feet in height in 1903 in *Journ. Board of Agriculture*, x. 345 (1904).

² *Arboretum Notes*, 166 (1889).

planted in 1847 and 1848, one of which bore cones in 1862. In Fulmodestone Wood, Norfolk, a tree planted in 1855 was 67 feet by 8½ feet when Henry measured it in 1904. At The Coppice, Henley, at 300 feet elevation, a tree planted in 1864 was 73 feet high by 9 feet 5 inches in girth in 1905. At Bayfordbury, Herts, the best specimen is 74 feet by 10 feet 2 inches. At St. George's Hill, near Byfleet, a tree growing on Bagshot sand was in 1904 75 feet by 8 feet 3 inches.

In Gloucestershire there are good trees at Tortworth, at Highnam, at Williamstrip Park, and at Huntley Manor, where Prof. Somerville measured one in 1904 76 feet by 13 feet.

At Whitfield, Herefordshire, there is a group of eleven very fine trees on an area of only 25 yards square, of which the tallest is about 95 feet by 12 feet, and the others would average 80 to 90 feet in height, by about 9 feet in girth, and contain from 100 to 120 cubic feet per tree. An acre of such trees, as thickly grown as this, would produce from 8000 to 10,000 cubic feet, which, considering that their age is not more than about fifty years, is a very remarkable yield of timber.

At Penllergare, near Swansea, there is another somewhat similar group of twelve trees on a triangle of which the sides are only about twenty yards, in which the best tree was about 75 feet by 10 feet, and the others from 4 feet to 8 feet in girth; only one of these was a really bad tree, and two of them were forked.

At Penrhyn Castle there are several very fine trees, of which the best that I measured in 1906 was about 90 feet by 12 feet 3 inches, but others may be larger. At Coed Coch, Abergele, there is a splendid tree which Mr. A. Hunter, the gardener at this place, measured in 1905, when it was 90 feet in height and 12½ feet in girth.

In Scotland the redwood seems to grow best in Perthshire, where all the largest that I have seen are found, namely, one at Castle Menzies, which in 1892 was 74 feet by 4 feet 6 inches; and at Moncrieffe, where a tree, mentioned by Hunter as 42 feet by 4 feet 11 inches in 1883, was in 1907 about 65 feet by 9 feet, and though healthy looks as though it had lost its top more than once.

A tree at Falkland Palace, Fifeshire, said to be then one of the finest in Scotland, was in 1892 65 to 70 feet by 9 feet. At Smeaton-Hepburn, East Lothian, in 1902, there was a tree 57 feet by 9 feet, planted in 1844, which had lost its top on several occasions. At Castle Kennedy the wind is evidently too severe for it, as the largest measured by Henry in 1904 was only 39 feet by 7 feet.

In Ireland the redwood has attained large dimensions in those districts which have a mild climate and a heavy rainfall. In Queen's County, where the rainfall is only moderate and sharp frosts occur, it has done badly, and is in marked contrast to the splendid *Wellingtonias* which are growing beside it in several places.

At Castlemartyr, Cork, there are several large specimens, one, about 70 feet in height, being in 1907 16½ feet in girth at 5 feet from the ground. At Fota, in the same county, a tree in 1903 measured 90 feet high by 10 feet in girth. This was reported¹ in 1891 to be 75 feet by 7½ feet. At Coollattin, in Wicklow, there

¹ *Journ. Roy. Hort. Soc.* xiv. 549 (1892).

are three trees, nearly equal in size, one of which measured in 1906 77 feet by 11 feet 5 inches. This¹ was 55 feet by 8½ feet in 1891. At Hamwood, Co. Meath, a tree, said to have been planted in 1847, was 59 feet high by 11 feet in girth in 1905. At Woodstock, in Kilkenny, there is a tree, which in 1904 was 91 feet by 13 feet 3 inches. This¹ was 68 feet by 10 feet 4 inches in 1891. At Churchill, Armagh, a tree,² planted in a bog in 1862, was 60 feet high by 6½ feet in 1884; but had lost its leader several times. Henry did not see this tree on his visit to Churchill in 1904. At the Conifer Conference of 1891 good trees were also reported to be growing at Shane's Castle in Antrim, Clonbrock in Galway, Courtown in Wexford, and Powerscourt in Wicklow.

The largest tree of this species that I have seen in Europe is a well-shaped one, branching to the ground, on the Isola Madre in Lake Maggiore, which in 1906 was no less than 104 feet high by 14 feet 8 inches in girth.

Pardé³ says that the trees at Les Barres were mostly killed to the ground in the winter of 1879-80, but have thrown up vigorous shoots which produce cones every year; and at Segrez I saw a tree which was killed in the winter of 1870-71 and afterwards threw up six or seven straight stems from the stool, which are now over 50 feet high.

TIMBER

The best timber, as a rule, is produced by trees growing on alluvial flats, that from trees growing on the slopes being hard and flinty. The sapwood, which is of no service, is whitish in colour and 1 or 2 inches in thickness. The heartwood varies in colour from light pink to dark mahogany, and is esteemed for many purposes. It is light in weight, soft, straight-grained, is easily worked; and although it requires much filling, is capable of taking a fine polish. Its durability is attested by the fact that trees which have lain for centuries in the forest have been taken to the sawmill and converted into useful lumber. Mr. D. N. M'Chesney says⁴ that in Manila the wood has been found proof against the attacks of the white ant, together with that of *Tsuga Albertiana* and *Libocedrus decurrens*, while the timber of *Pinus ponderosa*, *Picea Engelmanni*, and the Douglas fir suffered badly from these destructive insects.

In Europe the Californian redwood has established a market for itself, but supplies have been steadily falling off for some years. It is, however, still shipped in considerable quantities to China, Japan, Honolulu, and Australia. In its native country it is employed for both exterior and interior fittings of houses, sleepers, electric light and telephone poles, shingles, tanks, and vats. Very frequently the grain is bold, wavy, and very handsome; and is in demand for ceilings and large panels. Some splendid examples were used for the decoration of the Californian Court at the St. Louis Exhibition of 1904. The large burrs which are not uncommon in some districts, when cut into slabs, make very fine table tops showing a mass of close small eyes of a deep red colour. A very large plank of the wood was exhibited at the World's Fair, Chicago, 1903, which measured

¹ *Journ. Roy. Hort. Soc.* xiv. 556, 565 (1892).

² *Woods and Forests*, 1884, p. 624.

³ *Arbor. Nat. des Barres*, 52 (1906).

⁴ *Bull. Nos. 30 and 33, New Series, Division of Entomology; U.S. Department of Agriculture* (1901), p. 95.

16½ feet wide, 12¾ feet long, and 5 inches thick. The tree from which this extraordinary plank was cut was felled in Humboldt County, and was said to be 300 feet in height by 35 feet in diameter. Planks of 5 feet in width are imported, and I have myself purchased boards 4 feet in width absolutely free from knots and defects. In England this wood is chiefly used for the inside linings of furniture, and it is said to be one of the finest woods in the world for large signboards, as it maintains a remarkable consistency of shape under the most trying conditions of climate and exposure. The value in Liverpool in 1907 was from 2s. 2d. to 2s. 6d. per cubic foot, a price which cannot be said to encourage shipments that have to pay the cost of so long a sea carriage. The wood is usually of slow growth, and the annual rings are from thirty to fifty to the inch. The cells are so large that they can be seen by unaided vision. Resin ducts are almost entirely absent in both species of *Sequoia* but have been found by Jeffrey¹ in the flowering shoot and in the first annual ring of vigorous branches of adult *S. gigantea*, and in the wood of the shoot and root of redwood as the result of injury. (H. J. E.)

SEQUOIA GIGANTEA, WELLINGTONIA, BIG TREE

Sequoia gigantea,² Decaisne, *Bull. Bot. Soc. France*, i. 70 (1854), and *Rev. Hort.* 1855, p. 9, f. 1 (not Endlicher); Masters, *Gard. Chron.* xix. 556, f. 85 (1896); Sargent, *Bot. Gazette*, xlv. 226 (1907).

Sequoia Wellingtonia, Seemann, *Bonplandia*, iii. 27 (1855); Lawson, *Pinet. Brit.* iii. 299, tt. 37, 51, 53 (1884); Sargent, *Silva N. Amer.* x. 145, t. 536 (1896), and *Trees N. Amer.* 69 (1905); Kent, *Veitch's Man. Conifera*, 274 (1900).

Sequoia Washingtoniana, Sudworth, *Check List Forest Trees, U.S.* 28 (1898).

Wellingtonia gigantea, Lindley, *Gard. Chron.* 1853, pp. 820, 823; W. J. Hooker, *Bot. Mag.* 4777, 4778 (1854).

Taxodium Washingtonianum, Winslow, *Calif. Farmer*, 1854, ex Hooker, *Kew Journ.* vii. 29 (1855).

Taxodium giganteum, Kellogg and Behr, *Proc. Cal. Acad.* i. 151 (1855).

Washingtonia Californica, Winslow, *loc. cit.*

A tree attaining 320 feet in height, with a tapering stem, occasionally 90 feet in girth above the much enlarged and buttressed base. Young trees narrowly pyramidal. Old trees free of branches to 100 or 150 feet, with an irregular crown of short thickened branches. Trunk fluted with broad, low, rounded ridges; bark 1 to 2 feet thick divided into lobes 4 to 5 feet wide, corresponding to those of the trunk, separating into loose reddish fibrous scales, which expose the spongy middle bark. Branchlets pendulous, not distichously arranged but in dense masses, green in the first year, afterwards gradually becoming brownish with a thin scaly bark. Buds minute, without scales.

Leaves persistent for four years, arranged on the branchlets in approximately three ranks; on the main axes ovate acuminate, up to ½ inch long; on the lateral axes lanceolate, acute, ⅓ to ¼ inch long; appressed and decurrent at the base, free

¹ *Mem. Boston Soc. Nat. Hist.* v. 441 (1903).

² The tree was first described by Lindley, who called it *Wellingtonia gigantea*. *Wellingtonia* cannot be maintained as a distinct genus. *Sequoia gigantea* is the correct name, according to the rules of botanical nomenclature promulgated by the Vienna Congress of 1905, and is now adopted by Sargent.

and spreading from beyond the middle, rigid, ending in sharp cartilaginous points; lower surface green, rounded or keeled; upper surface with green midrib and two inconspicuous bands of stomata.

Staminate flowers, $\frac{1}{8}$ to $\frac{1}{3}$ inch long, with acute or acuminate connectives. Pistillate flowers with twenty-five to forty pale yellow bracts gradually narrowed into long slender points. Cones ripening in the second year, ovoid-oblong, 2 to 3 inches long by $1\frac{1}{2}$ to 2 inches wide, brownish; scales gradually thickening from the base to the dilated disc, which is $\frac{3}{4}$ to 1 inch broad, and often bears a reflexed spine in the centre of the transverse depression. Seeds, $\frac{1}{8}$ to $\frac{1}{4}$ inch long, light-brown, apiculate at the apex, surrounded by laterally united, often unequal wings, which are broader than the body of the seed. Proliferous cones have been observed.¹

Wellingtonia produces cones freely in many parts of the British Isles, but these are smaller in size as a rule than those of the wild tree and rarely contain mature seed. Mr. Richards informed me that he had sown a large quantity of seed, produced by a tree growing at Penrhyn on the lawn in an isolated sunny position, and only obtained eight seedlings. Barnes² raised young plants from seeds produced by a tree at Bicton. At Orton Longueville, Mr. Harding³ succeeded in raising six seedlings out of 100 seeds. The tree cones well at Dropmore, but has seldom if ever produced fertile seed there.

Wellingtonia differs markedly from the redwood, in not reproducing itself either by suckers from the root or by coppice shoots. In its native forests, seed is produced in great abundance, and numerous seedlings occur everywhere in the southern part of the area of distribution of the species; but in the northern groves seedlings are said to be totally wanting.

VARIETIES

None have been noticed in the wild state. Several have appeared in cultivation in Europe.

1. Var. *pendula*. Branches bent downwards at the base, and hanging for their whole length close to the stem, forming in young plants a slender pyramid and in older examples a tall narrow column. This remarkable variety was obtained out of the seed-bed by Lalande of Nantes in 1863, and was put upon the market in 1873 by Paillet of Châtenay-les-Sceaux, near Paris. The best tree⁴ of this kind is growing at M. Allard's arboretum at Angers, in France, and when measured by Elwes in 1907 was 44 feet high by 3 feet in girth, but only 13 feet round the branches. At Bicton,⁵ this variety is represented by a tree which in 1902 was 33 feet high by 26 inches in girth at 2 feet from the ground. At Brettargh Holt,⁵ Kendal, the residence of Charles Walker, Esq., a weeping Wellingtonia was reported to be 22 feet high in the same year. Another example, aged 26 years, growing at Dalkeith Palace and reported to be $19\frac{1}{2}$ feet high in 1902, was figured in the *Gardeners' Chronicle*.⁵ A specimen

¹ Carrière, *Rev. Hort.* 1887, p. 509, f. 103. Cf. *Gard. Chron.* ii. 649 (1887).
² *Gard. Chron.* 1868, p. 872. ³ *Ibid.* xxix. 55 (1901).
⁴ Described and figured by Rehder in Möller's *Deutsche Gärtner Zeitung*, March 22, 1902.
⁵ *Gard. Chron.* xxxi. p. 388, fig. 136, and p. 435; and xxxiii. p. 23 (1902).

30 feet in height at Berkhamstead, Herts, is mentioned by Webster.¹ In the *Revue Horticole*, 1906, p. 395, f. 157, a curious weeping Wellingtonia, growing at the Trianon, is figured. The stem, which is 42 feet in length, bends over and is supported on one side by a prop. Barron also obtained a weeping form, which was sold as *S. gigantea Barroni pendula*.²

2. Var. *aurea* (var. *aureo-variegata*). The young shoots are amber-coloured at first, but speedily become deep yellow, the colour being pretty uniform over the whole tree. The original plant was a seedling, which Hartland³ of the Lough Nurseries, Cork, received in 1856. It began to show colour when it was about a foot high, and after it had attained 8 feet, a large number of golden Wellingtonias were propagated from it by grafting. A specimen 20 feet high was growing⁴ in the public garden at Denbigh in 1887. We have seen no trees of this variety of a considerable size.

3. Several other varieties, which I have not seen, are mentioned by Beissner⁵ as *glauca*, *argentea*, *Holmsii*, and *pygmaea*. (A. H.)

DISTRIBUTION

Wellingtonia has a restricted distribution, being confined to the western slopes of the Sierra Nevada of California, in an interrupted belt at elevations of from 5000 to 8400 feet above sea-level, extending from the middle fork of the American River (lat. 39°) to the head of Deer Creek, just south of lat. 36°.

I am indebted to Mr. Gifford Pinchot for the most recent account which has been officially published of the big trees of California,⁶ illustrated by some excellent photographs; from which it appears that John Bidwell in 1841 was really the first to discover this tree in the Calaveras Grove, Prof. Brewer of Yale having been the first scientific visitor in 1864 to this and the Mariposa Grove. Mr. Whitney, in the *Yosemite Guide Book* (1870) described eight of the then known groves, namely:—

1. The North Grove in Placer county is on a tributary of the middle fork of the

¹ *Hardy Coniferous Trees*, 113 (1896).
² Another weeping form is said to have originated in Little and Ballantyne's nursery at Carlisle; but the original tree died in 1877. Cf. *Journal of Forestry*, iii. 260 (1879). ³ Letter to Kew.
⁴ *Gard. Chron.* ii. 276 (1887). ⁵ *Nadelholzkunde*, 165 (1891).
⁶ A "Report on the Stanislaus and Lake Tahoe Forest Reserves, by G. B. Sudworth," *Bulletin No. 28*; U.S. Dept. of Agriculture, Division of Forestry, published at Washington in 1900, which gives the following table of measurements of thirty of the big trees in the Calaveras Grove:—

Tree No.	Diameter 6 feet above Ground.	Height.	Tree No.	Diameter 6 feet above Ground.	Height.	Tree No.	Diameter 6 feet above Ground.	Height.
1	Feet. 9.0	Feet. 235	11	Feet. 12.5	Feet. 250	21	Feet. 15.0	Feet. 325
2	9.0	251	12	12.5	266	22	15.5	268
3	9.5	260	13	13.0	286	23	15.5	272
4	10.0	237	14	13.5	320	24	15.5	289
5	10.0	243	15	14.0	259	25	16.0	262
6	10.0	261	16	14.0	265	26	16.0	275
7	10.5	248	17	14.0	269	27	16.5	266
8	11.0	255	18	14.5	278	28	16.5	268
9	11.0	260	19	15.0	285	29	16.5	288
10	12.0	248	20	15.0	307	30	19.5	315

American river, at an elevation of 5100 feet, and 70 miles north of the Calaveras Grove. It now contains only six trees, of which the two largest are 240 and 220 feet high.

2. The Calaveras Grove¹ is at an elevation of 4750 feet, occupying a belt only 3200 by 700 feet in extent, and containing 90 to 100 trees of large size, besides a considerable number of small ones. The largest tree standing here was barked up to 116 feet high, and the bark set up in the Crystal Palace at Sydenham, where it was afterwards destroyed by fire. This tree was 302 feet high and 96 feet in girth at the ground. It was felled by boring holes all round the trunk with pump augers, which occupied five men for twenty-two days. An even larger tree in this grove was the "Father of the Forest," cut down in 1853, and now lying on the ground; it has been hollowed out by fire so that a man can ride through it on horseback for a distance of 82 feet. Its extreme length, so far as could be judged from the remains, was 365 feet, and its circumference at the base is said to have been 110 feet.

The largest living trees in this grove were as follows, only nine being, according to Whitney, over 300 feet:—

"The two Sentinels,"	over 300 feet high by 23 feet in diameter.
"The Pride of the Forest,"	300 " 23 "
"Abraham Lincoln,"	320 " 18 "
"Starr King,"	360 " girth not stated.
"General Scott,"	325 " "
"Keystone State,"	325 " diameter at 6 feet, 14 feet 3 inches.
"General Jackson,"	319 " " " 12 " 7 "
"Mother of the Forest,"	315 " " " 19 " 4 "
	without bark.
"Daniel Webster,"	307 " " " 15 feet

3. The Stanislaus or South Calaveras Grove is about six miles south-east of the last, and is said to have contained, when Mr. Sterry owned it, 1380 trees from 1 foot to 34 feet in diameter, but the number now existing is much less. The largest standing trees mentioned were as follows:—

"Columbus."	
"New York,"	over 300 feet high by 104 feet in girth.
"Ohio,"	" 311 " 103 "
"Massachusetts,"	" 307 " 98 "

Besides these, "Smith's Cabin," a hollow tree in which a hunter is said to have lived for three years, 21 feet by 16 feet in size inside, and "Old Goliath," a fallen tree said to be 100 feet or more in circumference, were remarkable for their size.

About 25 miles south-east of this is a grove called the Crane Flat Grove, most of the trees in which are said to be rather smaller than those in the Calaveras Groves.

¹ Cf. note 6 on p. 701.

4. The Mariposa Grove is the one best known to English travellers, and is usually visited from Clark's ranch on the road to the Yosemite Valley. It consists of two nearly distinct groves, the upper one being compact, on an area of 3700 by 2300 feet and containing 365 trees over 1 foot in diameter, besides a great number of small ones. The southern division or lower grove is said to contain only half as many Sequoias, and these are more mixed with other trees, such as Douglas fir, sugar pine (*Pinus Lambertiana*), *Abies concolor*, and *Libocedrus decurrens*. Many of the trees in both of them have been much injured by fire, which has destroyed many of the younger ones within the groves; but there are on the outskirts several small natural groups of young trees up to 6 or 8 inches in diameter. The largest tree here is the "Grizzly Giant," whose photograph is well known in many English houses, and which is 93 feet in girth at the ground, and 64 feet at eleven feet up; some of its branches are fully 6 feet in diameter. The tallest tree in this grove, according to Whitney, is 272 feet, and another is 270 feet by 26 feet in diameter at the base; only six in all are over 250 feet high.

5. The Fresno Grove is about 14 miles south-east of Clark's ranch, and is about 2½ miles long by 1 to 2 miles wide. It contains 500 to 600 trees, of which the largest is 81 feet in girth at 3 feet from the ground.

6. About 50 miles south-east of the Fresno Grove, along the slope of the sierra between the King's and Kaweah rivers, is by far the most extensive forest that has been found. It is about 30 miles north-east of Visalia, and is scattered over an area 8 to 10 miles long and 4 to 5 wide, at an elevation of about 4500 to 7000 feet. The average size of these trees is much smaller, only 10 to 12 feet in diameter, the largest measured, near Thomas's Mill, being 106 feet in girth near the ground, where a considerable portion has been burnt off. At 12 feet from the ground this tree was 75 feet in girth, its height being 276 feet, though the top was dead.

7. There are two other groves on the Tule river, of which the most northerly is 30 miles from the King's River Grove. These were discovered in 1867 by Mr. D'Heureuse when exploring for the Geological Survey. They extend over an area of several square miles and contain a considerable number of trees, of which no measurements are given.

8. Besides these there are small and little known groves on Dinkey Creek, a tributary of King's river, and on the headwaters of the Merced river, the last said to contain less than 100 trees.

Prof. W. L. Jepson of the University of California has been good enough to send us the following enumeration¹ of the existing groves of Wellingtonia, most of which he has visited this year:—

¹ This list will be published in Prof. Jepson's forthcoming work on the Trees of California.

TABLE OF BIG TREE GROVES AND FORESTS. BY WILLIS L. JEPSON.

Groves.	Locality.	Area in Acres.	Altitude.	No. of Trees.
NORTH GROVES.				
1. North Grove . . .	Middle Fork American River, Placer County	...	4300-5000	6
2. Calaveras Grove . . .	Stanislaus River, Calaveras County .	51	4800	101
3. Stanislaus Grove . . .	Stanislaus River, Tuolumne County	1000	5000	1380
4. Tuolumne Grove . . .	Merced-Tuolumne Divide, Tuolumne County	...	5800	30
5. Merced Grove . . .	Merced-Tuolumne Divide, Mariposa County	...	5500	60
6. Mariposa Grove . . .	South Fork Merced River, Mariposa County	...	6000	{ 365 182
7. Fresno Grove . . .	Headwaters Fresno River, Madera County	2500	5000	500
SOUTH GROVES.				
8. M'Kinley Grove . . .	Dinkey Creek, Fresno County .	...	5000	75
9. Converse Basin Forest	South Fork King's River, Fresno County	5000	6000-6500	...*
10. Boulder Creek Forest .	Boulder Creek, South Fork King's River, Fresno County	1500	6500-7000	...
11. General Grant Forest .	Gen. Grant Nat. Park, Fresno and Tulare Counties	{ 2000 to 3000	6500-7000	...
12. Redwood Cañon Forest	Redwood and Eshom Creeks, Tulare County	3000	5500-6500	...
13. North Kaweah Forest .	North Fork Kaweah River, Tulare County	1500	6000-7000	...
14. Giant Forest . . .	Marble Fork Kaweah River, Tulare County	2300	6500-7000	...
15. Cliff Creek Grove . . .	Middle Fork Kaweah River, Tulare County	...	7000	...
16. Harmon Meadow Grove	Middle Fork Kaweah River, Tulare County	...	7000?	...
17. Mineral King Forest .	East Fork Kaweah River, Tulare County	3000	5500-6500	...
18. Lake Cañon Grove . . .	East Fork Kaweah River, Tulare County	...	...	...
19. Mule Gulch Grove . . .	East Fork Kaweah River, Tulare County	...	...	...
20. Homer's Peak Forest .	East Fork Kaweah River, Tulare County	...	5500-7000	...
21. South Kaweah Forest .	South Fork Kaweah River, Tulare County	{ 3000 to 5000	5000-7000	...
22. Dillon Forest . . .	North Fork Tule River, Tulare County	1000	5000-7000	...
23. Tule River Forest . . .	Middle Fork Tule River, Tulare County	3500	5500-7000	...
24. Pixley Grove . . .	Middle Fork Tule River, Tulare County	...	6500-7000	...
25. Fleitz Forest . . .	Middle Fork Tule River, Tulare County	...	5000-6500	...
26. Putnam Mill Forest . .	Middle Fork Tule River, Tulare County	4000	5500-6000	...
27. Kessing Groves . . .	South Fork Tule River, Tulare County	...	5500-7000	...
28. Indian Reservation Forest	South Fork Tule River, Tulare County	1500	6000	...
29. Deer Creek Grove . . .	South Fork Deer Creek . . .	300	7000	150
30. Freeman Valley Forest	Kern River, Tulare County . . .	1000	5500-6500	...
31. Kern River Groves . . .	Kern River, Tulare County . . .	700	6500-7000	...

* Blanks in this column indicate that the trees are so numerous that they have not been counted.

One of the best accounts of the Wellingtonias and their surroundings is in Muir's *Mountains of California*. He states that the young trees have slender branches growing with great regularity down to the ground, as we see them on an English lawn; but when the tree attains 500 or 600 years old, the spiry, feathery, juvenile habit merges into the firm rounded dome-like habit of middle age, which in its turn takes on the eccentric picturesqueness of old age. The foliage of the saplings is dark bluish-green, while that of the older trees ripens to a warm brownish-yellow tint like that of Libocedrus. The bark is rich cinnamon brown, purplish in young trees and in shaded portions of the old ones. In winter the trees break out into bloom, myriads of small four-sided staminate flowers crowding the ends of the smaller sprays, colouring the whole tree, and when ripe dusting the air and the ground with golden pollen. The fertile cones are bright grass green, about 2 inches long by $1\frac{1}{2}$ inch wide, and are composed of about forty firm scales densely packed, with three to eight seeds at the base of each, a single cone thus containing 200 to 300 seeds, which are about $\frac{1}{4}$ inch long by $\frac{3}{16}$ inch wide, with a thin flat margin. The cones are very freely produced; and on two branches, $1\frac{1}{2}$ to 2 feet in diameter, Mr. Muir counted no less than 480. But of the millions of seeds produced, very few germinate; and of these not one in ten thousand lives through the vicissitudes of storm, drought, fire, and crushing by snow, to which they are exposed in youth.

Natural reproduction in the groves, when they have been protected from fire and grazing, is said to be at a standstill, owing to the dry humus beneath the trees forming an unsuitable seed bed; and it is only in the forests on the south fork of the Kaweah, and on the Tule river, where young trees of all ages can be found in abundance.

The damage, waste, and loss which has occurred in those groves which have been partially cut for timber is said to be enormous. When a large tree is felled its immense weight breaks a great part of the top into useless fragments, and crushes many other trees in its fall; whilst the usual means adopted to break up the logs into pieces which can be handled is by blasting; and this destroys another large part of the timber. When the best is removed, a mass of broken branches, timber, and bark, often 5 or 6 feet in depth, is left on the ground, which is later destroyed by fire; leaving complete devastation in place of the most beautiful forest; and it is said that owing to various causes, the lumbering of these forests has often been quite unprofitable to their owners.

Mayr¹ estimates the age of the largest tree which he measured, 33 feet in diameter at 13 feet above the ground, to be 4250 years. Sir Joseph Hooker² told Bunbury that, as the Wellingtonia makes repeated growths in the year, it is more difficult than is the case in other conifers to distinguish the shoot of one year from that of the preceding year; and he suspected that more than one ring of growth is formed in each year, and that in consequence the estimates of enormous age of this species are probably fallacious.

¹ *Waldungen Nordamerika*, 343 (1890).² Lyell, *Life of Sir C. J. F. Bunbury*, ii. 227 (1906).

INTRODUCTION

The Wellingtonia was introduced by Mr. J. D. Matthew, who visited the Calaveras Grove in July 1853, and sent home seeds immediately afterwards. In *Pinetum Britannicum*, p. 318, eleven trees of this origin are traced, namely, two each at Gourdiehill, Megginch Castle, and Ballendean, near Inchtute, and one each at the Kinnoul Nursery near Perth, Newburgh, Balbirnie, Inchry House, and Eglinton Castle; but none of these were so large when he wrote as those raised from later consignments. Lobb visited the Calaveras Grove in the autumn of the same year, and returned¹ to England in December 1853, bringing with him a large quantity of seed and two living plants. The latter were planted out in Veitch's nursery at Exeter, but only survived three or four years.

CULTIVATION²

The culture of the Wellingtonia presents no difficulty if care is taken to have the roots thoroughly spread out when planted out. They are often kept too long in pots, which causes their main root to curl round, and when this has assumed a corkscrew shape it never loses it. If the tree is transplanted every year or so while young, it may safely be removed when 4 or 5 feet high. As regards soil and situation it is more accommodating than the redwood, and even in heavy soil is rarely injured by spring frosts. It grows very fast in most places up to 40 or 50 feet high, and then, unless the soil is deep and well drained, often becomes stunted and increases more in girth than height. If planted in a park or field pastured by stock, it must be very carefully fenced, as horses and cattle will gnaw its bark persistently and do it much injury. I noticed a good instance of this in the park at Mark's Hall, Essex, where some Wellingtonias had been so much bitten by cattle that they resembled the trees in a toy Noah's Ark, one about 35 years old being only 12 feet high by 3 feet in girth. When surrounded by other trees, where it cannot extend its branches laterally, the girth is much less in proportion. A tree that I saw in a plantation at Powis Castle, which was growing extremely well, was 75 feet high and only 7 feet 3 inches in girth, whilst one in the lower park at the same place was 81 feet by 16 feet.

REMARKABLE TREES

When first introduced this tree made such a sensation in the horticultural world, that it was planted almost everywhere, and there are specimens at every place of importance in the United Kingdom, many of which are very nearly equal in size. The tallest at Windsor Castle was already 21 feet high in 1865, and is now, as I am

¹ *Hortus Veitchii*, 39, 346 (1906).

² An interesting article on the causes of success or failure in plantations on a large scale of this tree in South Hampshire appeared in *Gard. Chron.* ix. 794 (1878).

told by Mr. A. MacKellar, 85½ feet high and 12½ feet in girth at 3 feet from the ground.

The largest and finest tree I have measured myself is in an open but well sheltered glade near the lake at Fonthill Abbey, and was, in November 1906, certainly over 100 feet and probably 105 feet high, by 17 feet in girth (Plate 106).¹⁹⁶ This tree was raised at Eaton Hall from seed sent to Lord Stalbridge in 1861, and is not so old by seven years as many others in this country.

There are two very fine trees at Poltimore Park, Devonshire, the seat of Lord Poltimore, one of which I measured in August 1906, and found to be 98 feet by 16 feet 9 inches, but the gardener, Mr. Slade,¹ thinks it is taller. Near the Temple, at Highclere, there is a tree which I saw in 1903, of which the size is given by Mr. Storie, the forester, as 97 feet by 13 feet, but I could not verify this measurement myself.

One of the largest in girth that I know, is an ugly tree at Powderham whose top has long been broken, and which has formed immense branches, so thickly crowded that I could only get the tape round it with assistance. In 1906 it was no less than 17 feet 8 inches; but I must observe that the exact girth of such trees is of little importance, as it depends very much on the height at which the measurement is taken.

At Beauport, Sussex, there are two fine trees, one of which, planted in 1856, was, in 1904, 86 feet high by 13 feet 8 inches in girth. The other, a younger tree, measured 83 feet by 11 feet 11 inches. Sir Hugh Beevor measured in 1904 a tree at Hardwicke, Suffolk, 80 feet by 12 feet 4 inches, and another at Wooton, 85 feet by 14 feet 6 inches. Mr. R. Woodward, jun., reports in 1906 two trees at Wexham Place, Stoke Pogis, the residence of E. H. Wilding, Esq., which measured 79 feet by 9 feet 6 inches and 78 feet by 10 feet 8 inches. Canon Ellacombe² planted a tree at Bitton in 1855, which had attained 70 feet in height in 1888. A tree³ at Wrest Park, Bedfordshire, planted in 1856, was, in 1900, 74 feet high by 15 feet 3 inches in girth.

At Strathfieldsaye there is a fine large tree,⁴ planted in 1857, which I measured in 1903, and found to be 85 feet by about 12 feet. In 1907 it was 90 feet high, but the branches were so thick that I could not get the girth with sufficient accuracy to say how much increase it had made. A number of branches have become layered—a not uncommon occurrence in damp and sheltered situations—but when they have been allowed to remain long after taking root, it is perhaps better not to take them off, as this disfigures the tree for some time. There is also a fine avenue of this tree at Strathfieldsaye, which is more regular and satisfactory in growth than some others which I have seen. Another at Orton Longueville is no less than 700 yards from east to west, but some of the trees when I saw them seemed to be suffering from the wetness of the subsoil, the tops of many being stunted. There is also a fine

¹ Cf. Mr. Slade's remarks on this tree in *Gard. Chron.* xxvii. 406 (1900).

² *Gard. Chron.* iii. 801 (1888).

³ *Ibid.* xxvii. 373, fig. 121 (1900).

⁴ In 1868, this tree was 24½ feet high; in 1872, 30 feet high; in 1895, 71 feet high; and in 1899, 79 feet. A cutting from it was struck, and planted out in 1875, when about 2 feet high, and had attained, in 1896, 30 feet in height and 6 feet in girth, at 4 feet from the ground. Cf. *Gard. Chron.* xix. 8 (1896) and xxvi. 162 (1899).

avenue at Luton Park, in which most of the trees are good specimens, but unless the soil is good and uniform throughout, and the trees are selected with great care, I should not recommend this tree for avenues.

By far the best avenue of this tree that I have seen is one near Wellington College, which was planted in the year 1869 by the late John Walter, Esq., of Bear Wood, Berks, on a light, sandy soil which, however, seems to have suited the trees remarkably well, and on which the symmetry of their tops and uniformity of the growth is remarkable. It is about 1200 yards long, running about north and south, and is 25 yards in width. The trees are planted at 18 yards apart, which is about the right distance for this tree. The average height of the trees is 75 to 80 feet, and the largest that I measured on the west side near the top was 87 feet by 21 feet. Plate 198, taken specially for this work, gives a very good impression of its appearance. Mr. C. E. Salmon tells me that there is another avenue of this tree which was planted in 1871 by the late Mr. J. Walter in front of Bear Wood House.

At Aston Clinton, Bucks, the residence of Lady A. de Rothschild, there is a group of closely planted Wellingtonias with tall clean stems, tapering only slightly, and carrying timber size to 50 or 60 feet. The ground, which is a circular area 120 feet in diameter, is covered with decayed leaves and is free from herbaceous vegetation. On it there are seventy-two trees in all, ranging in height from 60 to 75 feet, and in girth from 4 feet 4 inches to 8 feet 2 inches at 6 feet from the ground, above the swollen base. This clump was planted in 1869, according to Mr. W. H. Warren, who has kindly sent us a photograph, reproduced in Plate 197. This beautiful grove, which was seen by Henry in 1906, shows how well the tree succeeds when planted densely on good land.

At Brickendon Grange, Hertford, the property of John Trotter, Esq., in a wood, composed of a mixture of common spruce, Wellingtonia, *Cupressus macrocarpa*, *Abies Lowiana*, and *Pinus ponderosa*, all planted at the same time, in 1861, the comparative girths of trees, measured by Mr. H. Clinton Baker, in December 1907, without selection, at 5 feet from the ground, are as follows:—

Wellingtonia: 3 feet, 5 feet, 5 feet, 5 feet 2 inches, 5 feet 3 inches, 5 feet 10 inches.

Cupressus macrocarpa: 4 feet, 4 feet 2 inches, 4 feet 8 inches, 4 feet 9 inches, 5 feet 3 inches, 5 feet 6 inches, 5 feet 7 inches, 5 feet 10 inches, 5 feet 10 inches.

Abies Lowiana: 4 feet, 4 feet 10 inches.

Pinus ponderosa: 5 feet 2 inches, 5 feet 3 inches.

Common Spruce: 2 feet 2 inches, 2 feet 5 inches, 2 feet 6 inches, 2 feet 7 inches, 2 feet 8 inches, 2 feet 8 inches, 2 feet 10 inches, 3 feet 1 inch, 3 feet 3 inches.

Sir John Stirling Maxwell sends me the following measurements of some Wellingtonias planted in 1864 or 1865 at Cloverley Hall, Shropshire, the seat of Capt. Heywood Lonsdale, in mixture with spruce and larch.

No.	Height.	Quarter-girth at 5 Feet.	No.	Height.	Quarter-girth at 5 Feet.
1.	64 feet	26 inches	12.	68 feet	24 inches
2.	66 "	24 "	13.	61 "	19 "
3.	67 "	30 "	14.	65 "	23 "
4.	66 "	24 "	15.	71 "	24 "
5.	61 "	24 "	16.	69 "	27 "
6.	73 "	34 "	17.	66 "	29 "
7.	62 "	23 "	18.	72 "	27 "
8.	60 "	19½ "	19.	68 "	27½ "
9.	63 "	20 "	20.	62 "	21 "
10.	65 "	18½ "	21.	70 "	23½ "
11.	58 "	23 "			

He also measured some at 3 and 6 feet to show their rate of growth as compared with other trees, as follows:—

	Girth at 3 Feet.		Girth at 6 Feet.		These trees were not selected with care, but were all good specimens of their kind.
	Feet.	Inches.	Feet.	Inches.	
Wellingtonia, 1	8	0½	6	3	} These trees were not selected with care, but were all good specimens of their kind.
" 2	8	7	7	2	
" 3	9	2	7	2½	
" 4	9	5½	7	9	
Common spruce, 1	5	7	4	5	
" 2	3	9	3	4½	
Larch	5	6½	4	10	
Austrian pine	6	0½	5	8½	

A tree planted in the pleasure ground at Cloverley by the late Mr. W. E. Gladstone in 1872, now measures 56 by 8½ feet; another planted Jan. 1, 1864, is now 65 by 11 feet.

In Scotland, the Wellingtonia has not attained as great a height as in England, but seems to grow well in many places. The finest I have seen is at Murthly, planted in 1857; this in 1891 measured 66½ feet by 9 feet 3 inches, and when I measured it in September 1906, had increased to 86 feet by 12 feet 5 inches. There is one at Castle Menzies which Hunter says was planted out of a pot in 1858, when it cost three guineas, and in 1883 measured 44 feet by 9 feet 3 inches. This has not grown much taller, though it had attained the immense girth of 21 feet when I last saw it in 1907. At Smeaton-Hepburn, East Lothian, a tree, planted in 1855, was measured in 1905 by Henry as 78 feet by 12 feet 9 inches. At Keir, Perthshire, there are several trees, the tallest of which measured, in the same year, 71 feet by 9 feet. At Haddo House, Aberdeenshire, a tree planted in 1857 and reported¹ to be 50 feet by 8 feet 4 inches in 1891, was, in 1904, 68 feet by 11 feet.

The largest trees, reported² by Renwick and M'Kay, are one at Buchanan Castle, Stirlingshire, which was 71 feet high by 9 feet 3 inches in girth in 1900,

¹ Journ. Roy. Hort. Soc. xiv. 501 (1892).

² Brit. Assoc. Glasgow, 1901, Fauna, Flora, and Geology, 144.

and another at Glendoune, Ayrshire, which was 9 feet 4 inches in girth in 1898.

In Ireland there are many fine trees, the tallest in the British Isles in 1891, of those reported at the Conifer Conference,¹ being one at Shanbally in Tipperary, which was then 80 feet in height by 8½ feet in girth.

The finest seen by Henry is growing at Ballykilcavan, Queen's County, the seat of Sir Hunt H. A. Johnson-Walsh, Bart., and measures 95 feet in height and 10 inches in girth. At Brockley Park, a few miles distant, the seat of W. Young, Esq., a tree measures 73 feet by 10 feet 9 inches. At Emo Park, in the same county, there is a fine avenue, though the trees are growing on poor shallow limestone soil. They are planted about 35 yards apart, and average 70 feet high by 10 feet in girth. On the lawn at this place there is a finer tree, 81 feet high by 10 feet 4 inches; and beside it, a redwood, planted at the same time, is only 50 feet high and doing badly.

At Coollattin, Wicklow, a tree measured, in 1906, 78 feet by 12 feet. It produces fruit freely, but the seed does not mature and when sown has never produced seedlings. At Churchill, Armagh, a tree, planted in a bog, was in 1905 67 feet by 12 feet, and looked very healthy. Two trees, 77 feet and 73 feet high, were reported² to be growing in 1897 at Fassaroe, near Bray, in Wicklow.

The largest Wellingtonia of which I have heard on the Continent is a tree near the Hotel Bonnemaison at Bagnères de Luchon (Haute Garonne), of which a large photograph has been kindly sent me by the Hon. W. Rothschild. This splendid tree measures rather over 91 high by 25 feet in girth at the ground. A tree at Locarno,³ on the northern end of Lake Maggiore, has attained, in 17 years after planting, a height of 72 feet and a girth of 9 feet 2 inches. The species appears to be quite hardy in the severe climate of Munich, as Dr. Mayr says that at Grafrath one only 10 years old was nearly 19 feet high, and had endured a frost of -25° Cent. without any injury; though in the winter of 1902-1903, when the thermometer fell to -28° Cent., the branches on the sunny side of the tree were somewhat browned. Trees, however, at Berlin,⁴ which had attained 30 to 40 feet in height, succumbed to the severe cold of the winter 1893-1894.

TIMBER

The timber is very light, soft, weak, and brittle, varying in colour from pale yellowish-brown to rich red-brown, with whitish sapwood, which occupies one to two hundred rings. In native specimens these are extremely close, fifteen or twenty to the inch in some cases.

The wood is said to be very durable in contact with the ground, and is largely used for making vine stakes and for shingles, also to some extent for building, fencing, and box-making. So far as I know it is never imported to Europe, and has no commercial value except locally.

¹ *Journ. Roy. Hort. Soc.* xiv. 571 (1892).

³ Christ, *Flore de la Suisse*, 77 (1907).

² *Gard. Chron.* xxii. 385 (1897).

⁴ Bolle, in *Garden and Forest*, 1894, p. 95.

In the British Museum of Natural History there is a section taken at about 18 feet from the ground, of a tree felled in 1892 at Fresno. The annual rings show that it was 1335 years old.

In *Garden and Forest*, v. 541-547, there is an account, with two excellent photographs, of the felling of a large Sequoia from which a specimen was taken for the Jesup Timber Collection in the Natural History Museum at New York. One of the pictures shows the tree in the act of falling; the other shows the stump, which at ground level was 90 feet in girth, and on its bark and outer edge fifty men are standing, and there is room for a hundred more. Mr. Moore, the Superintendent of the King's River Lumber Company, on whose land the tree was cut, estimated its contents at 400,000 feet, board measure, equal to about 40,000 cubic feet.

(H. J. E.)



GYMNOCLADUS AT CLAREMONT

PLATE 120.

69-12133



CEDAR ON MOUNT LEBANON

PLATE 127.



LEBANON CEDAR AT PAINSHILL

PLATE 128.



LEBANON CEDAR AT GOODWOOD

PLATE 129.



LEBANON CEDAR AT STRATHFIELDSAYE

PLATE 130.



LEBANON CEDAR AT PETWORTH

PLATE 131.



LEBANON CEDAR AT BLENHEIM

PLATE 132.



LEBANON CEDAR AT STRATTON STRAWLESS

PLATE 133.



LEBANON CEDAR AT BIRCHANGER



CEDAR AVENUE AT DROPMORE



A



B

ALGERIAN CEDARS AT TÉNIET EL HÁAD

PLATE 136.



ALGERIAN CEDAR AT ASHAMPSTEAD



ALGERIAN CEDAR AT FOTA

PLATE 138.



DEODARS IN THE HIMALAYA



DEODAR AT BICTON



LIBOCEDRUS CHILENSIS IN CHILE

PLATE 141.



LIBOCEDRUS DECURRENS AT FROGMORE



CUNNINGHAMIA SINENSIS AT BAGSHOT PARK

PLATE 143.



A
LIQUIDAMBAR IN AMERICA



B
NYSSA SYLVATICA IN AMERICA

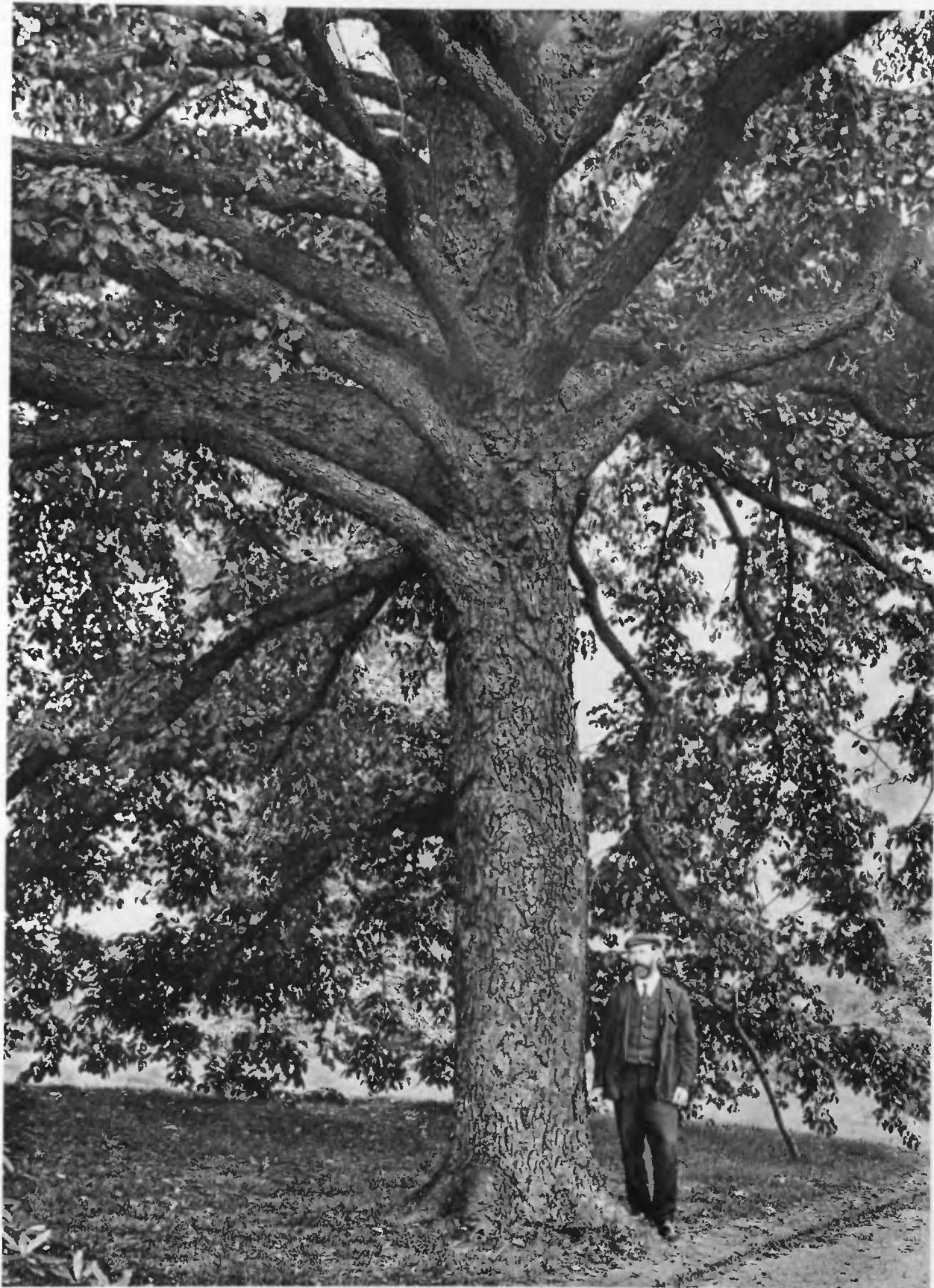


NYSSA AT STRATHFIELDSAYE



SASSAFRAS AT CLAREMONT

PLATE 146.



CORYLUS COLURNA AT WOLLATON PARK

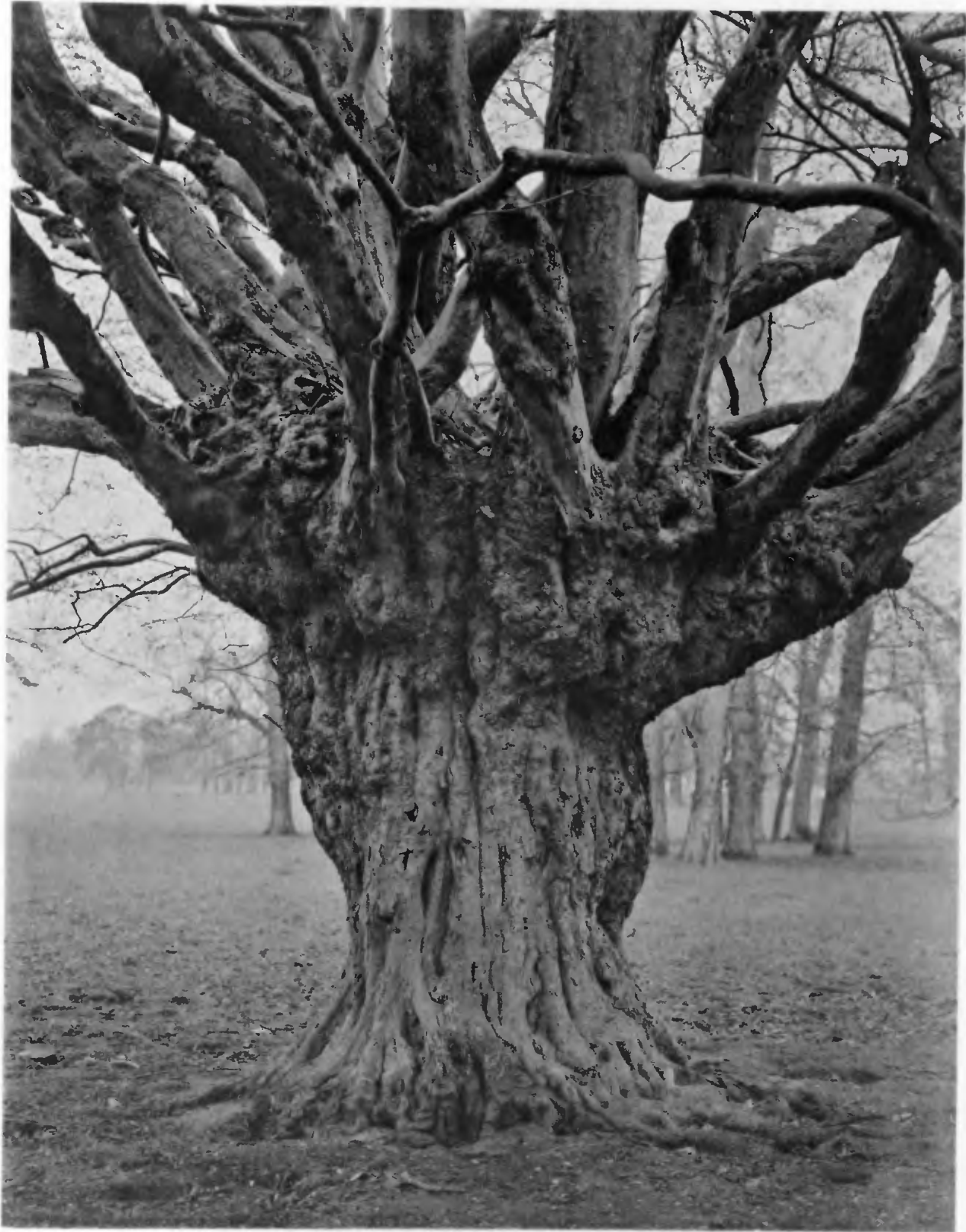
PLATE 147.



HORNBEAM AT CORNBURY PARK



POLLARD HORNBEAMS AT BAYFORDBURY



HORNBEAM AT EASTON LODGE



HORNBEAMS AT WEALD PARK



HORNBEAM AT GORDON CASTLE



HOP-HORNBEAM AT LANGLEY PARK, NORFOLK

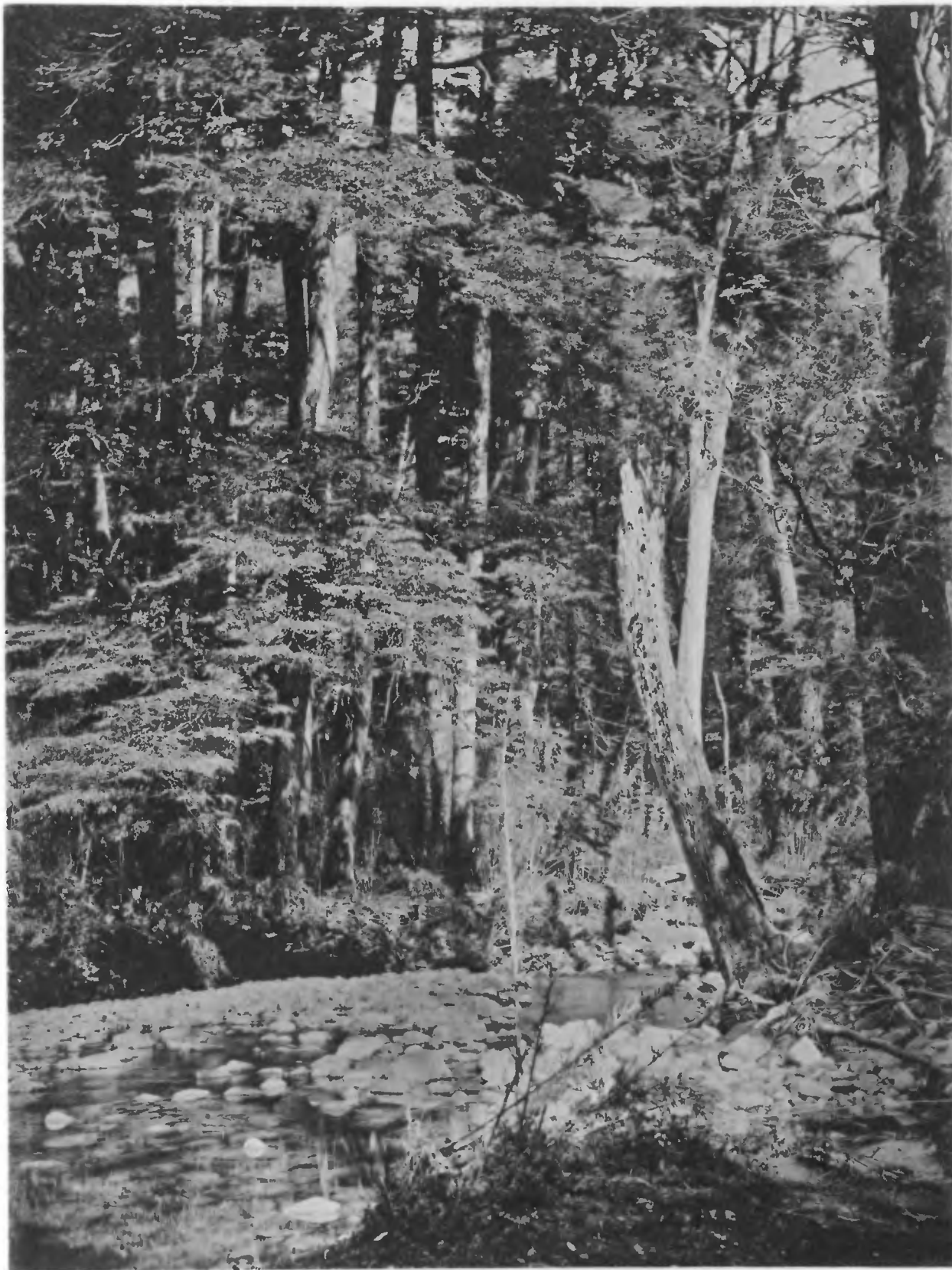


TASMANIAN BEECH AT FOTA



EVERGREEN BEECH AT BICTON

PLATE 155.



BEECH FOREST IN CHILE

PLATE 156.



ARBUTUS AT KILLARNEY

PLATE 157.



ARBUTUS HYBRIDA AT SEDBURY PARK

PLATE 158.



A

SCIADOPITYS IN JAPAN



B

SCIADOPITYS AT HEMSTED

PLATE 159.



SCOTS PINE AVENUE AT CARCLEW

PLATE 160.



SCOTS PINE AT BRAMSHILL

PLATE 161.



SCOTS PINE AT INVERARAY CASTLE



SCOTS PINE AT DUNKELD

PLATE 163.



SCOTS PINE AT GORDON CASTLE

PLATE 164.



SCOTS PINE AT LOCH MORLICH



SCOTS PINE AT ABERNETHY



SCOTS PINE AT ABERNETHY



SCOTS PINE IN BALLOCHBUIE FOREST

PLATE 168.



SCOTS PINE AT BALLOCHBUIE



HICKORY AT BUTE HOUSE



A

HICKORIES IN SYSTON PARK



B

PLATE 171.



HICKORY AT KEW

PLATE 172.



CARYA ALBA AT BROCKLESBY PARK

PLATE 173.



ORIENTAL PLANE AT ELY

PLATE 174.

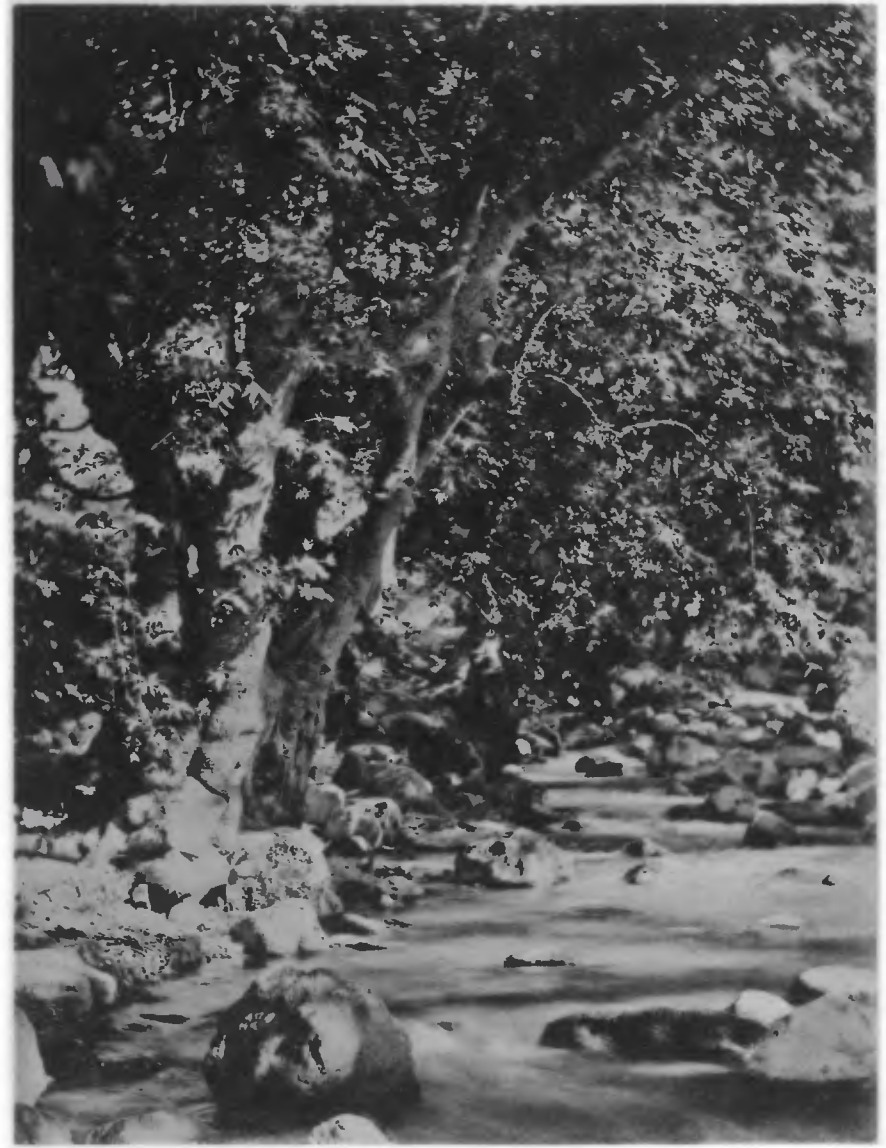


ORIENTAL PLANE AT CORSHAM COURT

PLATE 175.



A
WESTERN PLANE IN AMERICA



B
ORIENTAL PLANE IN SYRIA



RED MAPLE AT BAGSHOT PARK

PLATE 177.



LONDON PLANE AT ALBURY



SYCAMORE AT COLESBORNE

PLATE 179.



PLATE 180.

SYCAMORE AT NEWBATTLE



SYCAMORE AT DRUMLANRIG

PLATE 181.



SYCAMORE AT CASTLE MENZIES



SYCAMORE IN SWITZERLAND

PLATE 183.



COMMON MAPLE AT CASSIOBURY

PLATE 184.



COMMON MAPLE AT LANGLEY PARK, NORFOLK



NORWAY MAPLE AT EMSWORTH



NORWAY MAPLE AT PARK PLACE

PLATE 187.



NORWAY MAPLE AT COLESBORNE



ITALIAN MAPLE AT HARGHAM

PLATE 189.



MONTPELLIER MAPLE AT RICKMANSWORTH

PLATE 190.



SUGAR MAPLE AT PARK PLACE



RED MAPLE AT WHITTON

PLATE 192.



WESTERN MAPLE IN AMERICA

PLATE 193.



REDWOOD AT CLAREMONT

PLATE 194.



REDWOOD FOREST IN CALIFORNIA



WELLINGTONIA AT FONTHILL.

PLATE 196.

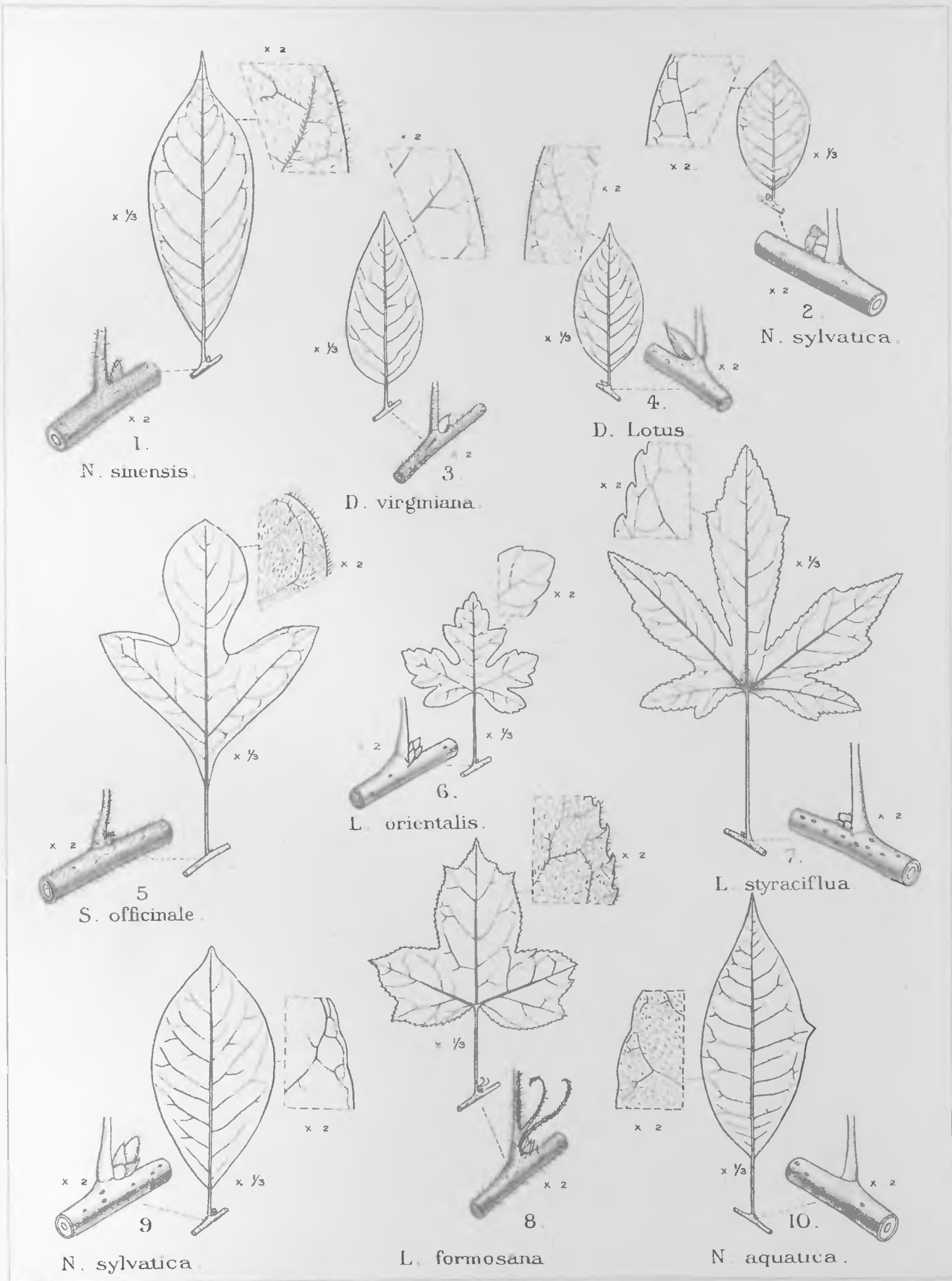


WELLINGTONIA AT ASTON CLINTON



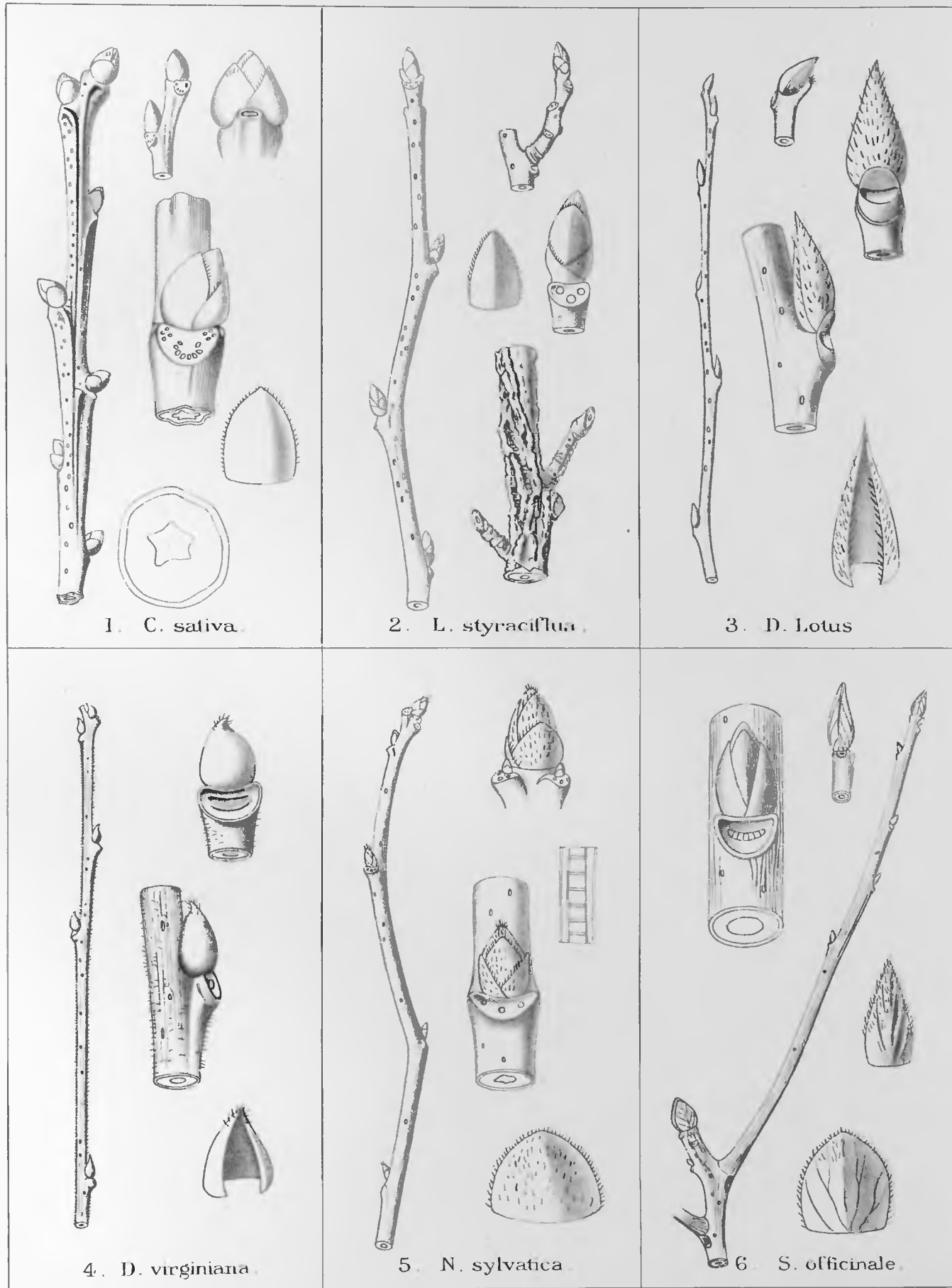
WELLINGTONIA AVENUE NEAR WELLINGTON COLLEGE

PLATE 198.



Hutt, del Huth, lith

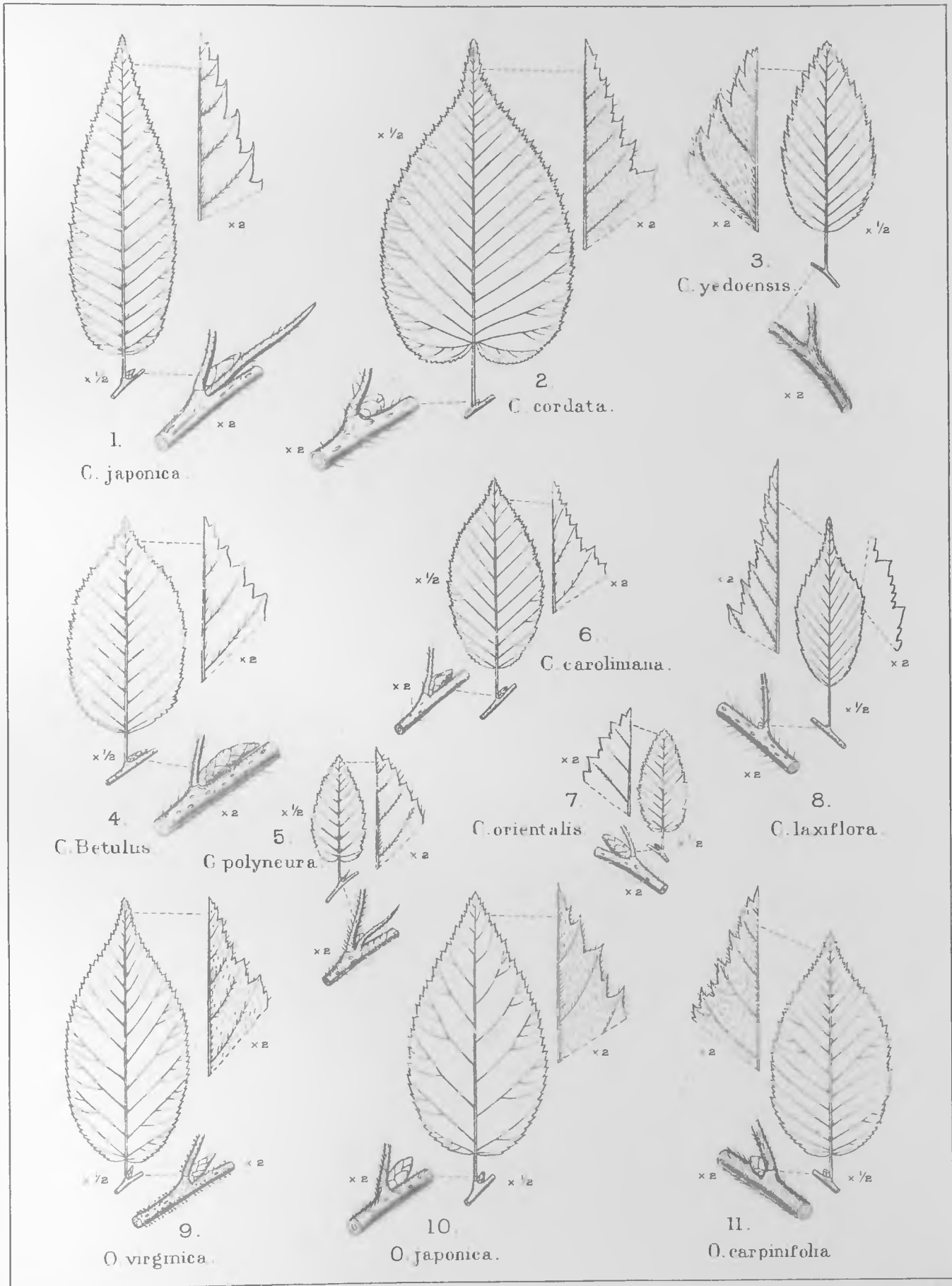
NYSSA, DIOSPYROS, SASSAFRAS, AND LIQUIDAMBAR

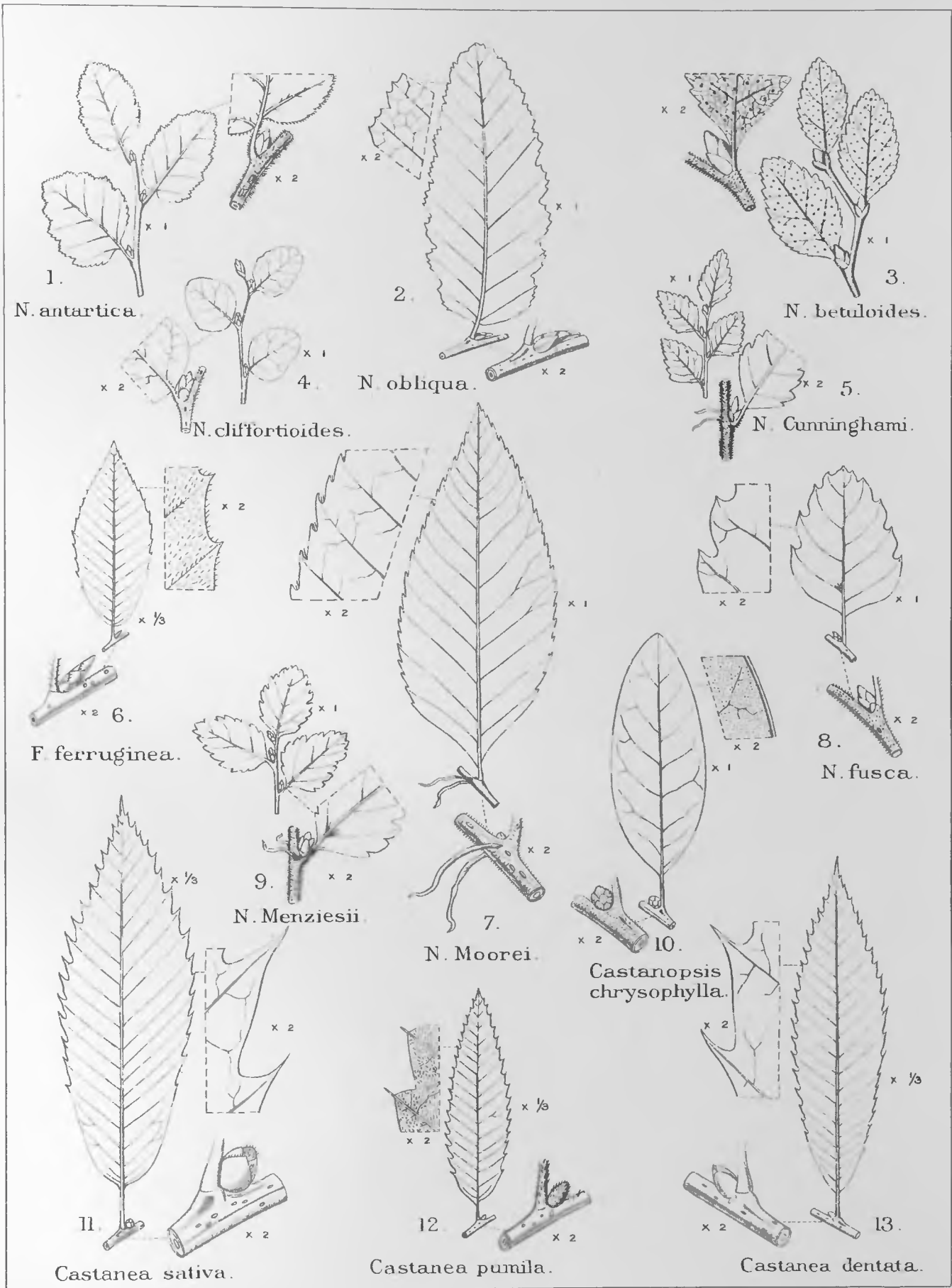


Hutt, del. Huth, lith.

PLATE 200

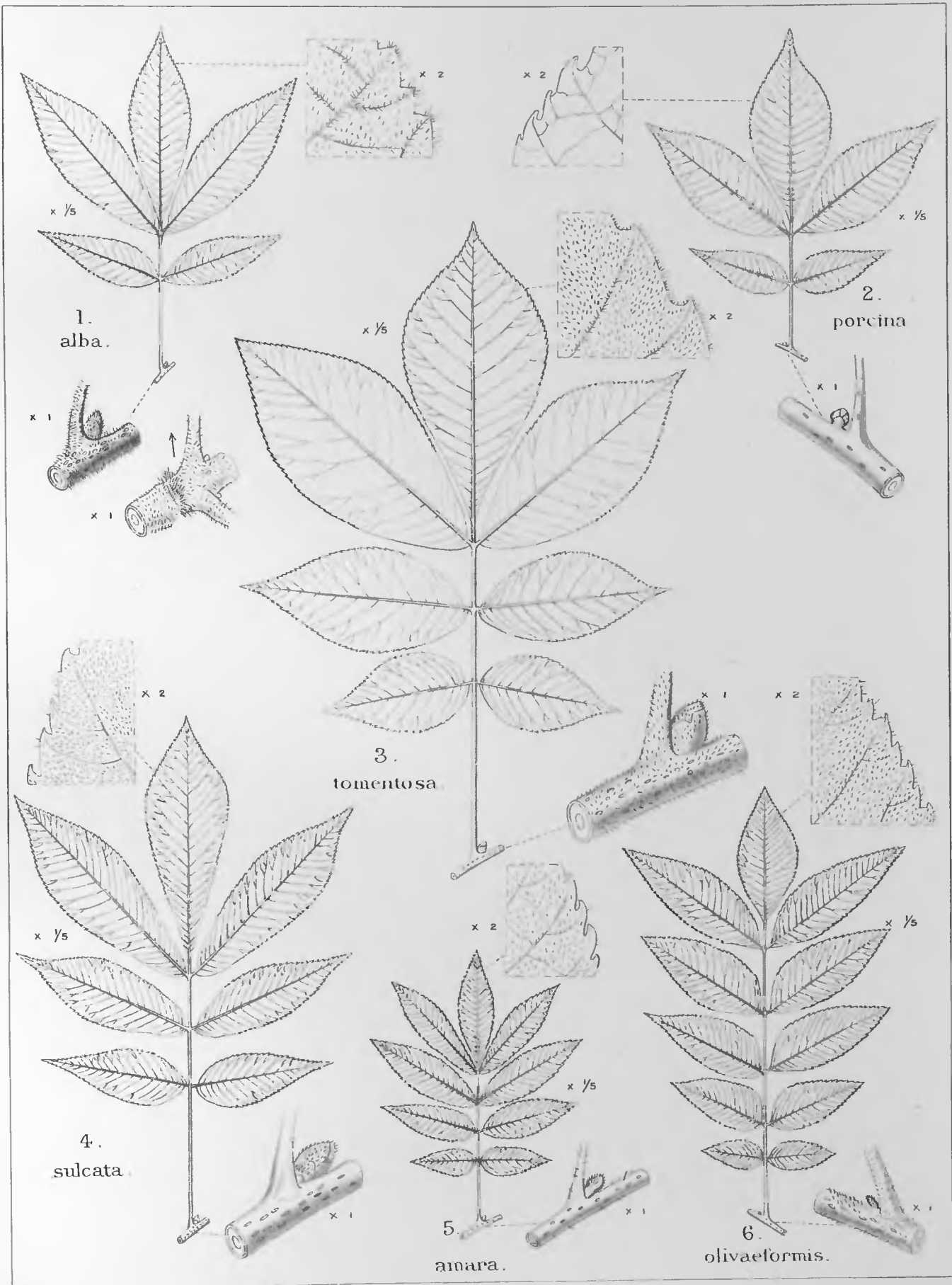
CASTANEA, LIQUIDAMBAR, DIOSPYROS, NYSSA, AND SASSAFRAS.

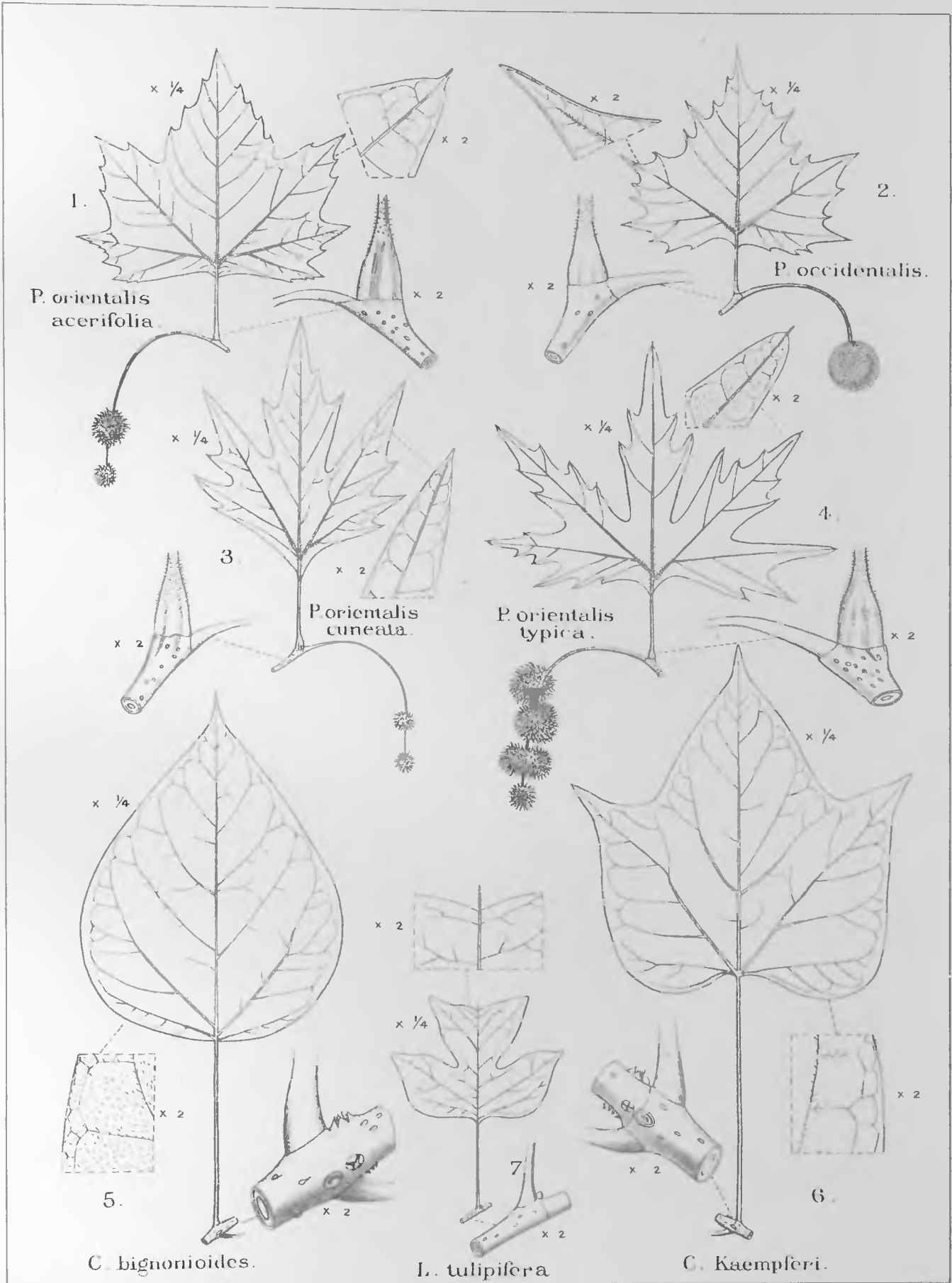


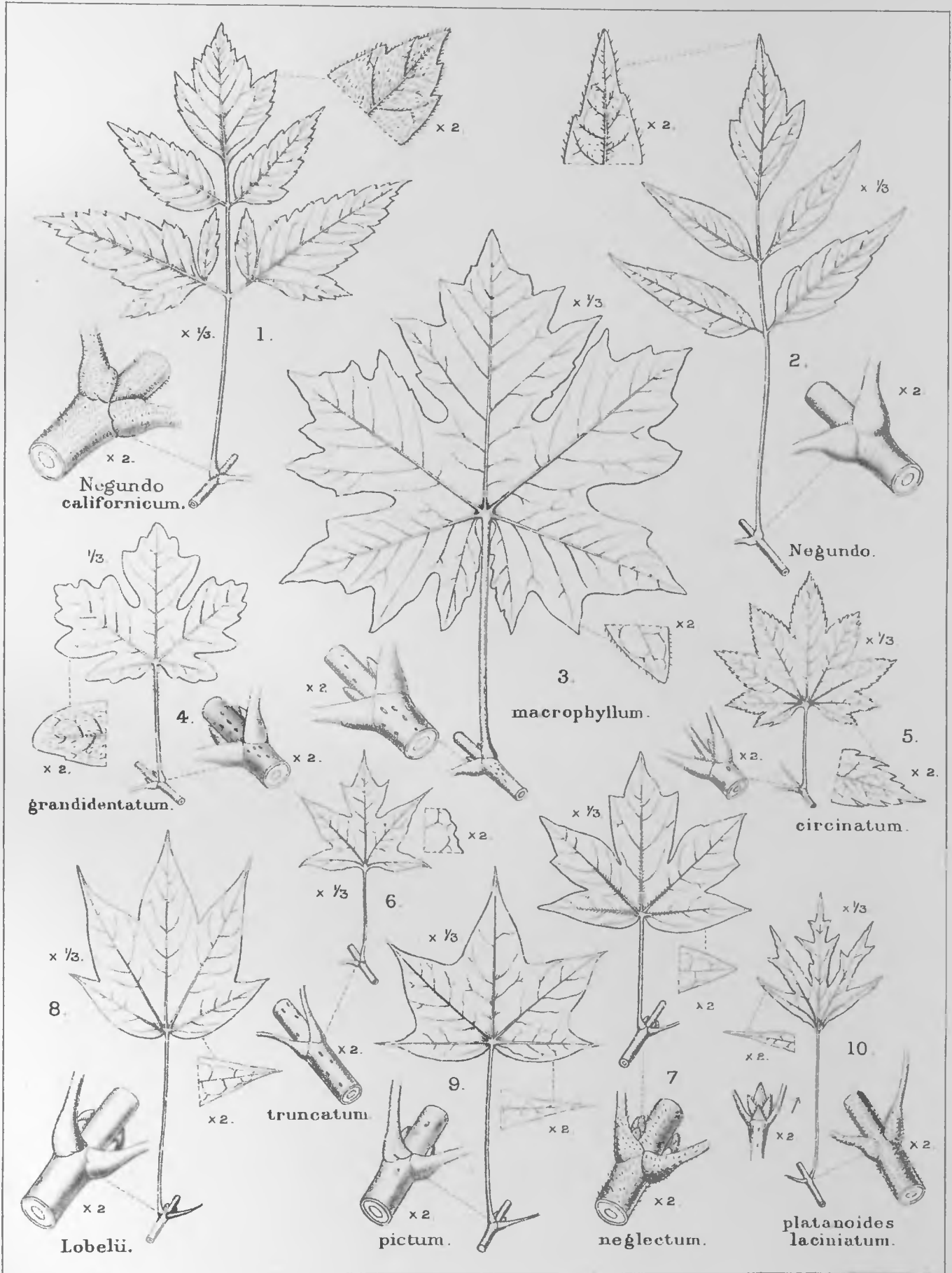


Hutt del. Hutch, lith.

NOTHOFAGUS, FAGUS, CASTANOPSIS, AND CASTANEA.



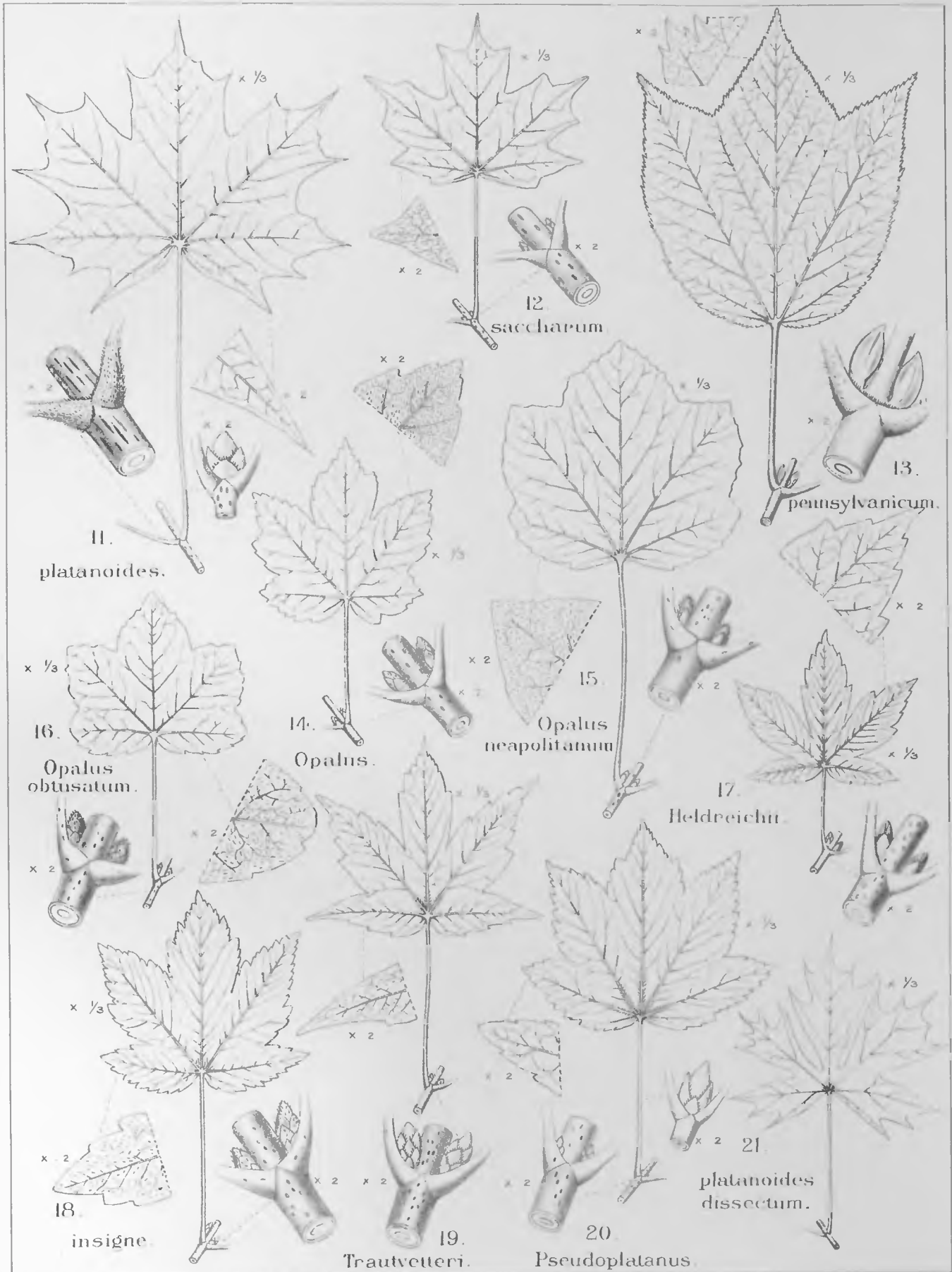


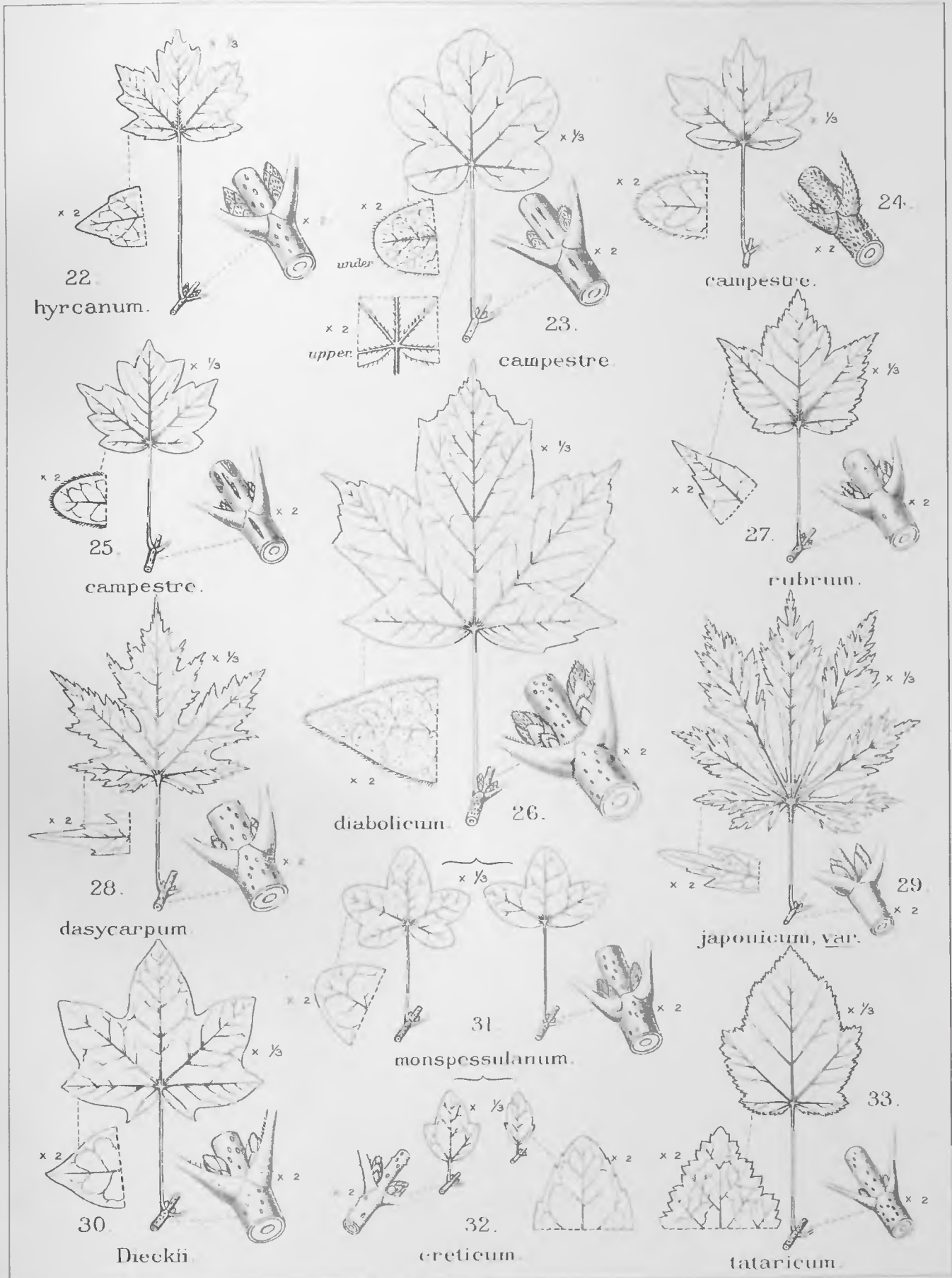


Huitt, del. Hutch, lith.

PLATE 205

ACER.





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v. 4
pt. 1

VOLUME IV



The Trees
of
Great Britain
& Ireland

BY
Henry John Elwes, F.R.S.
AND
Augustine Henry, M.A.

Edinburgh: Privately Printed

FHW

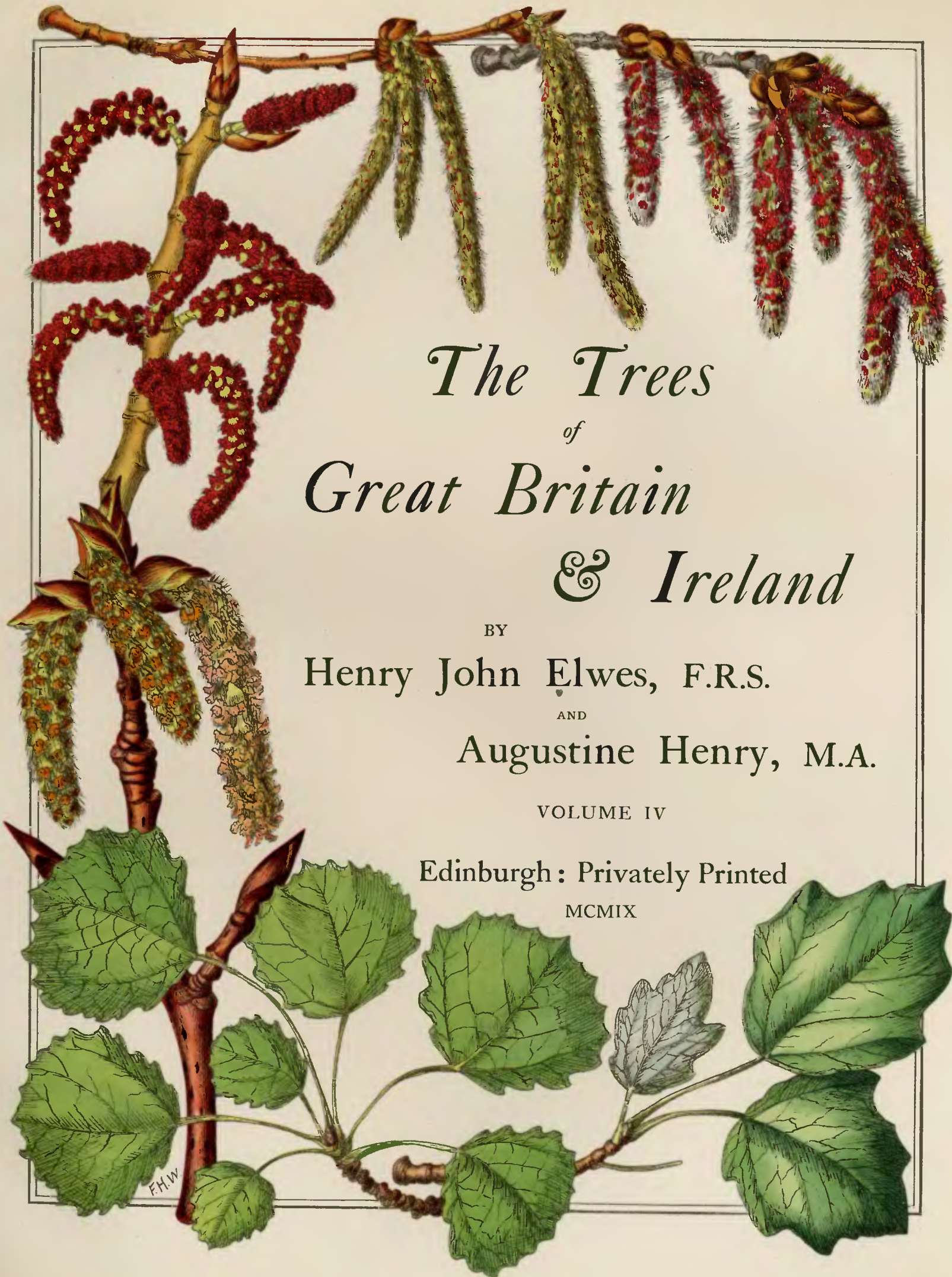
THE TREES OF GREAT BRITAIN AND IRELAND





NATIVE SCOTS PINE AT INVERGARRY

From a Drawing by Miss Ruth Brand



The Trees
of
Great Britain
& Ireland

BY
Henry John Elwes, F.R.S.
AND
Augustine Henry, M.A.

VOLUME IV

Edinburgh: Privately Printed

MCMIX

F.H.W.

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ABIES

Abies, Linnæus, *Gen. Pl.* 294 (in part) (1737); Bentham et Hooker, *Gen. Pl.* iii. 441 (1880); Masters, *Journ. Linn. Soc. (Bot.)* xxx. 34 (1893); Hickel, *Bull. Soc. Dendr. France*, 1907, pp. 5, 41, and 82; 1908, pp. 5 and 179.
Picea, D. Don, in Loudon, *Arb. et Frut. Brit.* iv. 2293 (1838).

EVERGREEN trees belonging to the order Coniferæ; bark containing numerous resin-vesicles; branches whorled. Buds, with numerous imbricated scales, with or without resin, usually two to five at the ends of the branchlets, the central bud terminal and largest, the others surrounding it in a circle on upright shoots, whilst on lateral branchlets those on the upper side are not developed; buds also occur rarely and few in number in the axils of the leaves on the branchlets below. Branchlets of one kind, usually smooth, but in certain species grooved, with raised pulvini; each season's shoot¹ marked by a sheath at the base, composed of the persistent bud-scales of the previous spring.

Leaves on fertile and barren branchlets, often different in length and thickness and in the nature of the apex; arising from the branchlets in spiral order, radially disposed on vertical shoots, but variously arranged according to the species on lateral branchlets; persisting for many years and giving the tree a dense mass of foliage; leaving as they fall circular scars on the branchlets; sessile, but usually narrowed just above the expanded circular base; linear, flattened and thin in most species, quadrangular in section in a few species; ventral surface always with two greyish or white stomatic bands, one on each side of the raised green midrib; dorsal surface with or without stomata, which when present are either in continuous lines, as in the quadrangular-leaved species, or are confined to near the tip of the leaf in the middle line, as in some flat-leaved species; apex acute, acuminate, or obtuse, notched or entire, spine-pointed in one or two species; resin-canals² two, constant in position for each species in the leaves on lateral branchlets, but in some species³ differing in position in the leaves on the upright or fertile branchlets, either *median*,

¹ In *A. bracteata*, all the bud-scales usually fall off, leaving ring-like scars at the base of the shoot.

² The position of the resin-canals is easily seen on examining a thin section with a lens; and can often be made out by squeezing the leaf, after it is cut across, when the resin will be observed exuding from the two canals.

³ In *A. pectinata*, *A. cephalonica*, and *A. Nordmanniana*, the resin-canals are marginal in the leaves of lateral branches, and are median in the leaves of cone-bearing branches. Cf. Gninier and Maire, in *Bull. Soc. Bot. France*, lv. 189 (1908).

when situated in the substance of the leaf about equidistant between its upper and lower surfaces, or *marginal* or *sub-epidermal*, when placed in the lower part of the leaf close to the epidermis; fibro-vascular bundle simple in some species, divided into two parts in other species.

Flowers monœcious, the two sexes on separate branchlets; male flowers usually abundant and on the lower side of the branchlets over the upper half of the tree; female cones on the upper side of the branchlets, usually only near the top of the tree, but in some species borne all over the upper half of the tree. Staminate flowers,¹ solitary in the axils of the leaves of the preceding year's shoot; stamens spirally crowded on a central axis, anthers surmounted by a knob-like projection and dehiscing transversely. Female cones,¹ arising as short shoots, composed of numerous imbricated fan-shaped ovuliferous scales, and an equal number of much longer mucronate bracts; ovules inverted, two on each scale.

Mature cones erect on the branchlets, composed of closely imbricated woody scales, more or less fan-shaped with short stalks. Bracts adnate to the outer surface of the scales at the base; either concealed between the scales or with their tips exerted and then often reflexed over the margin of the scale next below; dilated at the apex, entire or two-lobed, prolonged into a triangular mucro. Seeds two on the inner surface of each scale, winged, and with resin-vesicles. The cones ripen in one season; and the scales, bracts, and seeds fall away from the central spindle-like axis of the cone, which persists for a long time on the tree. The seedling has four to ten cotyledons, stomatiferous on their upper surface.

The species of *Abies* are distinguishable from all other conifers by the circular base of the leaves, which on falling leave circular scars on the branchlets.

The species of *Abies* have been variously divided into sections by different authors, but no satisfactory arrangement has yet been made out. Mayr proposed three sections based on the colour of the cones; but, as Sargent² points out, colour is not a constant character in several species. The cones are of value in the discrimination of the species, by taking into account their age, general appearance, and characters as a whole; but the scales are often very variable in shape in the same species, and the bracts, while more constant in form, often show considerable variation in their length. It is most convenient, in practice, especially as cones are in most cases not available for examination, to group the species, according to the characters of the buds, branchlets, and foliage, which are, as a rule, very constant in the same species. Hickel³ proposes three sections, based on the characters of the branchlets and buds; but his division is artificial, as it separates species closely allied by the characters of their cones.

Some notes on the genus *Abies*, for which we are indebted to Mr. J. D. Crozier, forester to H. R. Baird, Esq. of Durris, Kincardineshire, are inserted. Mr. Crozier's long experience in the east of Scotland gives a special value to his opinion on their respective qualities for planting in Scotland, which our own

¹ Both the staminate flowers and the young female cones are surrounded at the base by involucre of bud-scales.
² *Silva N. Amer.* xii. 97, *adnot.* (1898). Sargent proposes three sections, based on the characters of the leaves.

³ *Bull. Soc. Dendr. France*, 1907, p. 11.

could not have, though in almost every case he confirms the conclusions at which we had already arrived.

About thirty species are known, of which twenty-six have been introduced and are distinguished below. The silver firs are natives of the temperate parts of the northern hemisphere, usually occurring in mountainous regions; attaining high elevations towards the south, as in Guatemala, Algeria, Himalayas, and Formosa; and descending to low levels in the extreme north, as Alaska, Labrador, and Siberia.

The following table is based upon characters taken from the foliage, buds, and shoots of lateral branches, occurring on the lower part of the tree. As regards the leaves, their arrangement upon the branchlets, the position of the resin-canals, and whether the apex is entire or bifid must be noted. The presence of stomata on the upper surface of the leaf is peculiar to certain species. The young shoots are either smooth or deeply grooved with prominent pulvini; and are glabrous in some species, pubescent in others, the pubescence when present being either confined to the grooves or spread over the whole branchlet. The buds vary in size and shape and also in the quantity of resin, which in some cases is so slight that they may be described as non-resinous; whilst in other species the scales are covered with or deeply immersed in resin.

Certain species are distinguishable at a glance by some prominent character. *A. bracteata* has a bud entirely different from that of any other species. *A. Pinsapo*, with its short, thick, rigid leaves, standing out radially from the shoot, is unmistakable. *A. cephalonica*, with a more imperfect radial arrangement, is distinguished by its long flattened leaves ending in a single sharp cartilaginous point. *A. firma* is peculiar in its remarkably broad very coriaceous leaves, which end in two sharp unequal points. *A. grandis* has the leaves quite pectinate in the horizontal plane, those of the upper rank about half the size of those below. *A. Mariesii* is distinguished by the shoot being densely covered with a ferruginous tomentum. *A. brachyphylla* and *A. Webbiana* have deeply-furrowed shoots with prominent pulvini, which become more marked in the second year; and the bark begins to scale very early on the branches and trunk of the tree. *A. nobilis* and *A. magnifica* are peculiar in the upper median leaves curving up from the shoot after being appressed to it for some distance. *A. Pindrow* has long pale green leaves very irregularly arranged.

I. *Leaves radially arranged on the branchlets; apex of the leaf not bifid.*

1. *Abies Pinsapo*, Boissier. Spain. See p. 732.
Leaves rigid, short, less than $\frac{3}{4}$ inch long, thick, acute at the apex; resin-canals median. Shoots glabrous. Buds resinous.
2. *Abies cephalonica*, Loudon. Greece. See p. 739.
Leaves thin, flattened, about 1 inch long, ending in a sharp cartilaginous point; resin-canals marginal. Shoots glabrous. Buds resinous.
In var. *Apollinis*, the radial arrangement is imperfect, and the leaves end in a short point.

II. *Leaves on the lateral branches pectinate in arrangement; the two lateral sets either in one plane, or with their upper ranks directed upwards as well as outwards, showing a V-shaped depression, as seen from above, between the two sets.*

* *Resin-canals marginal.*¹

3. *Abies bracteata*, Nuttall. California. See p. 796.
Leaves long, 2 inches or more, rigid, ending in a spine-like point. Shoots glabrous. Buds peculiar in the genus, elongated, fusiform, membranous, non-resinous.
4. *Abies grandis*, Lindley. Western N. America. See p. 773.
Leaves all in one plane, those in the upper rank about half the length of those below, up to 2 inches long, bifid at the apex; upper surface grooved and without stomata. Shoots minutely pubescent. Buds small, resinous.
5. *Abies Lowiana*, Murray. California. See p. 779.
Leaves in a V-shaped arrangement, $1\frac{1}{2}$ to $2\frac{1}{2}$ inches long, bifid at the apex; upper surface grooved and with eight lines of stomata. Shoots and buds as in *A. grandis*.
6. *Abies firma*, Siebold and Zuccarini. Japan. See p. 762.
Leaves in a V-shaped arrangement, rigid, very coriaceous, broad, up to $1\frac{1}{2}$ inch long, ending in two sharp cartilaginous points. Shoots pubescent in the furrows between the slightly raised pulvini. Buds small, ovoid, only slightly resinous.
7. *Abies homolepis*, Siebold and Zuccarini. Japan. See p. 764.
Leaves in arrangement and appearance like *A. firma*; but shorter, less coriaceous, narrower, and whiter beneath. Shoots with prominent pulvini, glabrous. Buds ovoid, resinous, larger than in *A. firma*.
8. *Abies pectinata*, De Candolle. Europe. See p. 720.
Leaves pectinate in one plane or tending to a V-shaped arrangement, about an inch long, slightly bifid at the apex. Shoot grey, with short pubescence. Buds ovoid, non-resinous.
9. *Abies Webbiana*, Lindley. Himalayas. See p. 750.
Leaves V-shaped in arrangement, up to $2\frac{1}{2}$ inches long, bifid, silvery white beneath. Shoots with prominent pulvini and deep grooves, with a reddish pubescence confined to the grooves. Buds large, globose, resinous.

** *Resin-canals median.*²

10. *Abies balsamea*, Miller. Eastern N. America. See p. 803.
Leaves slender, scarcely 1 inch long, bifid at the apex, with six to eight lines of stomata in each band on the lower surface. Shoots, smooth, grey, with scattered short erect grey pubescence. Buds globose, resinous.
11. *Abies Fraseri*, Poiret. Alleghany Mountains. See p. 806.
Leaves as in *A. balsamea*, but shorter and whiter beneath, with eight to

¹ *A. cilicica* and *A. numidica*, with weak shoots, come in this section. See Nos. 22 and 23.

² *Abies lasiocarpa*, Nuttall, often has the leaves more or less pectinate, and might be sought for here. See No. 26.

twelve lines of stomata in each band beneath. Shoots smooth, yellowish, with dense reddish curved or twisted pubescence. Buds globose, resinous.

12. *Abies brachyphylla*, Maximowicz.¹ Japan. See p. 765.

Leaves in a V-shaped arrangement, short, scarcely exceeding $\frac{7}{8}$ inch, slightly bifid, white beneath. Shoots glabrous, with prominent pulvini and deep grooves. Buds conical, resinous.

III. *Leaves on lateral branches not pectinate above, but densely crowded, those in the middle line directed forwards in imbricated ranks, their bases not being appressed to the branchlet. On the lower side of the shoot the leaves are in two lateral sets.*

* *Resin-canals marginal.*²

13. *Abies Nordmanniana*, Spach.³ Caucasus, Northern Asia Minor. See p. 746.
Leaves up to $1\frac{1}{4}$ inch long, with rounded bifid apex. Shoots smooth, with short scattered erect pubescence. Buds ovoid, brown, non-resinous.
14. *Abies amabilis*, Forbes. Western N. America. See p. 782.
Leaves in arrangement and size like those of *A. Nordmanniana*, but much darker shining green, and with a truncate bifid apex; they emit a fragrant odour when bruised. Shoots smooth, with short wavy pubescence. Buds small, globose, resinous.
15. *Abies religiosa*, Schlechtendal. Mexico, Guatemala. See p. 808.
Leaves about 1 inch long, gradually narrowing from the middle to the usually entire apex, which is occasionally slightly emarginate. Shoots with prominent pulvini and dense minute erect pubescence. Buds shortly cylindrical, resinous.
The median upper leaves are much less numerous than in the two preceding species.
16. *Abies Mariessii*, Masters. Japan, Formosa. See p. 771.
Leaves shorter and broader than in *Abies Veitchii*, widest in their upper third, with a rounded and bifid apex. Shoot densely covered with a ferruginous tomentum. Buds small, globose, resinous.

** *Resin-canals median.*

17. *Abies Veitchii*, Lindley. Japan. See p. 768.
Leaves up to 1 inch long, truncate and bifid at the apex, uniform in width, very white beneath, with nine to ten lines of stomata in each band. Shoots smooth, covered with dense short erect pubescence. Buds small, globose, resinous.
The upper median leaves, pointing forwards, stand off from the shoot at a wider angle than in *A. Nordmanniana*.

¹ *Abies umbellata*, Mayr, is said to be very similar in foliage to this species. See the description of this species, p. 768.

² *A. numidica* with strong shoots, is distinguished from all these species by the leaves of the upper side being directed backwards. See No. 23.

³ *A. cilicica*, with strong shoots, resembles a weak *A. Nordmanniana*. See No. 22.

18. *Abies sachalinensis*, Masters. Saghalien, Yezo, Kurile Isles. See p. 760.
Leaves long and slender, up to $1\frac{3}{4}$ inch, uniform in width, with a rounded and bifid apex, white beneath, seven to eight lines in each stomatic band. Shoots with prominent pulvini, and a dense short pubescence confined to the grooves. Buds small, globose, resinous.
19. *Abies sibirica*, Ledebour. N. E. Russia, Siberia, Turkestan. See p. 758.
Leaves long and slender, up to $1\frac{1}{2}$ inch, uniform in width; apex rounded and either slightly bifid or entire; four to five lines in each stomatic band beneath. Shoots ashy grey, quite smooth, with a scattered minute pubescence. Buds small, globose, resinous.

IV. *Leaves on lateral branches not pectinate above; those in the middle line covering the branchlet, and curving upwards after being appressed to the shoot for some distance at their base. The leaves are in two lateral sets on the lower side of the branchlet. Resin-canals marginal.*

20. *Abies nobilis*, Lindley. Washington, Oregon, California. See p. 786.
Leaves above closely appressed by their bases to the branchlet, which they completely conceal; about 1 inch long, entire at the apex, flattened, grooved on the upper surface in the middle line; stomata usually present on both surfaces. Shoots with a dense, short brown pubescence. Terminal buds girt at the base by a ring of acute or subulately-pointed pubescent scales.
21. *Abies magnifica*, Murray. Oregon, California. See p. 792.
Leaves above appressed at their bases, for a short distance only, to the branchlet, which they do not completely conceal; longer than in *A. nobilis*, up to $1\frac{3}{4}$ inch, entire at the apex, quadrangular in section, not grooved on the upper surface; stomata always present on both surfaces. Shoots and buds as in *A. nobilis*.

V. *Leaves on lateral branches arranged in two ways, which are often observable on the same tree, and depend upon the vigour of the shoots.*

22. *Abies cilicica*, Carrière. Asia Minor. See p. 744.
Leaves either (A) pectinate above with a V-shaped depression between the lateral sets, or (B) with the median leaves above crowded and covering the branchlet, as in *A. Nordmanniana*. The leaves are slender, up to $1\frac{1}{4}$ inch long, not conspicuously white below, slightly bifid at the rounded or acute apex; resin-canals marginal. Shoots smooth, with scattered short erect pubescence. Buds small, ovoid, non-resinous.
Vigorous shoots of this species resemble a weak *A. Nordmanniana*; but with the leaves shorter, more slender, and less white beneath, the buds being much smaller.
23. *A. numidica*, De Lannoy. Algeria. See p. 737.
Leaves either (A) pectinate above with a V-shaped depression; or (B) crowded and covering the upper side of the branchlet, but different from

all other species in the median leaves above, in that case, being directed backwards and not forwards. Leaves short, up to $\frac{3}{4}$ inch long, broad, rounded at the entire or slightly bifid apex; in most cases with four to six broken lines of stomata on their upper surface near the tip; resin-canals marginal. Shoots brown, shining, glabrous. Buds large, ovoid, non-resinous.

VI. *Leaves irregularly arranged; those on the lower side of the branches not truly pectinate.*

24. *Abies Pindrow*, Spach. W. Himalayas. See p. 755.
Leaves all directed more or less forwards; those above irregularly and imperfectly covering the branchlet; those below mostly pectinate, but with some directed downwards and forwards. Leaves soft, pale green, up to $2\frac{1}{2}$ inches long, bifid at the apex with two sharp cartilaginous points; resin-canals marginal. Shoots grey, glabrous. Buds large, globose, resinous.
25. *Abies concolor*, Lindley and Gordon. Colorado, Utah, Arizona, New Mexico, Northern Mexico, Southern California. See p. 777.
Leaves imperfectly pectinate both above and below, some in the middle line being always directed forwards and not laterally outwards; up to 2 to 3 inches long; apex entire; upper surface convex and not grooved, bearing fifteen to sixteen lines of stomata; resin-canals marginal. Shoots smooth, olive-green, glabrous. Bud large, conical, resinous.
26. *Abies lasiocarpa*, Nuttall. Western N. America. See p. 800.
Leaves either (A) in an imperfect pectinate arrangement, or (B) with most of the leaves directed upwards, those in the middle line above crowded, and standing edgeways; $1\frac{1}{2}$ inches long, narrow, usually entire, with conspicuous lines of stomata on the upper surface, especially in its anterior half. Resin-canals median. Shoots smooth, with a moderately dense, short wavy pubescence. Buds small, conical, resinous.

Four species, *A. Delavayi*, Franchet;¹ *A. Fargesii*, Franchet;² *A. squamata*, Masters;³ and *A. recurvata*, Masters;⁴ occur in the mountains of western China and are not included in the above list. The two first species are reported by Masters to have been introduced by Wilson; but, on inquiry, we find that only one species of *Abies* from China is now growing in the Coombe Wood nursery. It is probably *A. Fargesii*; but, as the plants are still very young, we are uncertain of this identification, and think it best to leave this species undescribed for the present.

(A. H.)

¹ *Journ. de Bot.* 1899, p. 255; Masters, *Gard. Chron.* xxxix. 212, fig. 82 (1906).

² *Journ. de Bot.* 1899, p. 256; Masters, *Gard. Chron.* xxxix. 212, fig. 83 (1906).

³ *Gard. Chron.* xxxix. 299, fig. 121 (1906), and *Journ. Linn. Soc. (Bot.)*, xxxvii. 423 (1906).

⁴ *Journ. Linn. Soc. (Bot.)*, xxxvii. 423 (1906).

ABIES PECTINATA, COMMON SILVER FIR

Abies pectinata, De Candolle, in Lamarck, *Flore Franç.* iii. 276 (1805); Willkomm, *Forstliche Flora*, 112 (1887); Mathieu, *Flore Forestière*, 525 (1897); Kent, Veitch's *Man. Coniferae*, 530 (1900).
Abies alba,¹ Miller, *Dict.* ed. 8, No. 1 (1768); Kirchner, *Lebengesch. Blüthenpfl. Mitteleuropas*, i. 78 (1904).

Abies vulgaris, Poiret, in Lamarck, *Dict.* vi. 514 (1804).

Abies Picea, Lindley, *Penny Cycl.* i. 29 (not Miller) (1833).

Pinus Picea, Linnæus, *Sp. Pl.* 1001 (1753).

Pinus Abies, Du Roi, *Obs. Bot.* 39 (1771).

Pinus pectinata, Lamarck, *Fl. Franç.* ii. 202 (1778).

Picea pectinata, Loudon, *Arb. et Frut. Brit.* iv. 2329 (1838).

A tree attaining under favourable conditions about 150 feet in height and 20 feet or more in girth. Bark on young trees, smooth, greyish; ultimately fissuring and becoming rough and scaly. Buds small, ovoid, non-resinous; scales few, brownish, rounded at the apex. Young shoots grey, smooth, with a scattered short erect pubescence, which is retained in the second year.

Leaves on lateral branches pectinately arranged in two lateral sets; those below the longest and directed outwards and slightly forwards in the horizontal plane; those above directed upwards and outwards, forming between the two sets a shallow V-shaped depression. Leaves about 1 inch long, $\frac{1}{2}$ inch broad, linear, flattened, narrowed at the base, tapering slightly to the rounded, bifid apex; upper surface dark green, shining, with a continuous median groove and without stomata; lower surface with two white bands of stomata, each of seven to eight lines; resin-canals marginal.

On leading shoots the leaves are radially arranged, and differ considerably from those on lateral branches; they are thicker, with median resin-canals, acute and not bifid at the apex, and often show lines of stomata on their upper surface towards the tip. Leaves on cone-bearing branches are nearly all directed upwards, very sharp-pointed, and almost tetragonal in section.

Trees, standing in an isolated position, usually begin to flower at about thirty years old; when crowded in dense forests, much later, usually not before sixty years old.

Staminate flowers, surrounded at the base by numerous imbricated scales, cylindrical, about 1 inch long, with greenish-yellow stamens. Female cones, appearing in August of the previous year as large rounded buds, enclosed in brown scales, and situated just behind the apex of the shoot; in spring, when developed, erect, cone-shaped, about 1 inch long, surrounded at the base by fringed scales; bracts numerous, imbricated, denticulate, ending in long, acuminate points, and completely concealing the much smaller ovate, rounded ovuliferous scales.

¹ *Abies alba*, the oldest name under the correct genus, was never in use until lately, when it has been resuscitated by Sargent and some continental botanists. This is one of the cases where adherence to strict priority would lead to great confusion; and hence we have adopted the name *Abies pectinata*, by which the tree is generally known.

Cones on short stout stalks, cylindrical, slightly narrowed at both ends, obtuse at the apex, about 6 inches long, 2 inches in diameter, greenish when growing, dull brown when mature, with the points of the bracts exerted and reflexed. Scales tomentose externally, fan-shaped, about 1 inch broad and long; upper margin slightly uneven; lateral margins denticulate, each usually with a sinus, below the slight wings on the outer side of the scale; claw clavate. Bract with an oblong claw, extending up three-quarters the height of the scale, and expanding above into a lozenge-shaped denticulate lamina, which ends in a sharp long triangular mucro. Seed with wing about an inch long; wing about twice as long as the body of the seed.

SEEDLING

Seed sown in spring germinates in three or four weeks. The cotyledons, usually five in number, are at first enveloped, as with a cap, by the albumen of the seed; but speedily casting this off, they spread radially in a whorl at the summit of the short caulicle, and remain green on the plant for several years; about an inch in length, linear, obtuse at the apex, flat beneath, and slightly ridged on the upper surface, which shows two whitish bands of stomata. In the first year only a single whorl of true leaves, arising immediately above the cotyledons and alternating with them, is produced. Primary leaves short, acute, or obtuse, but not emarginate at the apex, and with the stomatic bands on the lower surface. A terminal bud closes the first season's growth, the plant scarcely attaining two inches high. In the second year ordinary leaves, arranged spirally on the stem, are produced. The growth of the plant in the first two or three years is mainly concentrated in the root, which descends deep into the soil, the increase in height of the stem above ground being trifling. The stem branches in the third or fourth year, and produces annually for some years one or two lateral branches, making no great growth in height, reaching in the ninth year an average of two feet. About the tenth year normal verticillate branching begins; and from this onwards the plant makes rapid growth.

VARIETIES

Dr. Klein gives in *Vegetationsbilder* illustrations of some remarkable forms¹ which the silver fir assumes at high elevations in Central Europe, and which he calls "Wettertanne" or "Schirmtanne." These trees have lost their main leader through lightning, wind, or otherwise, and have developed immense side branches which spread and then ascend, sometimes forming a candelabra-like shape. The finest of this type known to him is at St. Cerques in Switzerland, and measures at breast height no less than 7.40 metres in girth, about the same as the largest of the Roseneath² trees.

Other varieties, distinguished by their peculiar habit, occur in the wild state.

¹ These forms are also described by Dr. Christ in *Garden and Forest*, ix. 273 (1896).

² One of the trees at Roseneath, Dumbartonshire, has a similar growth of erect branches, like leaders from some of the horizontal limbs. This is figured, from a photograph by Vernon Heath, in *Gard. Chron.* xxii. 8, fig. 1 (1884). At Powerscourt there is also a large tree, 13 feet 3 inches in girth, with branches prostrate on the ground and sending up several upright stems.

Var. *pendula*,¹ with weeping branches, has been found in the Vosges and in East Friesland.

Var. *virgata*,² found in Alsace and Bohemia, has long pendulous branches, only giving off branchlets near their apices, and densely covered with leaves.

Var. *pyramidalis*.³ This form, which in habit resembles the cypress or a Lombardy poplar, was found growing wild in the department of Isère in France. A very fine example, about 35 feet high in 1904, is growing in the arboretum of Segrez.

Var. *columnaris*,⁴ very slender in habit, with numerous short branches, all of equal length, and with leaves shorter and broader than in the type.

Var. *tortuosa*, a dwarf form, with twisted branches, and bent, irregularly-arranged leaves.

Var. *brevifolia*, another dwarf form, distinguished by its short broad leaves.

Remarkable variations in the cones have also been observed. A tree, discovered by Purkyne⁵ in Bohemia, bore cones, umbonate at the apex, and with short and non-reflexed bracts. Beissner⁶ mentions a tree, growing in the park at Wörlitz near Dessau, which produced cones a foot in length.

DISTRIBUTION

The common silver fir is a native of the mountainous regions of central and southern Europe. The northern limit of its area of distribution begins in the western Pyrenees about lat. 43° in the neighbourhood of Roncesvalles in Navarre; and crossing the chain it extends along its northern slope as far as St. Béal; from here it bends northwards to the mountains of Auvergne, whence it is continued in a north-easterly direction through Burgundy and French Lorraine, crossing the eastern slope of the Vosges about the latitude of Strasburg. From here it curves for some distance westward, and reaching Luxemburg, is continued through Trier and Bonn to southern Westphalia. Across the rest of Germany, according to Drude, who gives a map of the distribution of the species, the northern limit extends as an irregular line about lat. 51°, which touches Hersfeld, Eisenach, the northern edge of the Thuringian forest, Glauchau, Rochlitz, Dresden, Bautzen, and Görlitz; and ends in the southern point of the province of Posen. Around Spremberg to the north of the limit just traced, it is found wild in a small isolated territory.

The eastern limit, beginning in Posen, extends through Poland along the River Wartha to Kolo, crosses to Warsaw, and descending through Galicia west of Lemberg, reaches the Carpathians in Bukowina; and is continued along the mountains of Transylvania to Orsova on the Danube.

The southern limit is not clearly known as regards the Balkan peninsula, as the silver fir, which occurs in the mountains of Roumelia, Macedonia, and Thrace,

¹ Kottmeier found peculiar weeping silver firs in the Friedeberg forest, near Wittmund in East Friesland, in 1882. Cf. Wittmack's *Gartenzeitung*, 1882, p. 406, and Conwentz, *Seltene Waldbäume in Westpreussen*, 161 (1895).

² Caspary, in Hempel's *Oesterr. Forstzeitung*, 1883, p. 43.

³ Carrière, *Conif.* 280.

⁵ Willkomm, *Forstliche Flora*, 118 (1887).

⁴ Carrière, *Rev. Hort.* 1859, p. 39.

⁶ *Nadelholzkunde*, 433 (1891).

supposed to be *A. pectinata*, is more probably a form of *A. Apollinis*. In Italy the common silver fir reaches its most southerly point on the Nebroden and Madonia Mountains of Sicily at lat. 38°. From here the limit follows the Apennines up through Italy, crosses into Corsica, and from there passes into Spain, where it extends from Monseny, near the Mediterranean coast in lat. 41° 25', parallel to the Pyrenees, through the mountains of Catalonia and northern Aragon to Navarre. In Spain the silver fir also occurs westwards on a few points of the northern littoral in the Basque provinces and Asturias.

Within the extensive territory just delimited, the silver fir is very irregularly distributed, being totally absent in many parts, as on the plains and lower mountains of southern Europe. In the eastern part of its area it occurs only as isolated trees or in small groups in the beech and spruce forests; whereas, in the western part, as in France and in parts of Germany, it forms forests of great extent, either pure or in which it is the dominant species.

In France the largest forests of the silver fir are in the Vosges and in the Jura. Important forests also occur in the eastern parts of the Pyrenees, the Cevennes, the mountains of Auvergne, and the Alps of Dauphiné. It is rare on the hills of Burgundy, and does not occur in the Ardennes. There are small woods of this species on some of the hills in Normandy, which are, however, supposed to be planted and not indigenous. The great forest of the Vosges¹ is about 50 miles long by 5 to 10 miles in width, and contains about 200,000 acres, situated mainly between 1100 and 3300 feet elevation. This forest consists chiefly of silver fir, though, in some parts, there is a considerable mixture of beech, spruce, and common pine. The most productive woods are on siliceous soil, and only contain 10 per cent of beech and pine; their mean annual production being about 100 cubic feet per acre, the volume of timber standing on each acre averaging 4500 cubic feet.

In the Jura there are even richer and more homogeneous forests than in the Vosges, being according to Huffel the finest in Europe. Here the soil is limestone. One of these forests, which covers Mount La Joux, between 2100 and 3000 feet altitude, contains 10,600 acres, and consists of about 90 per cent silver fir and 10 per cent of spruce. The annual yield per acre is 170 cubic feet of timber. The total volume of standing timber, including only trees over 2 feet in girth, is 6000 cubic feet per acre. The net revenue is thirty-two shillings an acre. There are several other forests equally valuable in this region.

One of the finest silver firs¹ in France, a tree called "Le Président," is growing in the forest of La Joux. It is 163 feet high, with a clean stem of 93 feet, and a girth of 15 feet; and contains 1600 cubic feet of timber. In the forest² of Gérardmer, in the Vosges, there are two fine trees. One, the *Beau Sapin*, has a height of 144 feet and a girth of 13 feet 8 inches; it contains 777 cubic feet of timber, and is valued at £16. The other, the *Géant Sapin*, has a height of 157 feet and a girth of 14 feet 5 inches; it contains 1095 cubic feet of timber, and is valued at £27. In the Pyrenees the silver fir occurs between 4500 and 6500 feet elevation, and trees

¹ See Huffel, *Économie Forestière*, i. 349, 350, 353 (1904).

² Cf. *Trans. R. Scot. Arb. Soc.* xviii. 131 (1905).

of great age, about 800 years old, are said¹ to have existed there at the beginning of the 19th century.

In Corsica the silver fir occurs in the great forests of *Pinus Laricio*, but is not abundant, as it only grows, as a rule, in scattered groups in the gullies, where the soil is deeper and richer than elsewhere; and at Valdoniello I only saw a few trees, none of which were of large size. M. Rotges, of the Forest Service, informed me that it occurs in greatest quantity in the forest of Pietropiano, near Corte.

In Italy the silver fir is unquestionably wild on the Apennines, and considerable forests exist at Vallombrosa and Camaldoli, which are now owned by the government. That at Camaldoli is particularly fine, the total area covered by the silver fir being about 1600 acres. The trees are dense on the ground and very vigorous in growth; and this is easily explained by the heavy rainfall, which, as measured at St. Eremo, in the middle of the forest, at 3600 feet altitude, averages about 80 inches annually. I saw, when I visited Camaldoli, in December 1906, no trees of great size; but one was cut down in 1884, and a log of it shown at the National Exhibition at Turin in that year, which measured 140 feet in height and 17 feet in girth.

The silver fir also occurs in Sicily in small quantity, on the higher mountains, and specimens without cones, which I saw in the museum at Florence, are peculiar in the foliage, and form possibly a connecting link between *A. pectinata* and *A. numidica*.

In Germany, towards the northern part of its area of distribution, the silver fir is met with growing wild on the plains, as in Saxony, Silesia, and Thuringia. Towards the south it is entirely a tree of the mountains, occupying a definite zone of altitude, which, in the Bavarian forest, lies between 950 and 4000 feet. The largest forests, which are nearly pure, occur in the Black Forest and in Franconia; those in Bavaria, Bohemia, Thuringia, and Saxony being smaller in extent.

In Switzerland small forests occur at Zurich, Payerne, and on Mount Torat; the silver fir ascending in the Swiss Alps to 5300 feet altitude. (A. H.)

As to the size² which the silver fir attains in its native forests, many particulars are given by French and German foresters, some of which have been quoted above. None exceed, however, what I have seen in the virgin forests of Bosnia, where I measured near Han Semec, at an elevation of about 3000 feet, a fallen tree over 180 feet long, whose decayed top must have been at least 15 to 20 feet more. Loudon states that he saw, in the museum at Strasburg, a section of a tree of the estimated age of 360 years, cut in 1816 at Barr, in the Hochwald, which was 8 feet in diameter at the base and 150 feet high.

The virgin forests of Silesia and Bohemia contain silver firs of immense size, of which very interesting particulars are given by Göppert,³ who states that, in Prince Schwarzenberg's forest of Krummau, there existed many silver firs of from

¹ Willkomm, *Forstliche Flora*, 116, note (1887).

² Kerner, *Nat. Hist. Plants*, Eng. trans. i. 722, gives the "certified height" of *Abies pectinata* as 75 metres, or 250 feet; but this is not confirmed by other authorities.

³ H. R. Göppert, *Skizzen zur Kenntniss der Urwälder Schlesiens und Böhmens*, 18 (1868).

120 to 200 feet high, free from branches up to 80 to 120 feet, and as much as 6 to 8 feet in diameter. He quotes Hochstetter,¹ who measured in the Greinerwald, near Unter-Waldau, at an elevation of 2563 feet, a silver fir blown down by a storm, which was 9½ feet in diameter at breast height and 200 feet long, and produced 30 klafter of firewood.

The silver fir is planted outside the area of its natural distribution in most parts of France, in Belgium, and in western and northern Germany, but not beyond lat. 51° in eastern Prussia. It is occasionally planted in Norway, and at Christiania has attained 68 feet in length by 3½ feet in girth. At Thlebjergene, near Trondhjem, where, on the side of a hill, sloping down to the sea, with an easterly exposure, a fine plantation,² mainly of spruce and Scots pine, was made in 1872 and subsequent years,—there are some splendid groups of silver fir, 30 to 40 feet in height, apparently exceeding in rapidity of growth the native spruce beside it. It is met with in gardens in the Baltic provinces of Russia, as in Lithuania where there is a small wood near Grodno, and in Courland and Livonia; here, however, it always remains a small tree, never bears cones, and is much injured by severe winters.

One of the most remarkable plantations in Europe is the one made by the Hanoverian Oberforster, J. G. von Langen, in the Royal Park of Jægersborg, near Copenhagen, about 1765. I visited this place in 1908, and measured some of the trees. I found that the largest now standing near the entrance at Klampenborg was 125 feet by 12 feet 10 inches. This tree is figured in a work³ kindly sent me by Skovrider H. Mundt. There are, however, many taller trees on the south side of the main drive, two of which I found to be 140 feet by 9 feet, and 140 feet by 8 feet in girth, respectively. I measured the girth of twenty trees out of sixty-two which are growing on an area of 100 by 30 paces, and believe them to average over 130 feet high, with an average girth of 7½ feet. In Lütken's work full details are given of the measurements of these trees taken in 1893, and confirmed in 1898 by Oppermann, who found 432 trees, averaging 38.9 metres in height and containing 1400 cubic metres per hectare; which is equal to 20,000 cubic feet per acre in the round, or 15,700 feet English quarter-girth measure. My own hasty estimate on the spot was about 12,000 feet English quarter-girth measure per acre. These wonderful silver firs grow on a deep, sandy loam, on level ground near the sea, and seem to have passed their prime. Some of their timber has been used as rafters in the Secretariat hall of the new Raadhus at Copenhagen.

*A. pectinata*⁴ was brought to the eastern United States early in the nineteenth century; but it is not hardy even in the middle states.

Witches' brooms and cankered swellings, due to the fungus *Æcidium elatinum*, De Bary, are common on the silver fir in the continental forests; and are often seen in Ireland and the south-west of Scotland,⁵ though apparently rare in England, where they have been noticed in Norfolk⁶ and at Haslemere.⁷

¹ Hochstetter, *Aus dem Böhmerwalde*, *Allg. Augsb. Zeit.* 1855, No. 182. Cf. Sendtner, *Die Vegetations-Verhältnisse des Bayerischen Waldes* (1860).

² Seen by Henry in 1908.

³ Lütken, *Den Langenske Forstordning*, p. 286, fig. 5 (Copenhagen, 1899).

⁴ Sargent, *Silva N. Amer.* xii. 100, *adnot.* (1898).

⁵ Somerville, in Hartig, *Diseases of Trees*, Eng. trans. 179 (1894).

⁶ *Trans. Norfolk and Norwich Naturalists' Soc.* vii. p. 255.

⁷ Specimens at Kew.

The swellings which affect the trunk or branches are due to the irritation of the fungus mycelium, which is perennial and stimulates the wood and bark to abnormal growth. These swellings become fissured and are entered by the spores of other fungi, which rot the wood; and the tree, if the stem is affected, is often broken off at the weakened spot by storms or falls of snow. The witches' brooms begin as young shoots, bearing small yellowish leaves, on the under surface of which two rows of *aecidia* are developed in August. These shed their spores at the end of that month and the leaves soon afterwards die and fall off. The affected shoots keep on growing, and develop into peculiar growths, set upright generally on the branches, and consisting of numerous twigs anastomosed together. The fungus passes one stage of its life on various species of *Stellaria*, *Cerastium*, and their allies, and Fischer¹ recommends the extirpation of these plants from nurseries in which the silver fir is raised.

The silver fir is very liable in its native forests to be attacked by the mistletoe. Modified roots, the so-called sinkers of the parasite, have been found in the wood enclosed in forty annual rings and as much as 4 inches long, showing that mistletoe may live on the tree for forty years. When the mistletoe dies the rootlets and sinkers survive for a time, but finally moulder and fall to pieces. The affected parts of the wood show numerous perforations, and exactly resemble the wood of a target that has been penetrated by shot or small bullets.²

The bark of the silver fir remains alive on the surface to an advanced age; and, on this account, when branches, stems, or roots of adjoining trees get into contact, they often become grafted together. This is the explanation of the curious phenomenon of the vitality of the stumps of certain trees in forests. After the stem is cut down, these stumps continue to increase in size and produce a callosity, which eventually covers the stump in the form of a hemispherical cap. Such a stump procures its nourishment from an adjoining tree, with which its roots have become grafted.³

CULTIVATION

The silver fir⁴ was introduced into England about the beginning of the seventeenth century; but the exact date is uncertain. The earliest trees recorded are two mentioned by Evelyn,⁵ which were planted in 1603 by Serjeant Newdigate in Harefield Park in Middlesex. These had attained about 80 feet high in 1679, but from inquiries made by the late Dr. Masters, there is no doubt that they have long since been cut down.

Though in its own country the silver fir is a tree of the mountains, yet it attains its greatest perfection in the south and west of England, Scotland, and

¹ Abstract of Fischer's paper in *Journ. Roy. Hort. Soc.* xxvii. 272 (1902).

² See Kerner, *Nat. Hist. Plants*, Eng. trans. i. 210, fig. 48 (1898). We have never seen or heard of mistletoe on the silver fir in this country.

³ See Mathieu, *Flore Forestière*, 529 (1897).

⁴ Staves were found, in 1900, lining the ancient wells in the Roman city of Silchester, Hants; and the wood was identified by Marshall Ward with *A. pectinata*. The casks, from which the staves had been taken, were probably imported from the region of the Pyrenees, and had either contained wine or Samian ware. Cf. Clement Reid, in *Archæologia*, lvii. 253, 256 (1901).

⁵ *Sylva*, 106 (1679).

Ireland, under conditions of soil and climate very unlike those of its native forests. Though it will endure the severest winter frosts without injury, yet unless under the cover of other trees, or in very sheltered situations, it is often injured by spring frost, on account of its tendency to grow early. As regards soil it is somewhat critical, for though Boutcher¹ says that he has seen the largest and most flourishing silver firs on sour, heavy, obstinate clay, yet I have never myself seen fine trees on any but deep, moist, sandy soils, or on hillsides where the subsoil was deep and fertile. He also says it is vain to plant them in hot, dry, rocky situations, and this is my own experience on oolite formations, where I have never seen a large or well-developed silver fir. In the east and midland counties they usually become ragged at the top before attaining maturity, and in this country rarely attain a great age without suffering from drought and wind.

Though foresters of continental experience recommend this tree for underplanting, on account of its ability to grow under dense shade, yet from an economical point of view it cannot be recommended here; and I do not know of any place in England where the financial results of planting the silver fir are, or seem likely to be, such as would justify growing it on a large scale; partly because of its very slow growth when young, and partly because its timber is not valued as it is in France and Germany. Mr. Crozier's experience² is very noteworthy.

The silver fir seeds itself very freely in some parts of England, Scotland, and Ireland,³ but the seedlings are so slow in growth and so delicate for the first few years, that few survive the risk of frost, rabbits, and smothering. Sir Charles Strickland tells me that in a wood of silver firs at Boynton, Yorkshire, which were mostly blown down in 1839, he remembers that a few years afterwards the growth of young seedlings was in places so dense that he could hardly force his way through them. Some of these self-sown trees are now 6 feet in girth and 60 to 70 feet high, but many are stunted from want of space. Their parents are rough and branchy, dying at the top, and 10 to 12 feet in girth.

REMARKABLE TREES

Though the silver fir will probably be in time surpassed in height and girth by some of the conifers of the Pacific coast of America, yet at present it has no rival in size among coniferous trees in Great Britain. Perhaps the tallest which I have seen in England is the magnificent tree (Plate 208) which grows in Oates Wood, at the top of Cowdray Park, Sussex, at an elevation of 500 to 600 feet, and now owing to its being deprived of the shelter of the surrounding trees, likely to be blown down

¹ Boutcher, *A Treatise on Forest Trees*, 146 (1775).

² Formerly one of our most reliable trees, but now hopelessly unreliable as a timber crop, owing to its susceptibility to attack by Chermes. Like the larch, our old trees are practically immune to attack, but the difficulty in getting up young stock—experienced throughout the greater part of the country—is likely to lead to its extinction altogether as an economic species. Has been much recommended by continental trained foresters—even of late years—for the purpose of underplanting in our Scotch woods, and some of those experiments I saw lately. The result is a hopeless failure in all of them.—(J. D. CROZIER.)

³ At Auchendrane, near Ayr, according to Mr. J. A. Campbell, there are several acres of self-sown seedlings; and in County Wexford I have also seen great numbers.

by the first severe gale. I measured this tree in 1906 in company with Mr. Roberts, forester to the Earl of Egmont, as carefully as the nature of the ground would allow, and believe it to be still over 130 feet in height; when I first saw it in 1903 it was taller. It is clear of branches to at least 90 feet and 10 feet 2 inches in girth. In the background some spruce which are even taller may be seen in our illustration.

I am informed by Mr. F. H. Jervoise, of Herriard Park, Hants, that there was a silver fir there which probably exceeded this height before its top was broken off about sixteen years ago. A photograph, taken in 1851, shows the height to have been then at least double what it now is, namely 70 feet, and another tree standing not far off measures approximately 140 feet.

In the Shrubbery at Knole Park, Kent, a very large silver fir is now about 110 feet high, with a clean bole about 80 feet by 12 feet; but its top is broken off, and it looks as if it might have been much taller.

At Longleat there are a great number of very fine silver firs near the Gardens, and also in the valley at Shearwater, the largest of which I measured in 1903, and found to be about 130 feet by 16 feet 5 inches in girth.¹ Mr. A. C. Forbes estimated the contents of this tree at 550 feet, and in the *Trans. Eng. Arb. Soc.* v. 399, gives the measurements of a group of twenty-seven trees, 120 years old, growing on an area of $\frac{1}{3}$ of an acre at the same place as follows:—Average height, 130 feet; average girth at 5 feet, 9 feet; average contents, 180 cubic feet. Total, 5000 cubic feet. I doubt whether any similar area of ground in England carries so much timber, except, perhaps, a group of chestnut and oak in Lord Clinton's park at Bicton. Silver fir requires unusually good soil to attain these dimensions. Plate 209 shows a part of this grove which stands at an elevation of about 500 feet on a greensand formation.

There is a row of very fine silver firs by the road on Breakneck hill in Windsor Park, one of which I measured as 130 feet by 11 feet, and no doubt many as large, or nearly so, can be found in other parts of the south and west of England; but, as a rule, when the tree attains about 100 to 110 feet its top ceases to grow and becomes ragged.

Near the great cedar at Stratton Strawless (see Plate 133) there are some tall silver firs, one of which in 1907 was 131 feet by 9 feet 7 inches; and Mr. Birkbeck informed me that another, believed to be the tallest tree in Norfolk, and measuring 135 feet, had been blown down in 1895 at the same place.

There are some very fine silver firs still standing at Eslington Park, Northumberland, which were planted about 1760, though Mr. Wightman, the gardener, informs me that the largest, which could be seen standing above all the other trees, was blown down in a gale in December 1894. It measured 122 feet by 21 feet at five feet from the ground, and at fifty feet from the ground was still 9 feet in girth.

Almost equal to these are the trees in the Ladieswell Drive, near Alnwick Castle, Northumberland, which I saw in 1907; though not much exceeding 100 feet

¹ Loudon states that the tallest silver fir known in England in his time was believed to be at Longleat, and measured 138 feet high by 17 feet in girth; but this tree cannot now be identified.

in height, they measure from 14 feet to 16 feet in girth, the largest being estimated by Mr. A. T. Gillanders, forester to the Duke of Northumberland, to contain about 600 cubic feet each.

At Rydal Park, Cumberland, Mr. W. F. Rawnsley informs me that a silver fir was felled which contained 420 cubic feet, and doubtless there are others in the north-west of England as large.¹

In Wales, however, I have seen none remarkable for size, though there are many places which seem as suitable as those I have mentioned.

In Scotland the silver fir attains its maximum of size in the south-west, and in a district where the climate is most unlike that of central Europe; being much warmer in winter, cooler in summer, and with a rainfall of 60 to 80 inches and even more in exceptional years.

On the Duke of Argyll's property at Roseneath are the champion silver firs of Great Britain, both as regards age and girth. Strutt figures them in *Silva Scotica* (plate 6), and states that the largest was then about 90 feet by 17 feet 5 inches. Loudon, twenty years later, gave the height as 124 feet, the age as 138 years, and the diameter of the trunk as 6 feet; but this height is almost certainly an error, as when I visited Roseneath in September 1906, a careful measurement made the largest about 110 feet by 22 feet 7 inches, and the other, which stands close by it, 105 feet by 22 feet 1 inch.² Plate 210, from a negative for which I have to thank Mr. Renwick, is the best I have been able to obtain of these noble trees, which grow close to sea-level in deep sandy soil. The Duke of Argyll believes them to have been planted about 1620 or 1630.

Near Inveraray Castle, on the lower slopes of Dun-y-Cuagh, Mr. D. Campbell, the Duke's forester, showed me some splendid silver firs, over 120 feet high and 15 feet in girth, and assured me that in his younger days he had helped to measure some which were much larger; one he believed to have been 24 feet in girth, containing over 800 feet of timber. On the Dalmally road, a little above the stables at Inveraray, are the tallest trees of the species that I have seen in Scotland; one measures 135 feet, or perhaps as much as 140 feet, by 16 $\frac{1}{2}$ feet; another about 135 feet by 14 feet 3 inches; and there may be even taller ones here which I could not measure. These splendid trees were, as the Duke of Argyll informs me, probably planted by Duke Archibald in 1750, but their timber is so coarse that it is of little value, and is principally used by Glasgow shipbuilders for keel blocks.

Some of the most remarkable silver firs which I have seen in any country are at Ardkinglas, now the property of Sir Andrew Noble, near the head of Loch Fyne. They are described by J. Wilkie, and well illustrated in the *Trans. Scot. Arb. Soc.* ix. 174, and show a tendency, which I cannot explain, to throw out immense branches, which, after growing horizontally 10 to 15 feet from the main trunk, turn up and form an erect secondary stem. The largest of these (*op. cit.* plate 11), according to Wilkie's careful measurement in 1881, was 114 feet high by 18 feet in girth at

¹ Sir Richard Graham of Netherby Hall, Cumberland, showed me a very remarkable tree in a wood called Hog Knowe, which has large spreading branches, 80 paces in circumference, and measures 98 feet by 14 $\frac{1}{2}$ feet. Mr. Watt of Carlisle has been good enough to send me a photograph of this tree, taken by his sister.

² See *Gard. Chron.* xxii. 8, fig. 1 (1884), and xxvii. 166, fig. 39 (1887), where good illustrations of these trees are given.

2½ feet. I made it in 1905 about 21 feet at the same height and 14 yards round the roots. Wilkie computed that the main stem contained 557 cubic feet and the branches 692 cubic feet, including bark, which exceeds the largest tree of the species recorded in this country. I certainly have never seen anything surpassing it in bulk, even in the virgin forests of Bosnia, though I have measured a fallen silver fir there which was at least 200 feet high. Another of these trees figured on plate 12 of the same volume, was estimated at 437 feet in the stem, and 449 feet in the ten principal limbs. At the same place is a very fine tree which Mrs. Henry Callender, who showed it to me, called "The Three Sisters," 115 feet high according to Wilkie,—I made it, twenty-four years later, 120 feet,—with a bole only 8 feet long, where it divides into three tall stems nearly equal in height and measuring just above where they separate, 8 feet 4 inches, 8 feet 5½ inches, and 8 feet 7 inches respectively.

The Union trees,¹ in the avenue at Auchendrane, Ayrshire, planted in 1707, are six in number, the largest being, in 1902, 97 feet high and 16 feet 1 inch in girth. Another tree in the flower garden here, planted at the same time, was 110 feet by 16 feet in 1902.

In the island of Bute, James Kay describes, in *Trans. Scot. Arb. Soc.* ix. p. 75, some fine silver firs which grew in a clump north-east of the circle walk in the woods of Mountstuart, the seat of the Marquess of Bute. They were of immense height (120 feet), and could be seen for miles standing out like an island among this forest of sylvan beauty. There were nineteen silver firs, five spruce, one Scots pine, and two birches, all standing on a space of 60 yards square, where they were healthy and not overcrowded. They were very uniform in size, and ran from 10 to 12 feet in girth, ten being straight to the top and nine forked at 30 feet to 60 feet up.²

In other parts of Scotland the silver fir usually attains smaller dimensions, the largest that I have seen being on the banks of the Tay, near Dunkeld, and at Dupplin Castle, where I measured a tree over 100 feet high by 17½ feet in girth. But Mr. W. J. Bean, in *Kew Bulletin*, 1906, p. 266, mentions an immense tree, which was blown down on November 17, 1893, near Drummond Castle, when 210 years old. The stump of this tree was 6½ feet in diameter, and the cubic contents are said to have been 1010 cubic feet.

At Dawyck, near Peebles, in a cold situation at about 500 feet above the sea, Mr. F. R. S. Balfour showed me some large silver firs which far surpass the larches growing near them, which are believed to have been planted about 1730. The largest of the firs is 112 feet by 15½ feet.

In most parts of Ireland the silver fir is a thriving tree wherever planted, and seems to be well suited to the climate. It was probably introduced early in the eighteenth century, as, according to Hayes, there were trees 100 feet high and 12 feet in girth in 1794 at Mount Usher, in Co. Wicklow. The largest silver fir in Ireland that we know of is at Tullymore Park, Co. Down, the seat of the Earl of Roden, growing in a sheltered valley below the house. Col. the Hon. R. Jocelyn, who showed me

¹ Cf. Renwick, in *Trans. Nat. Hist. Soc. Glasgow*, vii. 265 (1905).

² Mr. Kay informs me that many of the trees described by him thirty years ago have since been blown down, and I could not identify these silver firs when I visited Bute recently.

this tree in 1908, informed me that it was marked on a plan about 200 years old, and though still vigorous in appearance, it seems to be hollow for some way up. It measures from 115 to 120 feet high, with a girth of 18 feet 10 inches; and at about 20 feet from the ground throws out four large branches, which become erect, and form a tree of the candelabra type. (Plate 211.) At Carton, the seat of the Duke of Leinster, a tree was 16 feet 1 inch in girth in 1904, but the top had been blown off by the great gale of 1903. The finest silver firs in Ireland are probably those growing at Woodstock, Co. Kilkenny, where the biggest tree was in 1904 over 120 feet high by 15 feet 4 inches in girth. There are also here four trees standing so close together that they can be encircled by a tape of 30 feet; one of these is 133 feet high by 10 feet 10 inches in girth. At Avondale, Co. Wicklow, Mr. A. C. Forbes measured a tree in 1908, 125 feet in height and 15 feet 4 inches in girth. At Tykillen, Co. Wexford, the silver fir grows well and seeds itself freely, but does not attain anything like the dimensions above noted. There are fine trees at Castlemartyr, Co. Cork, one of which measures 114 feet by 14 feet 8 inches.

TIMBER

Though on the Continent the wood of the silver fir is in some districts, and for purposes where strength combined with lightness is required,¹ valued more highly than that of the spruce or pine, yet in England it is little appreciated, because it seldom comes to market in any quantity, and the trees are rarely clean enough to make good boards. But I am assured by Dr. Watney that, when slowly and closely grown, it is distinctly superior in quality to that of the spruce, and that he uses it in preference on his own property for estate building; and Mr. H. E. Asprey, agent to the Earl of Portsmouth at Eggesford, Devonshire, where this tree grows very well, tells me that he finds the timber quite equal to that of spruce for all estate purposes. The Marquess of Bath informs me that a lot of 22 trees, averaging 140 feet each, were sold privately at 5½d. per foot, and used at Trowbridge for making tin-plate boxes; but most of his silver fir timber goes to the Radstock coal pits, where it is used underground.

Laslett says² that "the pinkish white and scarcely resinous wood works up well, with a bright silky lustre, and is of excellent quality for carpentry and ship-work. It is light and stiff, and like spruce takes glue well. Nevertheless it is as yet far less in request than the latter, though it is employed in the making of paper pulp, as well as for boards, rafters, etc."³ So little is it known, however, to the English timber merchant that the author of *English Timber* does not even mention it, and I am not aware that it is imported to England as an article of commerce.

Strasburg turpentine, which was formerly extracted from the resinous glands found on its bark and largely used for the preparation of clear varnishes and at one time used as medicine, is now apparently superseded by other resins, though, according to Flückiger and Hanbury,⁴ it was still collected to a small extent in the Vosges in 1873.

(H. J. E.)

¹ Cf. Mouillefert, *Essences Forestières*, 338 (1903).

² *Timber and Timber Trees*, 343 (1896).

³ Christ, *Flore de la Suisse*, 255 (1907), says that its white wood is delicate and not so much in request as the more resinous wood of the spruce.

⁴ *Pharmacographia*, 615 (1879).

ABIES PINSAPO, SPANISH FIR

Abies Pinsapo, Boissier, *Biblioth. Univ. Genève*, xiii. 167 (1838), and *Voyage Espagne*, ii. 584, tt. 167-169 (1845); Masters, *Gard. Chron.* xxiv. 468, f. 99 (1885), xxvi. 8, f. 1 (1886), and iii. 140, f. 22 (1888); Kent, *Veitch's Man. Coniferae*, 534 (1900).

Pinus Pinsapo, Antoine, *Conif.* 65, t. 26, f. 2 (1842-1847).

Picea Pinsapo, Loudon, *Encycl. Trees*, 1041 (1842).

A tree attaining about 100 feet in height and 15 feet in girth. Bark smooth in young trees, becoming rugged and fissured on old trunks. Buds ovoid, obtuse at the apex, resinous. Young shoots glabrous, brownish, with slightly raised pulvini.

Leaves on lateral branchlets radially arranged, linear, flattened, but thick, rigid, short, $\frac{1}{2}$ to $\frac{3}{4}$ inch long by about $\frac{1}{10}$ inch wide, gradually narrowing in the upper third to the acute apex; upper surface convex without a median furrow and with eight to fourteen lines of stomata; lower surface with two bands of stomata, each of six or seven lines; resin-canals usually median.¹ In young plants the leaves are longer and end in sharp cartilaginous points. On cone-bearing branches the leaves are short and thick, lozenge-shaped in section, with twenty or more lines of stomata on the upper surface, and two bands of stomata of about ten lines each on the lower surface, which has a prominent keeled midrib.

Staminate flowers crimson, cylindrical, $\frac{1}{2}$ inch long, surrounded at the base by two series of broadly ovate obtuse scales.

Cones sessile or subsessile, brownish when mature, pubescent, cylindrical, tapering to an obtuse apex; 4 to 5 inches long by $1\frac{1}{4}$ to $1\frac{3}{4}$ inches in diameter. Scales: lamina three-sided, 1 inch wide by $\frac{7}{8}$ inch long, upper margin almost entire, lateral margins nearly straight, lacinate; claw short, obcuneate. Bract minute, situated at the base of the scale, ovate, orbicular or rectangular, denticulate, emarginate with a short mucro. Seed with wing $1\frac{1}{4}$ inch long; wing two to three times as long as the body of the seed. In cultivated specimens the cones and scales are usually considerably smaller than in wild trees.

Cotyledons² six, convex and stomatiferous on the upper surface, flattish and green on the lower surface.

HYBRIDS

A series of hybrids have been obtained between *A. Pinsapo* and two other species, *A. cephalonica* and *A. Nordmanniana*, of which a full account is given by Dr. Masters in his valuable paper on hybrid conifers.³

1. *Abies Vilmorini*, Masters.⁴ This is a tree growing at Verrières near Paris, which has the following history. In 1867, M. de Vilmorin placed some pollen of *A. cephalonica* on the female flowers of a tree of *A. Pinsapo*. A single fertile seed was produced, which was sown in the following year; germination ensued and the

¹ The resin-canals in this species are variable in position. Cf. Guinier and Maire, in *Bull. Soc. Bot. France*, lv. 190 (1908).

² Masters, *in litt.*

³ *Journ. Roy. Hort. Soc.* xxvi. 99 seq. (1901).

⁴ *Ibid.* 109.

seedling was planted out in 1868. M. Phillipe L. de Vilmorin¹ states that the tree was in 1905, 50 feet high by 5 feet in girth; and has three main stems, one of which, however, was broken by a storm two years ago. In its habit and foliage it resembles *A. Pinsapo* more than the other parent. The leaves, however, are longer and less rigid than in *A. Pinsapo*, and bear stomata only on their lower surface; moreover their radial arrangement on the branchlets is imperfect. The cones, which are produced in abundance and contain fertile seeds, resemble those of *A. cephalonica*, being fusiform in shape; they have longer bracts than in *A. Pinsapo*, in some years exserted, in other years shorter and concealed between the scales. Seedlings raised from this tree, now four years old, have acuminate sharp leaves like those of *A. cephalonica*.

2. *Abies insignis*, Carrière, *Rev. Hort.* 1890, p. 230. This hybrid was obtained in 1848 or 1849 in the nursery of M. Renault at Bulgnéville in the Vosges. A branch of *A. Pinsapo* was grafted on a stock of the common silver fir (*A. pectinata*); and after some years the grafted plant produced cones. Seeds from these were sown; and of the seedlings raised one-half were like *A. Pinsapo*, the remainder being intermediate in character, it was supposed, between *A. Pinsapo* and *A. pectinata*; and the variation was considered to be the result of graft hybridisation. However, at no great distance there was growing a tree of *A. Nordmanniana*; and it is more probable that the hybrid character of the seedlings was the result of a cross from *A. Pinsapo* fertilised by the pollen of *A. Nordmanniana*. A complete account of these seedlings is given by M. Bailly.²

3. *Abies Nordmanniana speciosa*, Hort.² This hybrid was raised in 1871-1872 by M. Croux in his nurseries near Sceaux, the cross being effected by placing pollen from *A. Pinsapo* on female flowers of *A. Nordmanniana*. A full account of this hybrid is given by M. Bailly.²

4. *Moser's hybrids*. Four different forms, all raised from *A. Pinsapo*, fertilised by the pollen of *A. Nordmanniana*, which were obtained in 1878 by M. Moser at Versailles. Full details are given in Dr. Master's paper, to which we refer our readers.

DISTRIBUTION

A. Pinsapo has a restricted distribution, being confined to the Serrania de Ronda, a name given to the mountainous region around Ronda in the south of Spain. The late Lord Lilford informed Bunbury³ in 1870 that he had seen it growing on the Sierra d'Estrella in Portugal; but we have not been able to confirm the statement.

There are three main forests of this species, none of considerable extent, occurring in localities at considerable distances apart. I visited these forests in December 1906, and explain the rare occurrence of the tree as due to the fact, that in the dry climate of the south of Spain, it can only exist on the northern slopes of mountain

¹ *Hortus Vilmorinianus*, 69, plate xii. (1906). See also *Gard. Chron.* 1878, p. 438; *Rev. Hort.* 1889, p. 115, and 1902, p. 162, fig. 66.

² *Rev. Hort.* 1890, pp. 230, 231.

³ *Arboretum Notes*, 147 (1889).

chains running due east and west; and these are seldom met with. In such situations the soil is never exposed to the direct rays of the noonday sun, and preserves in consequence a great deal of moisture. The tree never grows even on north-west or north-east slopes, and is strictly limited to aspects looking due north.

The most important forest is in the Sierra de la Nieve, a few miles to the east of Ronda. Here the tree extends for several miles in scattered groves on the north slope of the range, growing on dolomitic limestone soil, usually in gullies or under the shade of the cliffs. It occurs mainly at elevations of 4000 to 5900 feet, though it occasionally descends to 3600 feet. In shaded situations and where the soil is deep, there are dense groves of thriving trees, without any admixture of other species; but at the lower elevations, where there is more sun, the trees are scattered and mixed with oak and juniper. In exposed situations, at high elevations, the trees are windswept, stunted, and more or less broken. Seedlings are numerous in many places. The largest trees, seen by me, were a group, on the road across the mountain from Ronda to Tolox, at a spot called *Puerta de las animas*. One of these (Plate 212) was 106 feet in height and 13 feet 8 inches in girth; and another with a double stem, not so tall, girthed 16 feet 3 inches. This group is overhung by a precipice, and is at 4700 feet altitude. The stump of a tree, which had been cut down, showed 240 annual rings and was 32 inches in diameter.

The second forest, and by far the most picturesque, lies to the west of Ronda, on the northern slope of the precipitous peak, Cerro S. Cristoval or Sierra del Pinar, close to the mediæval town of Grazalema. The fir grows here on a talus, composed of sharp angular white limestone stones; and the contrast between the dense mass of green foliage of the tree and the pure white ground from which it springs, is remarkably beautiful. The stones and pebbles are loosely aggregated; and beneath the surface they are mixed with a mass of black mould, in which the roots of the tree freely spread. The fir extends along the precipitous side of the mountain for about two miles, forming a band of continuous forest, which reaches nearly to the summit of the peak, attaining about 5800 feet altitude, and descending generally to 4000 feet, reaching in one gully to 3600 feet. Seedlings are numerous. There is no undergrowth, except an occasional daphne; but climbers like ivy and clematis are common. None of the trees are so tall as those in the Sierra de la Nieve; but many have gigantic short trunks, in one case girthing 25 feet, and are extremely old. In this forest, trees with glaucous foliage, not seen elsewhere, are not at all uncommon.

The third wood of *A. Pinsapo* occurs on the Sierra de Bermeja, which overhangs the town of Estepona and the Mediterranean coast. This wood, which covers only a small area, is most accessible from Gaucin, a station on the railway between Gibraltar and Ronda. Here the soil is disintegrated serpentine rock, and the tree grows on the northern slope, between 4100 and 4900 feet, though stunted specimens occur up to 5400 feet. The fir is pure on the precipitous upper part of the mountain; but lower down is mixed with *Pinus Pinaster*. The largest tree, which I measured, was 90 feet high by 13 feet 5 inches in girth.

Isolated groups of a few trees, the remains of former forests, are reported to be growing on the Sierra de Alcaparain, near Carratraca, north-east of Ronda, and at Zahara and Ubrique, not far from Grazalema. Mr. Mosley of Gibraltar, who gave me valuable help and information, saw *A. Pinsapo* also growing on the Sierra Blanca de Ojen near Marbella.

HISTORY AND CULTIVATION

This species was discovered by Edmond Boissier in 1837. He sent about half-a-dozen seeds to M. de Vilmorin in the same year, and from one of these was raised the very fine tree, which is now growing at Verrières¹ near Paris, and which is certainly the oldest cultivated specimen. This tree was in 1905, 70 feet high by 7 feet 3 inches in girth. *Abies Pinsapo* was introduced into England in 1839 by Captain Widdrington,² who was the first to obtain information about the existence of a new species of *Abies* in Spain, though he was anticipated in its discovery by Boissier. (A. H.)

In cultivation this has proved to be, all over the southern, midland, and eastern counties, one of the most ornamental of its genus, and is perfectly hardy on dry soils throughout Britain, ripening seed at least as far north as Yorkshire. It is one of the few silver firs that seems to require lime to bring it to perfection, and though it will grow fairly well on sandy soils, it will not thrive without perfect drainage, or on heavy clay. It seems to have a great tendency to divide into several leaders and often forms a bushy rather than a clean trunk, unless carefully pruned. It is not often injured by spring frost, and, though not likely to have any economic value, is a tree that should be planted in all pleasure grounds on well-drained soil, and in a sunny situation.

The seedlings which I have raised grow at least as fast as those of *A. pectinata*, and are hardier when young, but require five or six years' nursery cultivation before they are fit to plant out.

The wood is soft and knotty like that of most of the silver firs when grown singly in cultivation.

REMARKABLE TREES

Though specimens of this tree of from 50 to 60 feet high are found in many places all over England, we have not measured any which are specially remarkable. The largest recorded at the Conifer Conference in 1891 was a tree reported to be 62 feet high by 9 feet in girth, at Pampisford in Cambridgeshire; but these measurements were erroneous, as it now is only 56 feet high by 7 feet 3 inches in girth. Here there is a remarkable dwarf form³ of this species, which is only a foot in height, with branches prostrate on the ground for 6 or 7 feet.

The largest tree we know of is growing in a sheltered position in moist soil, at Coed Coch, near Abergele in North Wales, the residence of the Hon. Mrs. Brodrick.

¹ *Hortus Vilmorinianus*, 69, pl. 7 (1906).

² *Sketches in Spain*, ii, 239.

³ This is var. *Hammondi*, Veitch, *Conifers*, ed. i. p. 105.

The gardener, Mr. Hunter, informs us that it is 82 feet high by 10 feet 2 inches in girth; but has never coned. There is a fine tree at Oakly Park, Ludlow, measuring 70 feet by 5 feet 8 inches in 1908.

At Hardwicke, Bury St. Edmunds, Sir Hugh Beevor measured a tree in 1904, which was 63 feet high and 8 feet 11 inches in girth. At Fornham Park, also in Suffolk, he found a tree, which was planted in 1866, 50 feet by 6 feet 7 inches; and says that its growth kept pace with that of an Atlantic Cedar close by. Col. Thynne has taken a photograph of a narrow, pyramidal, symmetrical tree at Longleat, which was 65 feet high by 7 feet 9 inches in 1906 (Plate 213). At Dogmersfield Park, Hants, the seat of Sir H. Mildmay, I measured a well-shaped tree, 65 feet high by 6 feet 10 inches.

There are several good trees at Lilford Park, Oundle, growing on oolitic limestone; but Lord Lilford informed Henry that these were not raised from seed brought home by his father, and could give no confirmation of Bunbury's statement that the latter found the tree growing wild in Portugal.

At Essendon Place, Hertford, a slender tree was 68 feet high by 5 feet 1 inch in 1907. At Merton Hall, near Thetford, Norfolk, there is a tall tree, 75 feet by 5 feet 10 inches, the stem being bare of branches for 30 feet.

At Highnam, Gloucestershire, Major Gambier Parry reports a fine specimen, growing in the pinetum, which measured 60 feet by 6 feet 8 inches in 1906.

At the Rookery, Down, Kent, the gardener, Mr. E. S. Wiles, reported in 1906 a fine specimen, 70 feet by 9 feet, which is growing on stiff yellow loam, intermingled with flint and clay, resting on chalk.

In Wales the best that I have seen is a tree at Bodorgan, Anglesey, the seat of Sir G. E. Meyrick, which in 1906 was about 70 feet high, and had some large witches' brooms growing on it.

In Scotland, we have seen none of more than average size, a tree at Scone being about the best, and, generally speaking, the climate seems too cold for this tree. Sir Archibald Buchan-Hepburn, however, reports one at Smeaton-Hepburn, East Lothian, which was 60 feet by 7 feet 9 inches in 1908.

In Ireland, there is a tree at Curraghmore, Co. Waterford, which the gardener, Mr. D. Crombie, reported in 1905 to be 65 feet high by 8 feet in girth. At Carton, the seat of the Duke of Leinster, there is a good tree, 54 feet high by 8 feet in girth in 1903. At Coollattin, Wicklow, another was 55 feet by 4 feet 10 inches in 1906.

Prof. Hansen states¹ that fine trees of 50 feet high or more may be seen in several Danish gardens, where it has produced cones; and that the tree exists in the south of Sweden and Norway.

In the eastern United States it² never really flourishes, although it is possible to keep it alive for many years in favourable situations, even as far north as eastern Massachusetts.

(H. J. E.)

¹ *J. R. Hort. Soc.* xiv. 476 (1892).

² Sargent, *Silva N. Amer.* xii. 100, *adnot.* (1898).

ABIES NUMIDICA, ALGERIAN FIR

Abies numidica, De Lannoy, ex Carrière, *Rev. Hort.* 1866, pp. 106, 203; Van Houtte, *Flore des Serres*, xvii. 9, t. 1717 (1867); Masters, *Gard. Chron.* iii. 140 (in part and excluding figures) (1888); Trabut, *Rev. Gén. Bot.* i. 405, ff. 17, 18 (1889); Kent, Veitch's *Man. Coniferae*, 529 (1900).
Abies Pinsapo, Boissier, var. *baborensis*, Cosson, *Bull. Soc. Bot. France*, viii. 607 (1861).
Abies baborensis, Letourneux, *Cat. Arb. et Arbust. d'Algérie* (1888).
Pinus Pinsapo, Parlature, DC. *Prod.* xvi. 2, p. 423 (in part) (1868).
Picea numidica, Gordon, *Pinet.* 220 (1875).

A tree attaining 70 feet in height and 8 feet in girth. Bark grey, smooth in young trees, becoming scaly and fissured on old trunks. Buds large, ovoid, acute at the apex, non-resinous; scales ovate, acute, with white scarious margins, usually free at the apex. Young shoots brown, shining, glabrous, with slightly raised pulvini but without grooves.

Leaves on lateral branches pectinate below, the two lateral sets directed outwards in the horizontal plane; those above shorter, crowded, directed upwards, and either, as on weak shoots, forming a narrow V-shaped pectinate arrangement, or, on strong shoots, with the median leaves directed backwards (not seen in any other species) and covering the upper side of the branchlet. Leaves short, $\frac{1}{2}$ to $\frac{3}{4}$ inch long, $\frac{1}{2}$ inch broad, linear, flattened, gradually tapering to the base, broadest above the middle or uniform in width in the upper three-fourths, rounded at the apex, which is sometimes entire but usually slightly bifid; upper surface dark green, shining, with the median groove often faint and rarely continued to the apex, in many leaves with four to six broken lines of stomata in the middle line near the apex; under surface with two white bands of stomata, each of about eight to nine lines; resin-canals marginal. Leaves on cone-bearing branches all more or less upturned, those of the middle ranks also directed slightly backwards, short, rigid, rounded and entire at the apex.

Cones on short stout stalks, brownish, cylindrical with an obtuse apex and tapering base, about 5 inches long by $1\frac{1}{2}$ inch in diameter, with the bracts entirely concealed. Scales; lamina fan-shaped, $1\frac{1}{4}$ inch wide, $\frac{3}{4}$ inch long, upper margin almost entire, lateral margins denticulate and either straight or with a wing on each side above; claw short, obcuneate. Bracts, scarcely reaching half the height of the scales, with a broad oblong claw and an expanded ovate denticulate lamina, which is acuminate or cuspidate at the mucronate apex. Seed with wing about an inch long; wing about $1\frac{1}{2}$ times as long as the body of seed. Cones of cultivated trees have smaller scales with more developed lateral wings; and shorter bracts, scarcely reaching $\frac{1}{4}$ the height of the scale.

The seedlings of this species have been fully described by Fliche.¹

¹ In *Bull. Soc. Forest. Franche-Comté et Belfort*, 1903, p. 168.

IDENTIFICATION

The short broad leaves, which have usually four to six broken lines of stomata on their upper surface near the apex in the middle line, are a good mark of this species. On strong shoots the backward direction of the median leaves, which densely cover the upper side of the branchlet, is also very characteristic.

DISTRIBUTION

Abies numidica is very restricted in its distribution, being, so far as is known, confined to a small area towards the summit of the northern slope of Mount Babor, in the Kabylie range in Algeria. It grows between 5000 and 6600 feet altitude in a climate where snow lies upon the ground from December to April. In January, 1907, I visited Kerrata, at the head of the famous gorge of Chaba-el-Akra; and found that the ascent of the mountain, only a few miles distant, was impracticable. M. Bernard, Inspector of Forests at Bougie, who has charge of the forest of Mt. Babor, informed me that the northern slope contains an area of 4000 acres, and is clothed with a dense forest, composed mainly of cedar and *Quercus Mirbeckii* in the upper zone between 4700 and 6600 feet, and of *Q. Mirbeckii*, *Q. castaneaefolia*, and *Acer obtusatum*, in the lower zone below 4700 feet. The total number of trees of *Abies numidica* scarcely exceeds 3000; and they only grow towards the summit, where they occur scattered amongst the cedars and oaks. None of the trees are more than 70 feet high, and the largest is only 8 feet in girth. The small size is due to their exposed position, and possibly to the destruction of larger trees by the natives in former times. Seedlings are rare; and according to M. Bernard, this is accounted for by the poor germinating quality of the seed, as only 4 to 15 per cent of it produced plants with him. The soil on which the tree grows is limestone, its surface being composed of stones and pebbles, underneath which there is a considerable mixture of mould.¹

Abies marocana, Trabut,² discovered in January 1906 by M. Joly, in the mountains south of Tetuan, in Morocco, is intermediate in the characters of the foliage between *A. numidica* and *A. Pinsapo*. M. Trabut showed me a branchlet, when I was in Algiers in 1907; but in the absence of cones, it is impossible to decide whether it deserves to rank as a new species. Seeds of this should be readily procurable; and the attention of travellers is directed to the possibility of introducing a new silver fir. (A. H.)

HISTORY AND CULTIVATION

The Algerian fir was discovered in 1861 by Captain de Guibert. The first seeds were sent to France in 1862 by M. Davout, a forest officer; and another supply and six young plants were forwarded in 1864 by M. de Lannoy.

¹ M. Maurice de Vilmorin, in *Arbres Forestiers Etrangers*, 33 (1900) gives an account of *Abies numidica* on Mount Babor. He noticed that many of the trees had short stout trunks, free of branches to 10 or 12 feet, occasionally more or less twisted, and often dividing into several stems.

² In *Bull. Soc. Bot. France*, liii. 154, t. 3 (1906). In the plate, the name *Picea marocana*, Trabut, appears by mistake.

The tree is rare in cultivation in England. There are two or three young specimens at Kew; and Kent, writing in 1900, mentions small trees, about 20 feet high, growing at Bicton, and Streatham Hall in Devonshire.

At Pampisford, Cambridgeshire, there are two trees with fine healthy foliage, the larger of which, 37 feet high and 3 feet 2 inches in girth, bore cones in 1907. There is also a specimen at Highnam 35 feet by 3 feet 2 inches. Though we have not identified any specimens in Scotland Mr. Crozier speaks of it as a handsome and free-growing tree which bore cones in 1906 and seems quite at home at Durris.

In Ireland the finest we know of is at Fota, where a tree 39 feet by 6 feet was bearing cones in 1908. Lord Barrymore informs us that it was planted in 1878. There is a good specimen at Glasnevin, 38 feet by 3 feet 7 inches in 1906; and one at Castlewellan measured, in the same year, 25 feet by 3 feet.

At Verrières¹ near Paris, two trees, dating from the original introduction in 1862, were, in 1905, 46 feet in height by 4 feet 3 inches in girth. (H. J. E.)

ABIES CEPHALONICA, GREEK FIR

Abies cephalonica, Loudon, *Arb. et Frut. Brit.* iv. 2325 (1838); Masters, *Gard. Chron.* xxii. 592, f. 105 (1884); Kent, *Veitch's Man. Coniferae*, 498 (1900); Halácsy, *Consp. Fl. Græcæ*, iii. 450 (1904).

Abies Apollinis, Link, *Linnaea*, xv. 528 (1841).

Abies Regina Amalia, Heldreich, *Gartenflora*, ix. 313 (1860).

Abies Panachaica, Heldreich, *Gartenflora*, x. 286 (1861).

Picea cephalonica, Loudon, *Gard. Mag.* xv. 238 (1839).

Pinus cephalonica, Endlicher, *Cat. Hort. Vindob.* i. 218 (1842).

A tree attaining about 100 feet in height. Bark greyish brown, smooth in young trees, in old trees fissuring into small oblong plates. Buds conical or ovoid, obtuse at the apex, composed of thick ovate acute keeled scales, with prominent tips, and covered with a layer of resin. Young shoots smooth, light brown, shining, glabrous.

Leaves on lateral branches radially arranged, but not so regularly as in *A. Pinsapo*, their apices pointing outwards and slightly forwards, those of the upper ranks shorter than those beneath. Leaves linear, flattened, curved, about 1 inch long, $\frac{1}{8}$ to $\frac{1}{2}$ inch broad, abruptly tapering at the base, narrowing gradually in the anterior two-thirds, and ending in a long cartilaginous point; upper surface dark green, shining, with the median furrow not continued to the apex, and usually with several broken lines of stomata; lower surface with two white bands of stomata, each of seven or eight lines; resin-canals marginal. Leaves on cone-bearing branches all upturned, curved, rigid, broad, with the apex simply acute and not prolonged into a fine cartilaginous point.

Cones, on short stout stalks, about 6 inches long by $1\frac{1}{2}$ inch in diameter, cylindrical, slightly tapering at both ends, brownish, with the bracts golden brown, exposed, and reflexed. Scales: lamina narrowly fan-shaped, almost triangular;

¹ *Hortus Vilmorinianus*, 69, pl. 1 (1906).

upper margin convex, undulate or entire; lateral margins with two short denticulate wings; base curving but not auricled on each side of the oblong claw. Bracts: claw oblong, $\frac{1}{8}$ inch wide, extending $\frac{3}{4}$ the length of the scale; lamina lozenge-shaped, $\frac{1}{4}$ inch wide, denticulate, ending in a triangular mucro, exerted and reflexed over the edge of the scale next below. Seed-wing about twice as long as the seed; seed with wing about 1 inch long.

Seedling;¹ caulicle tapering upwards, reddish brown, erect, stout. Cotyledons, five or six, acute not mucronate, about $1\frac{1}{4}$ inch long; upper surface dotted irregularly with stomata and grooved in the middle line. Primary leaves half the length of the cotyledons, not mucronate; lower surface with stomata.

Var. *Apollinis*, Beissner, *Nadelholzkunde*, 440 (1891).

Abies Apollinis, Link, *Linnaea*, xv. 528 (1841).

This variety differs from the type in the arrangement and shape of the leaves. On lateral branchlets the radial arrangement is imperfect, most of the leaves standing crowded on the upper side of the branchlet, with their apices directed upwards, those in the middle line straight and vertical, those on the sides curved and bending upwards; on the lower side of the branchlet a few leaves are directed downwards and forwards. Leaves thicker and broader than in the type, about $1\frac{1}{4}$ inch long by $\frac{1}{10}$ to $\frac{1}{12}$ inch broad, ending in a short acute point, bevelled off from behind; upper surface with a continuous median groove and two to three short lines of stomata near the tip; lower surface with two bands of stomata, each of ten lines.

The cones do not differ in any essential characters from those of the type; and the differences noted by Murray² in the broader bract and expanded wing of the seed are trifling and inconstant.

Halácsy considers *Abies Reginae Amalie* and *Abies panachariaca* to be mere synonyms of *Abies cephalonica*; and only allows the variety *Apollinis*, distinguished, according to him, by its acute leaves, those in the type ending in an acuminate or very sharp spine-like point. According to other authorities, *A. Reginae Amalie* is more akin to var. *Apollinis* than to the type. In all probability there is a series of intermediate forms connecting the type and var. *Apollinis*.³

DISTRIBUTION

According to Halácsy this species occurs in the sub-alpine region of almost all the higher mountains of Greece, between 2700 and 5700 feet elevation. The type is met with in the island of Cephalonia on Mount Enos; and on the mainland—in Doris on Mount Kiona, in Attica on Mount Parnes, and in Arcadia on

¹ Masters, in MS., who states that in var. *Apollinis* the cotyledons are seven in number, sub-acute at the apex, and about 1 inch long; primary leaves shorter and more pointed than the cotyledons.

² *Proc. Roy. Hort. Soc.* iii. 141 (1863).

³ Guinier and Maire, in *Bull. Soc. Bot. France*, lv. 187, figs. 2 and 3 (1908), describe a variety, with leaves like those of *A. cilicica*, which grows on Mount Pindus in Thessaly.

Mounts Mænalus, Madara, Thaumasion, and Rhudia. Var. *Apollinis* occurs, in Epirus on Mounts Tsumerka, Strungula, Peristeri; in Thessaly, on Pindus and Olympus; in Eubœa on Mount Dirphys. It has also been found in Hellas on Mounts Ceta, Tymphrestus, Parnassus, Helicon, Cithæron, Pateras, and Parnes; and in Peloponnesus on Mounts Chelmos, Olenos, Malevo, Taygetos.

As Halácsy considers *Abies Reginae Amalie* to be the same as the type, and not the var. *Apollinis*, his account of the distribution differs from that generally adopted, in which the view taken is that the type is confined to the island of Cephalonia, and that all the continental forms are referable to the var. *Apollinis*.¹

In Cephalonia the forest of this species occurs on Mount Enos, along a ridge 4000 to 5000 feet above sea-level and about 12 to 15 miles in length. It was 36 miles in circumference in 1793; but its area was considerably reduced by disastrous fires in 1798. No recent account of this forest, of which full details were given by General Napier in 1833, has come under our notice.

The form which occurs in the mountains of Arcadia, distinguished as var. *Reginae Amalie*² by some authors, is remarkable for its capacity of producing coppice shoots, when the trunk is felled; and the main stem, even when untouched, is said often to produce secondary stems and branches from the old wood. (A. H.)

CULTIVATION

Seeds³ were first sent from Cephalonia to England by General Sir Charles Napier in 1824; and the first plants, few in number, were raised by Mr. C. Hoare of Luscombe Castle, who distributed them to various places.⁴ Some time afterwards Mr. Charlwood⁵ sold seeds to the public, having received a cask of cones from General Napier.

The form *Reginae Amalie* was first noticed in 1856 by Schmidt of Athens, who found a forest of this tree near Tripolitza in Central Arcadia; its seeds have recently been introduced abundantly.

A. cephalonica seems to be quite hardy over the greater part of Great Britain, but it is rather more susceptible to spring frosts than *A. Pinsapo*, because it starts earlier into growth, and on this account should not be planted in low, damp, or exposed places. It seems to grow on limestone, but not to be so distinctly a lime-loving tree as *A. Pinsapo*. It ripens seeds in good years in the south of England, but the seedlings which I have raised do not grow so fast as those of *A. Pinsapo*.⁶

¹ With regard to the occurrence of this variety in Roumelia, Macedonia, and Thrace, see our remarks on p. 722 concerning the distribution of *A. pectinata* in the Balkan peninsula.

² See Regel, *Gartenflora*, ix. 299, fig. (1860); and Seemann, *Gard. Chron.* 1861, p. 755 fig.

³ Loudon, *loc. cit.*

⁴ A list of these places is given in Loudon, *Gard. Mag.* 1838, p. 31, and in *Pinetum Britannicum*, ii. p. 179.

⁵ Loudon, *Gard. Mag.* 1839, p. 238.

⁶ Owing to its susceptibility to late frosts and to attack by Chermes, it is now nearly impossible to grow this tree up to a planting size. Its timber, when closely grown and of some age, is, in my opinion, the best of the European silver firs, being hard, close in texture, and heavier in a dry state than any I have yet handled. Var. *Apollinis* is less subject to injury by frosts and attack by Chermes than the above, and seems well adapted for planting in the north of Scotland. In cultivation it maintains a more conical outline, and is easily distinguished from the type.—(J. D. CROZIER.)

REMARKABLE TREES

Probably the finest tree in the British Isles is the one growing at Barton, Bury St. Edmunds, which in 1908 was 95 feet in height by 13 feet 3 inches in girth. This tree (Plate 214) is very symmetrical, branched to the ground, and in full vigour, though probably it has nearly attained its limit of height, as the top of the crown of foliage is flattened. This is one of the original plants raised at Luscombe, and was planted at Barton in 1838, being then about thirteen or fourteen years old. According to Bunbury,¹ it did not suffer in the slightest degree from the severe winter of 1860. In 1857, it was 35 feet in height; and in 1858 began to bear cones, which are confined to the topmost of the lateral branchlets. In 1867, the height had increased to 58 feet, and the trunk at three feet from the ground was 7 feet in girth. Seedlings have been frequently raised from its seed. One of these seedlings, which was sent many years ago to Lord Rayleigh, is now growing at Terling Place, Essex, and measures 53 feet high and 3 feet 3 inches in girth.

Another of the original trees is now growing at Luscombe Castle, near Dawlish, in a rather exposed place, about 200 feet above sea level; when I saw it, in April 1908, it was a healthy and well-shaped tree, 75 feet by 11 feet.

There is a very fine healthy tree at Blount's Court, Oxfordshire, which Henry measured in 1907, as 87 feet in height by 10 feet 8 inches in girth. Another planted at the Coppice, Henley, in 1860, measured in 1905, 62 feet high by 8½ feet in girth. At Pampisford, Cambridgeshire, there are two trees, the larger of which was, in 1908, 55 feet by 6 feet 1 inch. The Cephalonian fir has been largely planted on Lord Walsingham's estate at Merton, Norfolk, the largest specimen, 52 feet by 9 feet 7 inches, dating from 1852. On the Thetford road there is an avenue of these trees, growing in loose, shallow sand, which have attained at forty-eight years old an average girth of 8½ feet. The growth of the tap-root is stopped by the compact chalk sub-soil, wide-spreading horizontal roots being formed, which have no great hold in the shifting sand; and several trees have been uprooted by storms.

At Heron Court, near Christchurch, I measured in 1906 a very large tree with ragged top, 82 feet by 10 feet 8 inches. At Beauport, Sussex, there is a good tree, which in 1904 was about 80 feet high by 10 feet 3 inches in girth.

At Powderham there is a very large and spreading, but ill-shaped tree, which appears as though in the mild, soft climate of south Devon it would not be long lived. In 1892 it was recorded as the largest in Great Britain, being then 77 feet by 11 feet at 3 feet from the ground.

At Killerton there is a large tree which measured in 1903 80 feet by 11 feet 9 inches. It forks at about 25 feet. At Highclere another, in the same year, measured 75 feet by 11 feet. At High Canons, Herts, Mr. H. Clinton Baker measured a tree in 1908, which was 58 feet by 8 feet 3 inches. At Bayfordbury, a tree planted in 1847 was 70 feet by 6 feet 11 inches in 1905.

At Castle Kennedy there is a very wide-spreading tree, which in 1904 measured

¹ *Arboretum Notes*, 144.

59 feet by 9 feet 8 inches. Around it were several natural seedlings, from 1 foot to 5 feet in height. At Smeaton-Hepburn another measured, in 1905, 53 feet high by 10 feet in girth. A number of Cephalonian firs were planted at Blairadam, the seat of Sir Charles Adam, Bart., in Kinross-shire, by his ancestor Sir Frederick Adam, who was governor of the Ionian Islands in 1824, and who was censured by General Napier for not sufficiently protecting the forests in Cephalonia. Several of these trees still survive at Blairadam, the largest in the garden near the entrance gate being 49 feet high, and 8 feet 2 inches in girth at 4 feet. It divides into several stems at about 25 feet. Another measures 42 by 5½ feet, and there are several smaller ones, but the tops in most cases have been at various times injured by wind and frost. In other parts of Scotland the tree grows fairly well, but not so fast as in the south, the best I have heard of being at Abercairney, where Mr. Bean¹ records one 75 feet high in 1906. As this, however, was in 1892 only reported as 50 feet high there may be a mistake. Other good trees are growing at Whittingehame, East Lothian, at Haddo House, Aberdeenshire, and at Ochtertyre,¹ Perthshire.

In Ireland, the largest Cephalonian Fir known to us, is growing at Adare Manor, Co. Limerick, the seat of the Earl of Dunraven; and, in 1903, was 86 feet high by 9 feet 4 inches in girth.

At Powerscourt, Co. Wicklow, a tree measured, in 1903, 55 feet by 8 feet 9 inches; and at Hamwood, Co. Meath, there is a fair specimen which in 1904 was 50 feet by 9 feet 6 inches.

At Cahir Park, Co. Tipperary, there are four trees of nearly equal size, one measuring 46 feet by 6 feet 2 inches. Specimens sent in 1906 by Mr. Austin Mackenzie show that these trees belong to var. *Apollinis*.

In the Botanic Garden at Bergielund, near Stockholm, a tree, planted in 1890, was, when seen by Henry in August 1908, 30 feet in height and 1 foot in diameter, and exceeds in rapidity of growth all the other conifers in the garden. In the Botanic Garden, at Christiania, there is a tree, about 25 feet in height, which is, however, not quite hardy, being slightly browned by frost. Hansen² says that this species had attained in 1891 a height of 44 feet and a girth of 6 feet, at 40 years old, in the gardens at Carlsberg, near Copenhagen.

A. cephalonica has proved hardy³ in eastern Massachusetts, where it has already borne cones.

Though General Napier stated that the wood of this tree in Cephalonia is very hard and durable, yet as grown in this country it is not likely to have any economic value, as it is too knotty and coarse for any but the commonest purposes.

(H. J. E.)

¹ *Kew Bulletin*, 1906, pp. 266, 267.

² *Journ. Roy. Hort. Soc.* xiv. 463 (1892).

³ Sargent, *Silva N. Amer.* xii. 99, *adnot.* (1898). Sargent, however, states in his account of the *Pinetum at Wellesley* in 1905, p. 12, that the tree here, which is 51 feet by 6 feet, was considerably injured in the severe winter of 1903-4.

ABIES CILICICA, CILICIAN FIR

Abies cilicica, Carrière, *Conif.* 229 (1855), and *Flore des Serres*, xi. 67, t. 1108 (1856); Tchihatcheff, *Asie Mineure*, ii. 494 (1860); Heuzé in *Rev. Hort.* 1856, p. 81, f. 14; Kent, Veitch's *Man. Conifera*, 500 (1900); Hickel, in *Bull. Soc. Dend. France*, 1908, p. 183.
Abies selinusia, Carrière, *Flore des Serres*, xi. 69 (1856).
Pinus cilicica, Kotschy, *Oestr. Bot. Wochenbl.* iii. 409 (1853).
Picea cilicica, Gordon, *Pin. Suppl.* 50 (1862).

A tree attaining in Asia Minor 100 feet in height and 7 feet in girth. Bark ashy-grey in colour, smooth in young trees, deeply fissured and scaly in old trees. Buds¹ small, non-resinous, ovoid, acute at the apex; scales few, keeled, with their tips more or less free and not appressed. Young shoots smooth, greyish-brown, with scattered short erect pubescence; bark fissuring slightly on the second year's shoot.

Leaves on lateral branches usually pectinately arranged, the upper ranks pointing outwards and upwards, thus forming a V-shaped depression above between the two lateral sets; on vigorous shoots, the median leaves on the upper side are directed forwards and upwards, and cover the branchlet, the V-shaped depression being obliterated. Leaves thin and slender, 1 to 1½ inch long, ⅙ inch wide, linear, flattened, uniform in width except at the tapering base, apex rounded or acute and slightly bifid; upper surface light green with a continuous median groove and usually without stomata, rarely with two to three short lines in the groove near the apex; under surface with two narrow greyish bands of stomata, each of six to seven lines; resin-canals marginal. Leaves on cone-bearing branches, upturned, curved, more rigid and broader than those on barren branches, minutely bifid at the truncate or obtuse apex.

Cones of wild trees subsessile or on short stout stalks, cylindrical, tapering to an acute apex, 6 to 9 inches long by 2 to 2½ inches in diameter, brownish when ripe. Scales² larger than in any other species; lamina 1¾ inch wide, ⅞ inch long, fan-shaped, upper margin thin and entire, lateral margins convex, denticulate, with a sinus on each side; claw short, obcuneate. Bract with an oblong claw, expanding above into an ovate or quadrangular denticulate lamina, tipped with a short mucro, extending to ⅓ or ½ the height of the scale. Seed-wing about 1½ times as long as the seed; seed with wing about 1¼ inch long. In cultivated specimens, scales smaller, 1½ inch wide by ¾ inch long; bracts with a very short claw and a lamina not reaching more than ¼ the height of the scale; seed with wing about 1 inch long.

DISTRIBUTION

This species is confined to Asia Minor and northern Syria, occurring on the Lebanon and the Antitaurus, and forming, in company with the cedar, great forests

¹ The buds are characteristic; and, as Hickel points out, distinguish this species from all the others.

² The peculiar hook-like processes of the scales which occur in some specimens are probably abnormal.

in the Cilician Taurus. It was first discovered by Kotschy¹ in the Cilician Taurus in August 1853, in the valley of Agatsch Kisse, at an elevation of 4000 to 5000 feet. It is known to the Turks as *Ak Illeden*, white fir, and grows in thick forests sometimes unmixed with other trees, sometimes in company with oaks, cedars, and junipers. Yew and *Pinus Laricio* also occur in these forests, which are protected from woodcutters by their inaccessibility. The climate of these mountains is extremely hot in summer, and cold in winter, with much snow in the upper region.

Post² says that it is found in alpine and subalpine Lebanon, and in the Amanus Mountains in the extreme north of Syria, but does not give any details of its size or the elevation at which it grows.

CULTIVATION

The first seeds, received by the museum at Paris in 1854 from M. Blanch, French Consul at Saida, failed to germinate. Balansa sent a good supply of seed in 1855. From these or from Kotschy's seed the few trees which we have found in England were probably raised.

The Cilician fir is extremely rare in cultivation in this country. The best specimen we have found is a tree, growing at Welford Park, Newbury, which in 1908 was 51 feet by 4 feet 4 inches. Mr. Ross, the gardener, informs us that he found this tree as a small plant in a pot, when he came to Welford Park in May, 1860. The tree has been considered by many people to be *Abies homolepis*, and was figured in the *Garden*, for 1904, under that name. It is unquestionably, however, *Abies cilicica*, of which it has the foliage, and only differs slightly from wild specimens in the smaller size of the cones and scales. Mr. A. B. Jackson has identified two at Bicton, 48 feet by 4 feet and 47 feet by 3½ feet respectively; and another at the Heath, Leighton Buzzard, which is 48 feet by 3 feet 10 inches.

The finest in Scotland is a tree at Durris, which Mr. Crozier reports to be 55 feet high and 5 feet 8 inches in girth. It was incorrectly labelled *A. amabilis*. Another good specimen is growing at Castle Kennedy, which measured in 1904, 48 feet in height by 5 feet 1 inch in girth. A second tree here, not so tall, is very thriving. Kent mentions a tree at Rosdhu in Dumbartonshire.

A tree at Glasnevin was 34 feet by 3 feet 2 inches in 1907; and a specimen, at Powerscourt, 37 feet by 2 feet 8 inches in 1906, did not seem to be very thriving.

There is a good specimen at Verrières, near Paris, of which a figure is given by M. Philippe L. de Vilmorin in *Hortus Vilmorinianus* (plate 1). This tree is about 60 feet high. Another and slightly taller tree is growing in the Parc de Cheverny, in the department of Loir et Cher. Pardé says that at Harcourt (Eure) it reproduces itself naturally.

According to Sargent,³ *Abies cilicica*, with the exception of *Abies concolor*, is the most beautiful of those silver firs, which are perfectly hardy and satisfactory in the north-eastern states of the U.S. Some trees are 40 feet in height, notably at

¹ *Reise in den Cilicischen Taurus* (1858).

² *Flora of Syria*, p. 751.

³ *Silva N. Amer.* xii. 99 adnot. (1898).

Mr. Hunnewell's pinetum, Wellesley, Mass.;¹ Mr. Hall's garden, near Bristol, Rhode Island; and Mr. Hoop's pinetum, West Chester, Pennsylvania. Sargent states that the tree does not thrive in western Europe, as the young shoots, which appear early in the spring, are killed by late frosts; and in consequence it is not propagated by nurserymen. Seeds from wild trees are difficult to procure. (A. H.)

ABIES NORDMANNIANA, CAUCASIAN FIR

Abies Nordmanniana, Spach, *Hist. Vég.* xi. 418 (1842); Regel, in *Gartenflora*, xx. 259, t. 699 (1871); J. D. Hooker, *Bot. Mag.* t. 6992 (1888); Masters, *Gard. Chron.* xxv. 142, f. 30 (1886); Kent, Veitch's *Man. Coniferae*, 526 (1900).
Pinus Nordmanniana, Steven, *Bull. Soc. Nat. Moscow*, xi. 45, t. 2 (1838); Loudon, *Gard. Mag.* xv. 225 (1839).
Picea Nordmanniana, Loudon, *Encycl. Trees*, 1042 (1842).

A tree attaining in the Caucasus over 200 feet in height and 15 feet in girth. Bark in cultivated trees greyish brown, smooth when young, becoming slightly fissured in older trunks. Buds ovoid, acute at the apex, brown, non-resinous, with ovate, acute, slightly keeled scales. Young shoots grey, smooth, with very scattered short erect pubescence.

Leaves on lateral branchlets, pectinately arranged below, the two lateral sets spreading more or less in the horizontal plane; those above shorter, directed forwards and densely covering the branchlet in imbricated ranks. Leaves linear, flattened, about 1 to 1½ inch long, 1/10 to 1/12 inch wide, uniform in width except at the gradually tapering base; apex rounded and bifid; upper surface dark green, shining, with a continuous median groove and without stomata; lower surface with two conspicuously white bands of stomata, each of eight or nine lines; resin-canals marginal. Leaves on cone-bearing branches all curved and upturned.

Staminate flowers ovoid-cylindric, 4/10 inch long, each with three series of involucre bracts.

Cones sub-sessile, cylindrical, tapering at both ends, about 6 inches long by 2 inches in diameter, brown in colour, with the bracts exserted and reflexed. Scales: lamina, about 1½ inch wide by ¾ inch long, either with a denticulate wing on each side or with straight lateral margins; claw obcuneate. Bract with oblong claw, expanding above into an almost orbicular lamina, which is denticulate and tipped with a long triangular mucro. Seed with wing about an inch long, the wing being twice the length of the body of the seed.

VARIETIES AND HYBRIDS

Several varieties are mentioned by Beissner, which are said to differ from the type in foliage, the leaves being shorter, glaucous, or yellow in colour. None of these appear to be in cultivation in England.

¹ Elwes saw this tree in May 1905, and remarked that it was very similar in growth to *A. Nordmanniana*, which has shorter darker leaves and denser habit. It had not suffered from the severe frost of the preceding winter which in some places had injured the Caucasian fir. According to Sargent, *The Pinetum at Wellesley in 1905*, p. 12, this tree is 49 feet high and 5 feet in girth.

Var. *equi-Trojani*, Guinier and Maire.¹ A peculiar form, discovered by Sintenis on Mount Ida in north-west Anatolia. It has reddish-brown glabrous shoots, leaves acute at the apex and only slightly emarginate, and cones with bracts much exserted and almost concealing the scales.

The hybrids, which have been obtained between *A. Nordmanniana* and *A. Pinsapo* are dealt with in our article on the latter species.

DISTRIBUTION

This species is a native of the mountains in the southern and south-eastern shores of the Black Sea, including the western spurs of the Caucasus. According to Radde,² it is entirely absent from the eastern parts of the Caucasus and Talysch, its easterly limit being longitude 42°. It usually grows between 3000 and 6600 feet elevation, and either forms pure forests or is associated with *Picea orientalis*, being occasionally mixed both with that species and *Pinus sylvestris*. It is said to prefer calcareous soil and to be dominant on the limestone formations, which are not so favourable to the growth of the oriental spruce and the common pine. In pure forests, the trees stand very close together; and in their deep shade underwood is absent and no light reaches the ground, which is very dry and covered with a thick layer of brown needles. Such forests are the last hiding-place of the European bison in a truly wild condition.

The largest tree mentioned by Radde, the age of which is not given, grew in the valley of the Labba in the district of Kuban, and measured 213 feet in height and 15 feet in girth at breast height, and the stem alone had a volume of 1236 cubic feet. On an area of about 2½ acres in this forest fifteen trees nearly as large were growing. It thrives best and attains its largest size at high elevations, 5000 to 6000 feet; where stems 150 to 170 feet in height, with a girth of 10 feet, are quite common. The oldest tree, which is recorded by Radde, was 370 years old, and measured 170 feet high by 10 feet in girth.

Abies Nordmanniana was also found by Balansa³ in Lazistan, and by Sintenis⁴ at Kostambul in Paphlagonia. Guinier and Maire⁴ in 1904 found it growing on Mount Olympus in Bithynia, where, on the northern slope between 3700 and 6000 feet, it forms extensive forests, either pure or mixed with *Pinus Laricio*, beech, oak, and chestnut, and constituting the timber line at 6300 feet. These botanists state that on Olympus, as well as in the Caucasus, it is a light-demanding tree, a least in the young stage, as the seeds everywhere germinate in open and unshaded places. The discovery by these authors of *A. Nordmanniana* on Mount Olympus and of the var. *equi-Trojani* on Mount Ida extends the distribution of this species westwards through northern Asia Minor to the borders of the Ægean Sea.

¹ In *Bull. Soc. Bot. France*, lv. 186, fig. 1 (1908). This variety was referred to *A. pectinata* by Boissier, in *Fl. Orientalis*, v. 701 (1881).

² *Pflanzenverb. Kaukasusland*, 184, 222, 244, etc. (1899).

³ Specimens in Kew herbarium.

⁴ In *Bull. Soc. Bot. France*, lv. 185, fig. 1 (1908). The silver fir on Mount Olympus was erroneously identified with *A. pectinata* by Boissier in *Flora Orientalis*, v. 701 (1881).

Abies Nordmanniana was first recognised as a distinct species by the Finnish botanist, Nordmann, Professor at Odessa, whose name it bears. He found it in 1836 in the Caucasian province of Imeretia. Pallas and other early botanists had referred the Caucasian silver fir to *Abies pectinata*. It was introduced¹ into Europe in 1848, when Alexander von Humboldt obtained seeds from the Caucasus, which were sown in the Berlin Botanic Garden. (A. H.)

CULTIVATION

No other silver fir found in the Old World is more thoroughly at home in Great Britain, for it grows luxuriantly on soils where the common silver fir will not thrive; is absolutely uninjured by spring frost, even in a young state, and ripens seed as far north as Perthshire and County Down. It seems equally at home on rich loam in the south-east of England, on oolite gravel in the Cotswold Hills, and in the peaty soil and wet climate of Argyllshire. Out of 102 returns sent to the Conifer Conference from all parts of Great Britain, 78 mention this tree and nearly all speak well of it, though it is said to fail at about thirty years old on strong loam in Worcestershire, and to be liable to aphids at Durriss in Kincardineshire.²

Sir Herbert Maxwell³ states that the Crimean silver fir (a misleading name, as it does not occur wild in the Crimea), after it attains twenty to thirty years of age, frequently succumbs to the attacks of aphids, and gives as an instance in proof of this, that at Benmore, where large numbers were planted thirty to forty years ago, very few now remain. But I do not think that this is a fair example, as the climate of Benmore is very wet, and the soil in many places very shallow. In the warmer and drier parts of Scotland I have seen many flourishing specimens, though not so fine as in England.

Wilkie⁴ says that at Tynninghame, in East Lothian, it is later in starting growth than the common silver fir, grows more freely when young, and either for use or ornament is certainly the more valuable of the two. Webster, also, whose experience was gained in Ireland, North Wales, and Kent, says,⁵ "If *A. nobilis* be the best of the Californian silver firs, this is without doubt the finest of the European or Asiatic species." He expected that at no distant date it would supplant the silver fir for forest planting, the timber being of excellent quality, the tree more ornamental, and less exacting as regards soil. He says that it succeeds well on reclaimed peat bog, stiff loam, decomposed vegetable matter, and light gravelly soils.

¹ Hansen, in *Journ. Roy. Hort. Soc.* xiv. 471 (1892). In the catalogue of the Pinetum at Beernem, in western Flanders, Baron Serret says that he received his specimen in April 1847, from Lawson and Son, Edinburgh; and the earliest introduction would seem from this to have been prior to that stated by Hansen.

² *A. Nordmanniana*, the most susceptible of all silvers to attack by Chermes either in a seedling or older state. For general purposes this tree is doomed, and it is only by repeated spraying with insecticide that it will be possible to preserve even the largest specimens. In growth, it has proved itself much slower than *A. pectinata*, and being densely branched and of a shade-bearing nature, its timber when cut up has generally been coarse and knotty. In Scotland it has never been regarded by foresters as of economic importance.—(J. D. CROZIER.)

³ Green's *Encyclopedia of Agriculture*, ii. 112 (1908). The erroneous statement that this fir occurs wild in the Crimea appears to have been first made in Veitch's *Man. Coniferae*, 1st ed. 102 (1881), and has been repeated by Masters, Hansen, the *Kew Handlist of Conifers*, etc. No species of *Abies* grows wild in the Crimea. Cf. Demidoff, *Voyage Russie Meridionale et la Crimée*, ii. 231, 232, 375, 646 (1842).

⁴ *Trans. Royal Scot. Arb. Soc.* xii. 211 (1889).

⁵ *Ibid.* 257.

As the seed can now be procured in quantity and at a cheap rate, even when home-grown seed is not available, there seems to be no reason why this beautiful tree should not be raised at the same rate as the common silver fir and planted in preference to the latter, for though it has not yet had time to attain its full size in this country it grows quite as fast, and from what little we know of its timber is likely to be at least as valuable. Its average rate of growth is from 1 to 2 feet annually when once established; and though we have as yet no evidence that it will endure dense shade as well as the silver fir, yet the accounts of its growth in the Caucasus lead one to expect that it will do so.

REMARKABLE TREES

Among the numerous specimens that we have measured in various places in England, I have seen none to surpass a very healthy and vigorous tree which grows in a wood facing east on the banks of the river at Eggesford, the property of the Earl of Portsmouth in Devonshire, which in April 1904 measured 84 feet by 5 feet 7 inches, and had produced cones. But a tree growing in a wood called Hook's Grove at Bayfordbury is perhaps taller; it was about 85 feet by 6 feet 10 inches in 1907.

At Strathfieldsaye, in the same year, I measured one as 78 feet by 6 feet 7 inches, and at Hemsted, in Kent, there is a tall but very slender specimen, not over forty years planted, which bids fair to become a very large tree. In 1905 it was 68 feet by only 3 feet 7 inches. At Lynhales, Herefordshire, the seat of S. Robinson, Esq., another is 70 feet by 5½ feet and growing freely.

In Wales it is thriving at Penrhyn; where there are two trees, one with its top broken being about 75 feet by 10 feet; the other even taller measures 6 feet 10 inches in girth; and at Hafodunos, where it does well in plantations, Henry measured one 60 feet by 6 feet 7 inches in 1904.

In Scotland the largest recorded in 1891 was at Poltalloch, and then was said to measure 70 feet by 6 feet, but when measured by Mr. Melville in 1906 he made it only 73½ feet by 7 feet 4 inches.

The finest I have seen myself is one at Moncreiffe which, in 1907, I made to be no less than 79 feet by 6½ feet; a healthy tree from which many seedlings have been raised. This is stated by Hunter to have been planted about 1856, and in 1888 was only 30 feet by 2 feet 2 inches. It is said to have been hybridised by the silver fir, but I could not see anything in the seedlings to distinguish them.

In Ireland it also grows very well. A tree at Carton, the seat of the Duke of Leinster, was 74 feet by 5 feet 4 inches, and one at Fota 68 feet by about 6 feet in 1903. Another at Mount Shannon, Limerick, measured, in 1905, 75 feet by 8 feet 9 inches. A good specimen at Ballykilcavan, Queen's County, measured 68 feet by 5 feet 2 inches in 1907. There are many fine healthy specimens at Dereen in Co. Kerry.

In the University Botanic Garden at Upsala, in Sweden, a tree was seen by Henry in 1908 which was about 40 feet high and branched into three stems near the ground, the result evidently of injury to the leader by severe frost in early youth.

According to Hansen,¹ it is said to thrive at Trondhjem in Norway, but Henry saw no specimens at Trondhjem or Christiania. It is often planted in Danish gardens and forests, and is quite hardy in Denmark.

According to Sargent,² it is very hardy in the eastern United States, as far north, at least, as eastern Massachusetts, but although handsome when young, is apt to become thin and shabby here at an early stage. (H. J. E.)

ABIES WEBBIANA, HIMALAYAN FIR

Abies Webbiana, Lindley, *Penny Cyclop.* i. 30 (1833); Griffith, *Icon. As. Pl.* t. 371 (1854); Masters, *Gard. Chron.* xxii. 467, f. 86 (1884), and x. 395, f. 47 (1891); Hooker, *Gard. Chron.* xxv. 788, ff. 174, 175 (1886), and *Flora Brit. India*, v. 654 (1888); Kent, *Veitch's Man. Coniferae*, 543 (1900); Gamble, *Indian Timbers*, 718 (1902).

Abies spectabilis, Spach, *Hist. Vég.* xi. 422 (1842).

Abies Mariesii, Masters, *Bot. Mag.* t. 8098 (1906) (not Masters, *Gard. Chron.* xii. 788 (1879)).

Pinus Webbiana, Wallich, *ex Lambert, Genus Pinus*, 77, t. 44 (1828).

Pinus spectabilis, D. Don, *Prod. Fl. Nepal.* 55 (1825).

Picea Webbiana, Loudon, *Arb. et Frut. Brit.* iv. 2344 (1838).

A tree, attaining in the Himalayas 150 feet or more in height and 35 feet³ in girth, with thick spreading horizontal branches; bearing a flattened crown of foliage. Bark speedily scaling on young stems; on old trunks, greyish brown, rough, irregularly fissured and very scaly. Buds large, globose, brownish, covered with resin, which conceals the keeled obtuse scales. Young shoots reddish brown with prominent pulvini, separated by deep grooves; pubescence short, erect, reddish, confined to the grooves and not spreading over the pulvini. In the second year's shoot the pulvini and grooves are more marked, the pubescence being retained.

Leaves on lateral branchlets pectinately arranged, in two lateral sets, each of several apparent ranks; the lower ranks on each side extending outwards in the horizontal plane; the upper ranks, with leaves becoming gradually shorter, directed outwards and upwards, and forming a V-shaped depression, in the bottom of which the upper side of the branchlet is plainly visible. Leaves 1 to 2½ inches long, ⅓ to ⅓ inch wide or more, linear, flattened, uniform in width except at the shortly tapering base, rounded and bifid at the apex; upper surface dark green, shining, with a continuous median groove and without stomata; lower surface with two broad conspicuously white bands of stomata; resin-canals marginal. Leaves on cone-bearing branchlets similar to those on barren branchlets.

Cones on short stout stalks, resembling in shape and colour those of *A. Pindrow*; in native specimens both from Sikkim and Kumaon, smaller than those on cultivated trees; scales fan-shaped, about ⅞ inch wide and ⅝ inch long (not including the short obtuse claw); bracts extending to near the upper edge of the scale, with an oblong claw, expanding above into a suborbicular denticulate lamina, tipped with a

¹ In *Journ. Roy. Hort. Soc.* xiv. 472 (1892).

² *Silva N. Amer.* xii. 98, *adnot.* (1898). The trees, however, at Wellesley, one of which is 59 feet by 5 feet, were slightly injured during the severe winter of 1903-4. Cf. Sargent, *The Pinetum at Wellesley in 1905*, p. 12.

³ Hooker, *Him. Journ.* ii. p. 108.

short triangular cusp and without any emargination. In cultivated specimens, cones very large, 6 to 8 inches long, 2 to 3 inches in diameter, bluish when growing, brownish when mature, cylindrical, slightly tapering to an obtuse apex; scales much broader than in wild specimens (1¼ inch); bracts only extending to about half the height of the scale, with a broad rectangular claw, only slightly narrower than the broadly ovate denticulate lamina, which is tipped with a short triangular cusp: seed with wing about an inch long; wing broadly trapezoidal, shining brown, and about 1½ times as long as the seed.

The cones of *Abies Pindrow* are very similar, the main difference being that in the latter the expanded portion of the bract is situated close to the lower edge of the scale, and is oval, less finely denticulate, and emarginate above with a minute mucro in the emargination.

VARIETIES

The above description, which, as regards the leaves and branchlets, applies to ordinary cultivated specimens of *Abies Webbiana*, also fits exactly the form of that species which occurs in Sikkim, and does not differ from the original description which was founded on specimens from Nepal. The high-level silver fir, however, which occurs in the western Himalayas appears to be a much shorter-leaved tree than that which is common in Sikkim; and has been supposed by some to be a form of *Abies Pindrow*. This form, which is apparently the same as specimens collected on the Chor mountain near Simla by Sir George Watt, is met with occasionally in cultivation, and may be distinguished as follows:—

Var. *brevifolia*,¹ a tree with smooth bark on the stem and branches. Young branchlets grey, with only slightly prominent pulvini; pubescence short, erect, brown, confined to the indistinct fine grooves between the pulvini. Leaves much shorter than in the type, not exceeding 1¼ inch in length, greyish beneath with two inconspicuous stomatic bands.

This variety differs in appearance from the type, which has longer leaves, very silvery white beneath; but agrees with it in the arrangement, texture, and shape of the leaves. The grey colour and comparative smoothness of the branchlets, and the smooth bark on the stem and branches, suggest some affinity with *A. Pindrow*; but the long, slender, narrow leaves of the latter species, differently arranged on the glabrous branchlets, are entirely different.

I first received cultivated specimens of this variety from Glasnevin, Kilmacurragh, and Batsford Park, where there are young trees, which have not yet produced cones. The Glasnevin and Kilmacurragh trees were raised from seed, sent from the Himalayas in 1879, but without any record of the precise locality; and they resemble the type in habit. The origin of the Batsford tree is obscure.

¹ Brandis, in *Indian Trees*, 692 (1906), distinguishes two forms of *A. Webbiana*, viz. :—

(a) "*A. Webbiana*, Lindley. High Level Silver Fir of N.W. Himalaya." This is identical with our var. *brevifolia*, and is not the same as *A. Webbiana*, Lindley.

(b) "*A. densa*, Griffith. East Himalayan Silver Fir." This, from a comparison of type specimens in the Kew Herbarium, is identical with *A. Webbiana*, Lindley, which was founded on *Pinus Webbiana*, Wallich, described from Nepal specimens.

A tree of this variety, with smooth bark on the trunk and branches, is growing at Powerscourt, and measured in 1906, 58 feet high by 5 feet 5 inches in girth. It bore numerous cones, similar to those of the type, but smaller in size and not so blue in colour. Another tree, about 40 feet high, also with very smooth bark, is growing at Holker Hall, Cark-in-Cartmel, Lancashire. (A. H.)

DISTRIBUTION

Abies Webbiana occurs in the inner Himalayas from Afghanistan to Bhutan at elevations of 10,000 to 14,000 feet, but rare¹ below 11,000 feet. In its western area, *i.e.* in the north-west Himalaya, it usually commences to grow at 1000 to 2000 feet above the line where *Abies Pindrow* disappears; and Gamble has never seen the two species growing together. It is here usually stunted and gnarled, with very short leaves and short thick cones, and occurs commonly with *Betula utilis* and *Rhododendron campanulatum*. Both it and the birch are the last trees to be seen before the treeless snowy wastes begin in the western Himalayas. In Nepal, according to Don, it occurs on Gosainthan.

In its eastern area, Bhotan and Sikkim, it is apparently a larger and finer tree. Griffith² mentions it, under the temporary name of *Abies densa*, as constituting vast forests in Bhotan, remarkable for their sombre appearance, at 12,000 feet, being rare under 9500 feet.

It is slow in growth, the average rate in Sikkim being about 12 rings per inch of radius, and is of much less economic importance than *Abies Pindrow* is in the north-west. Large quantities of planks, however, are exported from Lachoong to Tibet, and their preparation is an important native industry; but Hooker³ says that the timber of Sikkim conifers is generally soft and inferior to that of European species.

In Sikkim this is the most abundant conifer in the interior; extending from a little above 8000 to 13,000 feet or more; at its lower limits scattered or isolated among other trees at 9000 to 11,000 feet, and forming forests which are sometimes almost pure, or in the Lachen and Lachoong valleys mixed with *Tsuga Brunoniana*. Higher up on drier slopes it occurs scattered among *Larix Griffithi* and many species of shrubs and rhododendrons. On the Singalelah range which divides Sikkim from Nepal it begins to appear shortly before reaching Sandukpho, and on the boundary ridge north of that hill assumes a very wind-swept and often gnarled habit; the tops being often broken and covered with a dense mass of ferns, orchids, *Ribes*, begonias, and climbing plants of many species, and sometimes supporting shrubs and trees, which, favoured by the extremely moist summer climate, and from June to October almost constantly bathed in mist, become epiphytic. One tree which I specially noticed on this ridge at about 11,000 feet, bore on its decaying crown no less than four good-sized shrubs of different species, a *Pyrus*, an

¹ As in the Chor Hills, south of Simla.

² *Notule*, iv. 19 (1854), and *Itin. Notes*, ii. 141 (1848). Griffith subsequently abandoned his name *A. densa* and adopted that of *A. Webbiana*.

³ *Himalayan Journals*, ii. 45, note.

Aralia, a *Rhododendron*, and a birch, some of which had stems as thick as my leg. Plate 215 from photographs taken by my late friend, Mr. C. B. Clarke, at this spot, very well represents the trees I saw. The largest trees which I have found of this species were on the track from Lachoong to the Tunkra Pass, leading into the Chumbi valley, some of which must have been nearly 200 feet high, with stems clean up to 40 feet, and Sir Joseph Hooker measured a tree here no less than 35 feet in girth. Higher up, however, it assumes a stunted form and grows mixed with junipers.

HISTORY AND CULTIVATION

Abies Webbiana was discovered early in the nineteenth century by Captain Webb. Seeds were repeatedly sent to England by Dr. Wallich, which probably came from Nepal, but none appear to have germinated till 1822, when some plants were raised in the Fulham Nursery. It is remarkable that most of the trees of *A. Webbiana* seen in this country resemble more nearly the Sikkim form, than the short-leaved Western form. It is probable that none of the original trees now exist, as they were planted in the vicinity of London, where the tree does not thrive, as it is very liable to be cut by spring frosts.

Though this tree is one of the most beautiful of its genus in the few parts of England where it really succeeds; and will resist severe winter frosts without injury when on well-drained soil, yet its tendency to start into growth before the danger of spring frosts has passed, has caused its death in very many places. If seeds could be procured from the more alpine regions of Kashmir or the trans-Indus mountains, they might endure our climate better, but most of the trees now growing in England were probably raised from seed collected by Sir J. D. Hooker in Sikkim.

It ripens seed, however, in some parts of England and Scotland, and I have raised seedlings in 1901 from cones grown near Exeter, of which a few have survived though now not more than a foot high. A shady, elevated, and yet sheltered situation, is best for this species, and as regards soil a deep sandy loam.

REMARKABLE TREES

The largest specimen of *A. Webbiana* recorded at the Conifer Conference in 1891 was at Howick Hall, Northumberland, the seat of Earl Grey, and was then said to be 51 feet by 8 feet. I am informed by Mr. Lambert that it has lost its leader several times since this date, and now measures about 50 feet by 8½ feet.

The largest we have measured is a double-stemmed tree at Beauport, Sussex, 64 feet by 8½ feet in 1904; but Mr. A. B. Jackson found a tree at Tregothnan in Cornwall which was 74 feet by 8½ feet, and another tree at the same place 66 feet by 9 feet. Both of these bore cones in 1908.

At Menabilly, Cornwall, there is a healthy tree of no great size, which bore large cones in 1907, and these remained in perfect condition on the tree in April 1908, when I visited the place; and at Pencarrow there is one 64 feet by 6½ feet.

At Fulmodestone, Norfolk, in a wood where the Earl of Leicester has planted on a deep moist soil a large number of conifers, close enough to shelter each other, a tree was measured by Henry in 1905 as 69 feet by 6½ feet. It has since been much damaged by snow, but has produced cones from which Capt. R. Coke has raised a few seedlings, and now measures only about 60 feet high.

At Enville Hall, Stourbridge, there is a tree, which now looks as if it were suffering from drought. It measured, in 1904, 68 feet by 5 feet 4 inches.

A large tree, said to have been about 75 feet high, died and was cut down at Penrhyn in North Wales in 1902. The stump, which I saw, was about 7½ feet round. At Hafodunos, in North Wales, Colonel Sandbach states that this species is always nipped by the frost and forms new leaders when the old ones are killed, the growth being quite checked.

At Castle Kennedy there is a short avenue of trees of this species, averaging about 40 feet high by 6 feet in girth; but the tops had been cut off, as they had become bare and unsightly from exposure to wind. Here *A. Webbiana* begins to produce cones at an early age; and there is a seedling 20 feet high, with many smaller ones near it.

At Poltalloch, Argyllshire, I measured a fine healthy tree 61 feet by 5 feet 3 inches which in 1906 bore no cones.

At Keir, Perthshire, there are two trees, one with a broken top, the other 57 feet by 4 feet 10 inches, and more narrowly pyramidal than is usually the case. Seedlings were raised from the seed of this tree about ten years ago; but as a rule it bears very small cones (only 3 inches in length) with unfertile seed. A tree at Dunphail, Morayshire, has also produced small cones, which slightly resemble those of *Abies Mariessii*.¹ This tree was probably planted in 1856, and is now only 33 feet in height; but has a double leader.²

In Ireland, *A. Webbiana* thrives well, and there is a good number of fair-sized trees. It is said, however, to be slightly touched by frost at Fota, in the south of Ireland, where the temperature fell to 14° Fahr. during four nights in the winter of 1901-1902. A tree at Fota was in 1903, 47 feet high by 3 feet 7 inches in girth.

At Churchhill, Armagh, the seat of Mr. Harry Verner, there was growing in 1904 a tree laden with cones, even on the lowermost branches; it measured 53 feet by 4 feet 10 inches.

At Courtown, Co. Wexford, a tree was recorded at the Conifer Conference of 1891, as being 52 feet by 6 feet 3 inches. (H. J. E.)

¹ The Dunphail tree has been described and figured by Masters as *Abies Mariessii*, in *Bot. Mag.* t. 8098; but there is no doubt that this is erroneous. Specimens which I have seen show ordinary foliage and branches of *A. Webbiana*; and some of the cones are as large as those usually produced by this species.—(A. H.)

² Thrives at Durrís only in partial shade, when exposed it suffers much from late spring frosts, both top and branch shoots become clubbed and unsightly. Cones at a comparatively early age—about 25 years. Is of no economic value.

(J. D. CROZIER.)

ABIES PINDROW, PINDROW FIR

Abies Pindrow, Spach, *Hist. Vég.* xi. 423 (1842); Masters, *Gard. Chron.* xxv. 691, f. 154 (1886); Kent, Veitch's *Man. Coniferae*, 533 (1900); Gamble, *Indian Timbers*, 719 (1902); Brandis, *Indian Trees*, 692, 720 (1906).

Abies Webbiana, Lindley, var. *Pindrow*, Brandis, *Forest Flora Brit. India*, 528 (1874); Hooker, *Flora Brit. India*, v. 655 (1888).

Pinus Pindrow, Royle, *Illust. Bot. Himalaya*, 354, t. 86 (1839).

Picea Pindrow, Loudon, *Arb. et Frut. Brit.* iv. 2346 (1838).

A tree attaining in the Himalayas over 200 feet in height, with a girth of 25 feet. Narrowly pyramidal in habit, with the branches small and short. Bark smooth and silvery grey when young; greyish brown, deeply and longitudinally fissured on old trunks.

Buds large, globose, covered with white resin. Young shoots quite smooth, grey, glabrous, the bark fissuring slightly in the second year. Leaves on lateral branches mostly pectinate below, pointing forwards and outwards in the horizontal plane, some of the median leaves, however, being directed downwards and forwards; above, covering the shoot, those in the middle line much shorter and directed forwards and slightly upwards. Leaves, soft in texture, up to 2½ inches long, very narrow ($\frac{1}{16}$ inch wide), linear, flattened, shortly tapering at the base and narrowing gradually in the anterior third to the acute apex, which is bifid with sharp unequal cartilaginous points; upper surface dark green, shining, with a continuous median groove and without stomata; lower surface paler with two greyish bands of stomata, each of about eight lines; resin-canals marginal. Leaves on cone-bearing shoots all upturned and more or less directed forwards, covering the shoot in the middle line above, shorter than on barren branches and only slightly bifid at the apex.

Cones on short stout stalks, bluish when growing, brown when mature, cylindrical, about 6 inches long by 3 inches in diameter. Scales; lamina about 1¼ inch wide by ¾ inch long, fan-shaped, variable in form, with two slight wings in cultivated specimens, not winged and with the lateral edges straight or curved in wild specimens, base auricled. Bracts with the expanded portion situated on the scale just above the claw, oval, denticulate, emarginate above with a minute mucro. Seed with wing about 1 inch long, the wing narrowly trapezoidal and about 1½ times as long as the body of the seed.

IDENTIFICATION

Abies Pindrow is remarkably different in most characters from *Abies Webbiana*, with which it has been united by many authors. The trees are very distinct in habit, *A. Pindrow* forming, both in the Himalayas and in cultivation in England, a narrow pyramid with short branches; while *A. Webbiana* is a broader tree with wide-spreading branches. The bark of the former is smooth, that of the latter scaly. The former has smooth, glabrous, grey shoots; the latter has shoots with

prominent pulvini, separated by pubescent furrows. The cones are similar in size and colour; but differ in the shape and position of the bracts. The arrangement and character of the foliage are entirely different.

Var. *intermedia*.

Pinus (Abies) sp. nova (?), M'Nab, in *Proc. Roy. Irish Acad.* ii. 692, f. 19 (1876).

A tree at Eastnor Castle, planted thirty-seven years ago, and about 60 feet in height with a girth of 3 feet 4 inches, is apparently identical with the form described by M'Nab, who mentions two specimens, one collected in the western Himalayas by Hooker and Thomson, and another from a tree, which formerly grew at Castle Kennedy. Mr. Mullins, the gardener at Eastnor Castle, informs me that the tree is narrowly pyramidal in habit, with dark green foliage, and smooth bark on the stem and branches.

Specimens, which I have received, show the following characters:—Branchlets, buds, bark, and habit, as in *A. Pindrow*. Leaves more pectinate than in that species, and arranged on the branchlets as in *A. Webbiana*; about $2\frac{1}{8}$ inch in maximum length, dark shining green above; gradually tapering in the upper third, as in *A. Pindrow*; thicker than in this species; lower surface convex; resin-canals median, in which respect this variety differs from both *A. Pindrow* and *A. Webbiana*. Cones about 4 inches long and 2 to 3 inches in diameter, resembling those of *A. Webbiana* in the position and shape of the bracts.

This variety is intermediate in many respects between *A. Pindrow* and *A. Webbiana*, and is possibly a hybrid. (A. H.)

DISTRIBUTION

Abies Pindrow is more restricted in distribution than *A. Webbiana* and occurs at a lower elevation. It is met with in the outer Himalayas from Chitral to Nepal, at elevations of 7000 to 9000 feet, occasionally ascending to 10,000 feet; and commonly grows in ravines with a northerly or westerly aspect. It is often associated with *Picea Morinda*, *Quercus dilatata*, the deodar, and *Pinus excelsa*; but more often is accompanied by broad-leaved trees, such as the walnut, maples, bird cherry, and Indian horse-chestnut. Madden says that it forms dense forests on all the great spurs of Kumaon and occurs in Kashmir. According to Gamble, it has the same narrowly pyramidal habit with short branches which it assumes in cultivation in England. It grows very tall, but does not attain so great a height as the deodar. The largest trees correctly noted were measured in the Mundali forest in Jaunsar, and had heights varying from 188 to 206 feet with girths of 19 to 25 feet. The rate of growth averages 13 rings per inch of radius. It bears intense shade and its natural reproduction is excellent. The timber is employed indiscriminately with that of *Picea Morinda*, though not quite so good. It is used for planking, tea-boxes, packing-cases, and makes excellent shingles, and would be suitable for railway sleepers if creosoted.

REMARKABLE TREES

The finest trees in Britain are probably two, which I saw in 1906, growing in the grounds of Mr. Victor Marshall at Monk Coniston, the largest of which is now 69 feet high and 4 feet 9 inches in girth. The climate here is mild and damp, but the soil dry and slaty. Mr. S. A. Marshall wrote to Kew that one of these trees coned for the first time in 1902, and in 1904 produced many cones.¹

There is a well-shaped tree at The Coppice, Henley, the seat of Sir Walter Phillimore, Bart. It came from Dropmore as a young plant in 1858, and grew very slowly at first, sustaining some damage from the frost of May 1867. It is now healthy and thriving, and measured, in 1907, 62 feet high by 3 feet 8 inches in girth. At Bury Hill, Dorking, the seat of R. Barclay, Esq., there is a well-grown specimen, which he informed me had been raised from a tree at Denbies in the same neighbourhood, and which in 1908 measured 58 feet by 3 feet 2 inches. It grows, like so many of the best conifers in this country, on greensand. At Dropmore, a tree 48 feet by 3 feet 10 inches in 1905, coned for the first time in 1907. At High Canons, Herts, Mr. H. Clinton Baker measured a tree, which was bearing cones in February 1908, as 48 feet high by 2 feet 8 inches in girth; and in a wood, on his own property at Bayfordbury, there is a thriving young tree, 32 feet high and 1 foot 5 inches in girth. At Cuffnells, near Lyndhurst, a good-sized but badly-grown tree was bearing cones in 1907. At Leighton Hall, near Welshpool, the seat of Mrs. Naylor, there are three, at a considerable elevation, the best of which in 1908 was about 50 feet high. In the pinetum at Lyndon Hall, Oakham, Rutland, Henry measured in 1908 a fine specimen, 58 feet by 3 feet 3 inches, which was planted, according to Mr. E. L. P. Conant, by his father in 1864.

In Scotland I measured a tree at Conon House in Ross-shire, in 1907, which was about 50 feet by only 3 feet 4 inches. At Smeaton-Hepburn, East Lothian, a tree planted in 1844, according to Sir Archibald Buchan-Hepburn, Bart., was, in 1908, 56 feet high by 4 feet 1 inch in girth. Seedlings have been raised from it. At Durris, Mr. Crozier says that it suffers from the same causes as *A. Webbiana*. In Wigtownshire, this species is tender, and a tree at Galloway House, 48 feet by 3 feet 10 inches, as measured by Henry in 1908, has been much injured by frost. Sir Herbert Maxwell reports a good specimen at Stonefield, Loch Fyne; and another, in the Quarry garden at Gordon Castle, which measures 69 feet by 4 feet 9 inches.

In Ireland, the tallest tree is at Charleville, Co. Wicklow, the seat of Viscount Monck. In 1904 it was 60 feet by 5 feet 1 inch. It produced cones in 1903, and since then has been in an unhealthy state. This tree has sent forth from the stem epicormic branches. At Kilmacurragh, Co. Wicklow, the seat of Mr. Thomas Acton, there is a healthy tree, which, in 1904, was 51 feet high by 5 feet 5 inches. At Powerscourt, there are two good trees, one 55 feet by 5 feet in 1904, which bore cones in 1902, 1903, and 1904; the other is 42 feet by 6 feet 3 inches in girth. At Brockley Park, Queen's County, a tree, planted thirty-five years ago, measured in 1907, 51 feet by 5 feet 6 inches. (H. J. E.)

¹ A tree at Kenfield Hall, near Canterbury, produced cones in 1886. Cf. *Gard. Chron.* xxvi. 85 (1886).

ABIES SIBIRICA, SIBERIAN FIR

Abies sibirica, Ledebour, *Fl. Alt.* iv. 202 (1833); Masters, *Journ. Linn. Soc. (Bot.)* xviii. 519 (1881); Kent, *Veitch's Man. Coniferae*, 539 (1900).

Abies Pichta, Forbes, *Pin. Woburn.* 113, t. 39 (1840).

Abies Semenovii, Fedtschenko, *Bot. Centralblatt*, lxiii. 210 (1898), and *Bull. Herb. Boissier*, vii. 191 (1899).

Pinus sibirica, Turczaninow, *Bull. Soc. Nat. Mosc.* xl. 101 (1838).

Pinus Pichta, Endlicher, *Syn. Conif.* 108 (1847).

Picea Pichta, Loudon, *Arb. et Frut. Brit.* iv. 2338 (1838).

A tree attaining about 100 feet in height. Bark smooth, greyish, and covered with resin-blisters, even in old trees. Buds small, globose, brownish, smooth, and covered with resin. Young shoots ashy-grey, with a scattered minute erect pubescence, quite smooth, the pulvini not being at all prominent; in the second year, the bark fissures slightly, and the pubescence is retained.

Leaves on lateral branches resembling in arrangement those of *A. Veitchii*, but more irregular; the lower ones pectinate, and directed outwards and forwards, a few, however, in the middle line with their apices directed forwards and downwards; on the upper side the leaves cover the branchlet and are directed forwards and upwards in the middle line, being about three-fourths the length of the lower leaves. Leaves linear, flattened, slender, up to $1\frac{1}{2}$ inch long, $\frac{1}{20}$ inch wide, uniform in width except at the slightly narrowed base; apex rounded, slightly bifid or entire; upper surface light green, shining, with a continuous median groove and rarely two to three short lines of stomata near the apex in the middle line; lower surface greyish in colour, with two narrow bands of stomata, each of four to five lines; resin-canals median. Leaves on cone-bearing branches all upturned, curved, thick, short ($\frac{3}{4}$ inch long), acute at the apex.

Cones sessile, cylindrical, obtuse at the apex, 2 to 3 inches long, $1\frac{1}{4}$ inch in diameter, bluish when growing, brown when mature, with the bracts concealed. Scales; lamina fan-shaped, thin, $\frac{5}{8}$ to $\frac{3}{4}$ inch wide, $\frac{1}{2}$ inch long; upper and lateral margins denticulate; base with a sinus on each side of the obtuse claw. Bract, at the base of the scale, rectangular or reniform, coarsely denticulate, $\frac{3}{16}$ inch broad, with a short triangular mucro. Seed with wing about $\frac{5}{8}$ inch long; wing broad, purplish, about twice as long as the body of the seed.

The form¹ described by Fedtschenko as a new species (*A. Semenovii*) occurs in Turkestan. Specimens show longer leaves, more pubescent branchlets, and slightly different cone-scales and bracts. Korshinsky, however, in a note in the Kew herbarium, states that the Turkestan tree is identical with *A. sibirica* from the Ural and Altai; and the differences noted would probably disappear if there were more material to examine.

A weeping variety of this species was seen by Conwentz² in 1881 in Regel and Kesselring's nursery at St. Petersburg.

This species, with long slender leaves covering the branchlet above, is best

¹ Cf. Guinier and Maire's remarks on this form in *Bull. Soc. Bot. France*, lv. 184 (1908).

² *Seltene Waldbäume in Westpreussen*, 161 (1895).

distinguished by its ashy-grey smooth shoots which are minutely pubescent, and its small globose resinous buds. It can only be confused with *A. sachalinensis*, which has shoots with prominent pulvini, and leaves with broader and whiter bands of stomata below. *A. lasiocarpa*, which has, like this species, median resin-canals, is distinguished by the peculiar arrangement of the leaves, which have conspicuous lines of stomata on their upper surface.

DISTRIBUTION AND CULTIVATION

This species is the most widely distributed of all the silver firs, occupying large areas of both the plains and mountains of north-eastern Russia and Siberia. In European Russia it forms forests in company with spruce and larch, or rarely with birch and aspen; and occurs through the governments of Archangel, Vologda, Kostroma, Perm, Ufa, Kazan, and Orenburg. On the mountains it does not go as high as the timber line, and does not extend so far south in European Russia as the spruce. It is common in the Ural range, and attains perhaps its maximum development in the Altai,¹ where it forms vast forests between 2000 and 4500 feet elevation. In Turkestan it is found in the Thianshan mountains, and is reported by Korshinsky to form forests at low altitudes in the province of Ferghana, where it grows in mixture with *Picea Schrenkiana*. Its distribution in Siberia is not clearly known, but it appears to be widely spread from west to east, its northern limit on the Yenisei being 66° lat. and on the Lena 60° lat. It occurs on the high lands of Dahuria, and, according to Komarov, reaches its most easterly point in the Yablonoi mountains, being replaced in Kamtschatka, by *A. gracilis*, Komarov; and on the borders of the sea of Okhotsk and in Manchuria by *A. nephrolepis*, Maximowicz.

According to Loudon this species was introduced from the Altai into England in 1820. It is very rare in cultivation, and does not grow for any length of time in the south of England, where the climate is unsuitable to it. Even at Durris, Mr. Crozier describes it as "a slow-growing, many-headed, and evidently short-lived tree." There is an unhealthy specimen, about 15 feet high, at Ochtertyre in Perthshire. At Pampisford, Cambridgeshire, there is a small tree, 30 feet high by 13 inches in girth in 1907, narrowly pyramidal in habit, with the lower branches layering and producing five independent stems about six feet in height. This tree has been badly damaged by the snowstorm of April 1908. Another at Bicton measured 28 feet by 1 foot 8 inches in 1908.

In August 1908 I saw a fine specimen in the University Botanic Garden, Upsala, Sweden, which was 70 feet high and 1 foot in diameter, forming a very narrow pyramid, closely resembling the habit of *A. Pindrow*. Hansen² says that specimens, forty years old, have attained a height of about 40 feet in Denmark; and that there are beautiful examples in the Botanic Gardens at Helsingfors, Finland (lat. 60°), where many seedlings have sprung up around the old trees. (A. H.)

¹ I saw this tree in the forests on the north slopes of the Altai, where the climate was damp, but it did not strike me as a fine or large tree, and was not seen in the drier valleys towards Mongolia.—(H. J. E.)

² *Journ. Roy. Hort. Soc.* xiv. 477 (1892).

ABIES SACHALINENSIS, SAGHALIEN FIR

Abies sachalinensis, Masters, *Gard. Chron.* xii. 588, f. 97 (1879), and *Journ. Linn. Soc. (Bot.)* xviii. 517 (1881); Mayr, *Abiet. jap. Reiches*, 42, t. 3, f. 6 (1890); Sargent, *Forest Flora of Japan*, 83 (1894); Kent, *Veitch's Man. Coniferae*, 537 (1900).

Abies Veitchii, Lindley, var. *sachalinensis*, F. Schmidt, *Mém. Acad. St. Pétersbourg*, sér. 7, xii. 175, t. 4, ff. 13-17 (1868).

A tree attaining in Yezo 130 feet in height. Bark smooth, grey in colour. Buds small, ovoid-globose, rounded at the apex, covered with white resin. Young shoots grey, with prominent pulvini and grooves; pubescence, short, dense, and confined to the grooves. In the second year the pulvini, grooves, and pubescence are well-marked.

Leaves on lateral shoots arranged similarly to those of *A. Nordmanniana*; those below longest, pectinate in two sets in the horizontal plane, directed outwards and forwards; those above covering the branchlet in imbricated ranks, the median leaves shortest, directed forwards and appressed to the shoot. Leaves linear, flattened, slender, very thin, about $1\frac{1}{2}$ inch long, $\frac{1}{20}$ inch wide, uniform in width except at the shortly tapering base; apex rounded and shortly bifid; upper surface grass-green, shining, with a continuous median groove and without stomata; lower surface with two narrow bands of stomata, each of seven to eight lines; resin-canals median. Leaves on cone-bearing shoots up-turned, acute or rounded at the minutely bifid apex.

Cones, $3\frac{1}{2}$ inches long, $1\frac{1}{4}$ inch in diameter, cylindrical, tapering to an obtuse or slightly acute apex, conspicuously marked externally by the reflexed greenish bracts, which leave little of the surface of the scales visible. Scales crescentic, small; lamina, $\frac{1}{2}$ to $\frac{5}{8}$ inch wide, nearly $\frac{1}{4}$ inch long, deeply auricled by two basal sinuses, the denticulate wings ending in a sharp point on each side of the sinus; upper margin entire; outer surface densely tomentose. Bract with a broad cuneate claw, expanding above into an almost orbicular lamina, emarginate and mucronate on its upper margin. Seed with wing $\frac{3}{8}$ inch long; wing broader than long and shorter than the body of the seed.

VARIETIES

Var. *nemorensis*, Mayr, *loc. cit.* This variety is met with in north-eastern Yezo and the Kurile Isles, and is distinguished by its smaller cones, about $2\frac{1}{2}$ inches in length, with minute concealed bracts. In the cones this variety resembles *A. Veitchii*.

Sargent mentions a curious variety found by Miyabe in central Yezo, in which the bark, wood, and bracts of the cone are red in colour.

IDENTIFICATION

Abies sachalinensis agrees in many technical characters with *A. Veitchii*, but owing to its longer and more slender leaves looks different from that species, and would

not in practice be confused with it. The prominent pulvini of the young branchlets, which are only pubescent in the grooves, will distinguish it at once from *Abies sibirica*, which it resembles in general appearance. The latter species has quite smooth branchlets, provided with a scattered minute pubescence. (A. H.)

DISTRIBUTION AND CULTIVATION

This species was discovered in the Island of Saghalien by Schmidt in 1866, and was subsequently found, in 1878, in Yezo by Maries, who sent home seeds in the following year.¹ The tree is known in Japan as *Todo-matsu*.

It is a native of the Kurile Islands, Saghalien, and the northern island of Japan.² In Saghalien it either forms pure woods or is mixed with one or both of the spruces (*Picea ajanensis* and *Picea Glehnii*) which occur in that island.

This is the common, and perhaps the only, silver fir of Hokkaido, where it extends from nearly sea-level up to 4000 or 5000 feet altitude, and all over the island in suitable places; in the south usually as a scattered tree in mixed forests of deciduous trees; in the north and some parts of the west central districts in dense pure forests, or with a mixture of birch and poplar. The finest areas of this species are in the Imperial domains at Tarunai, Uryu, Kushiro, and in the State forests at Shari, and Kunajiri. I endeavoured to visit some of these under the guidance of Mr. Shirasawa, but owing to the torrential rains which flooded the country in the middle of July and broke the railway in many places, I was unable to do so. The country where these forests occur is much like parts of eastern Siberia, having a hot, moist summer, a warm autumn, and a very heavy snowfall which lies for four to five months; the climatic conditions, therefore, are such that the tree is not likely to be a success in Great Britain, and, so far as I could see, it has no special beauty to recommend it. The largest that I saw were about 100 feet by 9 feet, but it grows taller in some places.

The timber is of fair quality, and is used in house- and ship-building, also for furniture and paper-making; and is worth at Tokyo about 10d. per cubic foot.

The Saghalien fir is rare in cultivation, the largest specimen we have seen being one at Fota, in the south of Ireland, which was about 25 feet high in 1907. It looks healthy, but begins to grow early in the season, and is said to be frequently hurt by spring frost. We have measured no specimens in Scotland, but one at Murthly Castle, about 16 feet high, is reported by Mr. Bean³ as not looking healthy. According to Kent, the tree is, like most of the conifers coming from similar climates, unable to thrive in England. In New England, however, it grows much better, and I saw healthy young trees at Mr. Hunnewell's place at Wellesley, Massachusetts. (H. J. E.)

¹ *Hortus Veitchii*, 337 (1906).

² It was reported by Matsumura (*Tokyo Bot. Mag.* xv. (1901), p. 141), to occur in Formosa, on Mt. Morrison; but this was a mistaken identification, as the silver fir in this locality is *A. Mariesii*, according to Hayata, in *Tokyo Bot. Mag.* xix. (1905), p. 45.

³ *Gard. Chron.* xli. 117 (1907).

ABIES FIRMA, JAPANESE FIR

Abies firma, Siebold et Zuccarini, *Fl. Jap.* ii. 15, t. 107 (1844); Masters, *Gard. Chron.* xii. 198, 199 (1879), and *Journ. Linn. Soc. (Bot.)* xviii. 514 (1881); Mayr, *Abiet. Jap. Reiches*, 31, t. 1, f. 1 (1890); Shirasawa, *Icon. Ess. Forest. Japon.*, text 17, t. 6, ff. 1-21 (1900); Kent, Veitch's *Man. Coniferae*, 506 (1900).

Abies bifida, Siebold et Zuccarini, *Fl. Jap.* ii. 18, t. 109 (1844).

Abies Momi,¹ Siebold, *Verhand. Batav. Gen.* xii. 101 (1830) (*nomen nudum*).

Pinus firma and *Pinus bifida*, Antoine, *Conif.* 70, 79 (1846).

Picea firma, Gordon, *Pinet.* 147 (1858).

A tree, attaining 150 feet in height and 16 feet in girth. Bark of branches and trunk early becoming scaly, in old trees fissuring into small plates. Buds small, ovoid, obtuse at the apex, brown, glabrous, slightly resinous. Young shoots brownish grey, with the pulvini slightly raised and separated by grooves; pubescence short, erect, scattered, confined to the grooves. Older shoots retaining the pubescence and fissuring between the pulvini, which are not very prominent.

Leaves on lateral branches pectinately arranged; those below extending laterally outwards in the horizontal plane; those on the upper side gradually shortening to nearly one-third of the length of the lower leaves, and directed in two sets laterally outwards and slightly upwards, forming a shallow V-shaped arrangement.² Leaves up to $1\frac{1}{2}$ inch long, linear, flattened, very coriaceous, shortly tapering to the base, broadest about the middle ($\frac{1}{8}$ inch or more), gradually narrowing to the acute apex, which ends in two sharp cartilaginous points, unequal in size; upper surface dark green, shining, with a continuous median groove and without stomata; lower surface with broad greyish bands of stomata, each of about ten to twelve lines; resin-canals close to the epidermis of the lower surface. Leaves on cone-bearing branches upturned, rounded and entire or only minutely bifid at the apex.

Staminate flowers, $\frac{1}{2}$ inch long, ovoid-conic, surrounded at the base by two to three series of broadly ovate scales.

Cones on stout short stalks, cylindrical, tapering shortly at the base, and obtuse or flattened at the slightly narrowed apex, yellowish-green before ripening, brown when mature, 4 to 5 inches long by $1\frac{1}{2}$ to $1\frac{3}{4}$ inches in diameter, with the tips of the bracts exerted between the scales but not reflexed. Scales: lamina $1\frac{1}{16}$ inches wide by $\frac{5}{8}$ inch long, broadly trapezoidal; upper margin thin, minutely denticulate; lateral margins convex, denticulate; base broad with a sinus on each side of the obtuse claw. Bract extending either nearly up to the edge of the scale or beyond it, always visible externally between the scales, oblong in the lower half, expanding above into an oval lamina, which ends in a triangular cusp. Seed-wing broadly trapezoidal, about twice the length of the body of the seed. Seed with wing nearly $\frac{7}{8}$ inch long. Cotyledons four.

¹ This name, which has been adopted by Sargent, *Silva N. Amer.* xii. 101, *adnot.*, was published without any description, and cannot be maintained. Cf. Masters, *Gard. Chron. loc. cit.*

² On vigorous shoots, the leaves are directed more upwards so that the V-shaped depression is very acute.

The broad coriaceous leaves, ending in two cartilaginous points of unequal size, and pectinately arranged, are characteristic of this species, which when once seen, can scarcely be confused with any other.

Abies holophylla, Maximowicz,¹ which has been identified by Dr. Masters with *A. firma*, is considered by Komarov,² the latest observer, to be a distinct species. It differs in the leaves not being bifid, and also in the bracts of the cone, which are short, scarcely extending more than one-third the length of the scale. This species, according to Komarov, attains 150 feet high, and grows in mountain woods at elevations not exceeding 1800 feet above sea-level, in the Manchurian provinces of Ussuri, Kirin, and Mukden, and also in northern Korea. It was introduced into cultivation in Russia by Komarov, who sent seeds in 1898.

Other specimens of *Abies* from the Chinese provinces of Hupeh, Shensi, and Yunnan³ have also been considered by Dr. Masters to be *A. firma*; but this identification is doubtful. (A. H.)

DISTRIBUTION

This, the best known fir in Japan, is widely distributed in the south, and, according to Mayr, does not extend north of lat. 40°, and attains perfection in the warm sub-tropical provinces of Kii, Shikoku, and Kiusiu. It is very commonly planted in temple grounds and parks, but few of these specimens looked as if the isolated situation agreed with them; and wherever I saw the tree growing naturally, it was scattered among deciduous trees and other conifers in more or less shady places in the forest. It grows to a great size in the sheltered valleys and moist, deep soils of the central and southern provinces. I measured one at Myanohara, on the Nakasendo road near Wada, which was 135 feet by 16 feet, but this tree was dying at the top, and may have been planted or have been a natural seedling in a temple grove. Another in the forest near the entrance to Koyasan was about 120 feet high by 15 feet 9 inches in girth, but the average size of the mature trees that I saw was not over 100 feet by 9 feet. A third, growing close to a temple at Narai (Plate 216), measured 125 feet by $11\frac{1}{2}$ feet. As the timber is of little value except for packing-cases, tea-boxes, and pulp-wood, the tree is not much planted at the present time except for ornament. It reproduces itself freely from seed whenever the conditions are suitable, and its large greenish-yellow cones are fully formed in August.

According to Rein⁴ its natural habitat is from 1000 to 1500 metres, but though this may be the case in the southern island, I should say it was too high for the central provinces, as in Kisogawa I saw it much lower, and I do not think it there reaches 4000 feet.

This species was introduced into Europe in 1861 by J. Gould Veitch,⁵ but has never become common in cultivation, though it seems to be hardy even in some parts of Scotland. It undoubtedly requires a warm, moist climate to bring it to

¹ *Mél. Biol.* vi. 22 (1866).

² *Flora Manchuria*, 204 (1901).

³ *Journ. Linn. Soc. (Bot.)* xxvi. 557 (1902); and *Journ. Bot.* 1903, p. 270.

⁴ *Industries of Japan*, 235 (1889). Mayr says that it ascends to 700 feet in the north and to nearly 7000 feet in the south.

⁵ *Hortus Veitchii*, 335 (1906), where it is stated that it was also sent in 1878 by Maries.

perfection, and seems to be in most places a slow grower. The seedlings which I have raised from Japanese seed will not grow on my soil, from which I infer that lime is distasteful to them.

REMARKABLE TREES

The largest tree that we know of is at Carclew in Cornwall. This was reported in 1891 to be 45 feet by 2 feet 8 inches, and when I measured it in 1902 had increased to about 60 feet by 4 feet. Another at Pencarrow, in the same county, was about 59 feet by 6 feet 5 inches in 1908. At High Canons in Herts, Mr. Clinton Baker showed me a specimen which bore cones in 1907 and measured 47 feet by 3½ feet.

There is a good-sized tree at Grayswood, with longer and less sharp-pointed leaves than usual, and another at Tortworth which in 1905 was 30 feet by 3 feet 9 inches. A tree planted at Bagshot Park by the late Emperor of Germany on July 10, 1880, was, when I saw it in 1907, 36 feet by 3 feet 11 inches.

In Scotland¹ the best that we have seen is at Castle Kennedy, which, in 1904, Henry found to be 44 feet by 5 feet 5 inches. Another in a wood at Munches, Dalbeattie, was 30 feet by 2½ feet. Trees were reported to be growing in 1891² at Balmoral, and at Haddo House in Aberdeenshire, but we have not identified them.

In Ireland there were thriving trees at Fota 25 feet high, and bearing cones in 1907; at Hamwood, Co. Meath, 36 feet by 2 feet 10 inches in 1904; and at Powerscourt, which in 1906 was bearing cones, and measured 39 feet by 3 feet 11 inches.

(H. J. E.)

ABIES HOMOLEPIS

Abies homolepis, Siebold et Zuccarini, *Fl. Jap.* ii. 17, t. 108 (1844); Masters, *Gard. Chron.* 1879, p. 823, and *Journ. Linn. Soc. (Bot.)* xviii. 518 (1881).

Abies Tschonoskiana, Regel, in *Index Sem. Hort. Petrop.* 32 (1865).

Pinus Harryana, M'Nab, *Proc. R. Irish Acad.* ii. 689, Pl. 47, f. 16 (1876).

This species, imperfectly described by Siebold and Zuccarini, is considered by Mayr to be a form of *A. brachyphylla*. It is different in the pulvini of the branchlets, in the shape and arrangement of the leaves, and in the position of the resin-canals in the latter. Specimens in cultivation, described below, agree with the type of Siebold and Zuccarini's species in the Leyden Museum. The cones are unknown; and it is possible that it may be a juvenile form or variety of *A. brachyphylla*; but in the present state of our knowledge, it is best kept distinct.

¹ Has been tried at Durrus repeatedly, but does not live beyond a year or two. Quite unfitted for our climate.—(J. D. CROZIER.)

² *Gard. Chron.* x. 458 (1891).

As seen in cultivation at Kew, it is a small tree, resembling in bark and habit *A. brachyphylla*. The foliage, however, is rather like that of *A. firma*, and the tree is occasionally cultivated under that name.¹

Buds ovoid, obtuse at the apex, whitened with resin, much larger than those of *A. firma*. Young shoots grey, glabrous, with prominent pulvini and grooves, which become less marked in the second year.

Leaves on lateral branches arranged as in *A. firma*, those of the upper rank about half the length of those of the lower rank, linear, flattened, rigid and slightly coriaceous, up to about 1¼ inch long, 1½ inch wide (much narrower than in *A. firma*), tapering gradually to the base, and narrowing near the rounded or acute apex, which is bifid with two short unequal cartilaginous points; upper surface dark green, shining, with a continuous median groove and without stomata; lower surface with two raised narrow white bands of stomata, each of about eight lines; resin-canals marginal.

Though this species has been in cultivation² since 1876 or earlier, we have seen no large specimens; and are ignorant as to whether it changes in character as it grows older or is short-lived. Its distribution in Japan is not known.

(A. H.)

ABIES BRACHYPHYLLA, NIKKO FIR

Abies brachyphylla,³ Maximowicz, *Mél. Biol.* vi. 23 (1866); Masters, *Gard. Chron.* xii. 556 (1879), and *Journ. Linn. Soc. (Bot.)* xviii. 515 (1881); Hooker, *Bot. Mag.* t. 7114 (1890).

Abies homolepis,¹ Mayr, *Abiet. Jap. Reiches*, 35, t. 2 f. 3 (1890); Shirasawa, *Icon. Ess. Forest. Japon.* text 14, t. 3, ff. 1-12 (1900); and Kent, Veitch's *Man. Coniferae*, 513 (1900) (not Siebold et Zuccarini, *Fl. Jap.* ii. 17, t. 108 (1844)).

Pinus brachyphylla, Parlatore, in D.C. *Prod.* xvi. 2, p. 424 (1868).

Picea brachyphylla, Gordon, *Pinetum*, 201 (1875).

A tree attaining in Japan over 100 feet in height and 16 feet in girth. Bark fissuring and scaly on young branches and on the stems of young trees, becoming like that of a spruce on old trees. Buds ellipsoid or broadly conical, obtuse at the apex, smooth, brownish, resinous. Young shoots greyish, glabrous, with prominent pulvini, separated by deep grooves, the pulvini and grooves becoming more marked in older shoots.

Leaves on lateral branches pectinate; those below extending laterally outwards in the horizontal plane, with a few in the middle line directed forwards and downwards; those on the upper side of the branchlet directed upwards and outwards, in

¹ It is readily distinguishable from *A. firma* by its glabrous shoots, larger buds, and much less coriaceous and narrower leaves.

² M'Nab, *loc. cit.* mentions plants of this species, which were growing under the name of *A. Veitchii* in several nurseries.

³ The following description applies to the tree, described by Maximowicz, which is, in my opinion and that of Dr. Masters, very different from *Abies homolepis*, S. et Z., which is treated by us as a distinct species.

two lateral sets, separated by an acute V-shaped depression. Lower ranks with the longest leaves (about $\frac{7}{8}$ inch), those in the other ranks gradually diminishing in size as they approach nearer the middle line above. Leaves linear, flattened, uniform in width except at the gradually tapering base, about $\frac{1}{15}$ inch, rounded and slightly bifid at the apex; upper surface dark green, shining, with a continuous median groove and without stomata; lower surface with two broad conspicuously white bands of stomata, each of ten to twelve lines; resin-canals median.

Leaves on cone-bearing branches shorter than on barren branches, those on the upper side of the shoot crowded and directed upwards, so that the V-shaped depression between the lateral sets is scarcely visible.

Cones on short stalks, cylindrical, slightly narrowed at the base and apex, 4 inches long, $1\frac{1}{2}$ inch in diameter, purple when growing, brown when mature. Scales very thin and flat; lamina fan-shaped, $1\frac{1}{8}$ inch long by $\frac{3}{4}$ inch wide, upper margin entire, lateral margins with denticulate short wings; claw short and obtuse. Bract short, not extending half-way up the scale; with a sub-orbicular finely denticulate lamina, tipped by a minute mucro, and a short obtuse claw. Seed with wing about $\frac{3}{4}$ inch long, the wing about $1\frac{1}{2}$ times as long as the body of the seed. In cultivated specimens, the scales of the cone and the seeds are smaller than in wild specimens. The very thin flat scales with the short minutely denticulate bract distinguish well this species.

IDENTIFICATION

This species has short leaves very white underneath, with an acute V-shaped depression between the lateral sets on the upper side of the branchlet, and is best distinguished by the very prominent pulvini and grooves on the branchlets. The bark of the branches and young stems begins to scale very early, an unusual character in the silver firs, and conspicuous in this species, in *A. homolepis*, and in *A. Webbiana*. The resinous buds, glabrous shoots, and leaves with median resin-canals are additional points in the discrimination of *A. brachyphylla*.

(A. H.)

DISTRIBUTION

According to Mayr this tree occurs on the main island of Japan, between lat. 36° and 38° , in the interior of the mountainous provinces; where it attains its maximum development in the zone of the beech forests, some trees attaining as much as 130 feet in height. The Japanese informed Mayr that it was also present on the highest peaks of Shikoku; but Shirasawa limits its distribution to the central chain of Honshu above 3000 feet elevation, and says that it grows in mixture with broad-leaved trees.

To most Europeans it is the best known of the Japanese silver firs, as it grows abundantly at Chuzenji, a favourite tourist resort. Here at 4000 to 5000 feet it is

scattered through the forest of deciduous trees and attains a height of 100 feet or more, the largest that I measured being 105 feet high by 16 feet in girth, and 95 feet by 11 feet. Higher up the mountains it becomes mixed with *Abies Veitchii* and diminishes in size. Its range of distribution is not accurately known, for though Japanese botanists distinguish it from the other species, as *Dake-momi*, the foresters and woodmen, who call all silver firs *momi*, do not seem, so far as I could learn, to distinguish it from *A. Veitchii* and *A. Mariesii*.

CULTIVATION

The date of introduction of this tree is not certainly known. Kent gives it as about 1870, and Mr. H. J. Veitch tells me that he believes that the first seeds were sent by Dr. Regel from St. Petersburg, but it was at first grown under other names.

It seems to thrive in most parts of England as well as or better than the other Japanese firs, but neither the trees I have planted, nor the seedlings I have raised from Japanese seed, will live long on the calcareous soil at Colesborne; a moist climate in summer, and a deep sandy soil free from lime being apparently the most favourable conditions for its existence. At Kew it seems to grow faster than other firs.

At Pampisford, Cambridge, a narrow conical tree measured in 1907, 44 feet by 3 feet 6 inches. At Grayswood, Haslemere, a tree, obtained from Messrs. Veitch in 1882, measured in 1906, 41 feet by 3 feet 3 inches. Both these trees bear cones freely. A specimen at Bicton is about 47 feet high, and bore cones in 1902. There is a very thriving one on the lawn at Eridge Park, Kent, planted by the Duke of Manchester in 1885, which now measures 30 feet high by 3 feet. At Dropmore there is one which in 1908 was 32 by 2 feet. At Kew, where there are several thriving trees, this species first produced¹ cones in this country in 1887. At Pencarrow,² a tree measured 40 feet by 3 feet 10 inches in 1907.

In Scotland we have seen no specimen of any size.³

Kent figures a handsome tree at Castlewellan, Co. Down, which was about 35 feet high and coning freely in 1907. Henry measured one at Fota, which was, in 1903, 40 feet in height and 2 feet 8 inches in girth. Another at Glasnevin was, in 1906, 38 feet by 2 feet 6 inches.

This species⁴ is very hardy in eastern Massachusetts, U.S., where it has already produced cones. A tree in Mr. Hunnewell's pinetum at Wellesley was 35 feet high in 1905. (H. J. E.)

¹ *Gard. Chron.* ii. 248 (1887).

² This tree is figured under the erroneous name of *A. Veitchii*, in *Hortus Veitchii*, plate opposite p. 83 (1906).

³ *A. brachyphylla* seems in every way adapted for cultivation in the north of Scotland, but too little is yet known of rate of growth to enable an opinion to be formed of its economic value.—(J. D. CROZIER.)

⁴ Sargent, in *Silva, N. Amer.* xii. 102 *adnot.* (1898), and *The Pinetum at Wellesley* in 1905, p. 12.

ABIES UMBELLATA

Abies umbellata, Mayr, *Abiet. Jap. Reiches*, 34, t. 1, f. 2 (1890).

Abies umbilicata, Beissner, ex Mayr, *Fremdländ. Wald- u. Parkbäume*, 258 (1906).

This species is very imperfectly known; and there are no specimens in the Kew herbarium. The plants distributed in England some years ago under the name by Messrs. Veitch are identical with *Abies homolepis*, and, when seen by Mayr, were pronounced by him to be a form of *A. brachyphylla*.

According to Mayr this species is distinguishable with difficulty, when in the young state, from *A. brachyphylla*, with which it agrees in the disposition and form of the leaves, and in the characters of the buds and shoots. Mayr states, however, that the leaves are not so white underneath as in *A. brachyphylla*. I have received from Herr Späth of Berlin, a specimen of reputed *A. umbellata*, which agrees generally in buds, shoots, and foliage with *A. brachyphylla*; but has leaves slightly longer than, and not so conspicuously white beneath, as is usual in that species.

The cones, according to Mayr, resemble those of *A. firma*, and are very different in size, colour, scales, and bracts, from those of *A. brachyphylla*; and are described by him as greenish-yellow when growing, brown when mature, about 4 inches long by $1\frac{1}{2}$ inch in diameter, cylindrical, the flattened apex having in its centre a raised umbo; scales about $1\frac{1}{4}$ inch broad by $1\frac{3}{8}$ inch long; bracts narrowed in the middle, slightly shorter than the scales, only exerted at the base of the cone.

According to Mayr, this species is only found in a few localities in Japan, but grows in considerable quantity on Mount Mutsumine in the province of Musashi, where it occurs with *A. brachyphylla* in the beech forests. It grows also on the Iumonji-toge, leading from Musashi to Shinano, and is also probably not uncommon on the neighbouring mountains of Hida and Kai.

This species has been united by Sargent, Kent, and others with *A. firma*; but it is very different from that species in foliage and shoots. It is possibly a hybrid between *A. brachyphylla*, of which it has the foliage, and *A. firma*, which it resembles in its cones.

(A. H.)

ABIES VEITCHII, VEITCH'S FIR

Abies Veitchii, Lindley, *Gard. Chron.* 1861, p. 23; Masters, *Gard. Chron.* xiii. 275 (1880), and *Journ. Linn. Soc. (Bot.)* xviii. 515, t. 20 (1881); Mayr, *Monog. Abiet. Jap. Reiches*, 38, t. 2, f. 4 (1890); Kent, *Veitch's Man. Coniferæ*, 541 (1900); Shirasawa, *Icon. Ess. Forest. Japon.*, text 16, t. 5, ff. 23-42 (1900).

Abies Eichleri, Lauche, *Berlin. Gartenzeit.* 1882, p. 63.

Pinus selenolepis, Parlato, *DC. Prod.* xvi. 2, p. 427 (1868).

Picea Veitchii, Murray, *Proc. Roy. Hort. Soc.* ii. 347, ff. 52-62 (1862).

A tree, attaining 60 to 70 feet in height. Bark of trunk greyish and remaining smooth even in old trees. Buds small, subglobose, purplish, resinous. Young

branchlets smooth, brown, covered with moderately dense, short, erect pubescence, retained on the older branchlets, the bark of which becomes slightly fissured.

Leaves on lateral branches arranged almost as in *A. Nordmanniana*; those on the under side of the branchlet pectinate; those on the upper side shorter and covering the branchlet, the median ones pointing upwards and forwards, and not appressed so much as in *A. Nordmanniana*. Leaves, about $\frac{1}{2}$ to 1 inch long, $\frac{1}{16}$ inch wide, linear, flattened, gradually tapering to the base, uniform in width in the anterior half, with a truncate bifid apex; upper surface dark green, shining, with a continuous median groove and without stomata; lower surface with two conspicuously white, broad bands of stomata, in nine to ten lines; resin-canals median. On cone-bearing branches, the leaves are more crowded, and less plainly pectinate below, than is the case in barren branches.

Staminate flowers¹ $\frac{1}{4}$ inch long on a stalk of the same length; anthers stalked, connective developed into a saddle-shaped flap, from the back of which projects a horizontal or deflexed spur-like process.

Cones sessile or sub-sessile, cylindrical, flattened at the apex, 2 to $2\frac{1}{2}$ inches long, $\frac{3}{4}$ to 1 inch in diameter, bluish before ripening, brown when mature. Scales small; lamina $\frac{5}{8}$ inch wide, $\frac{3}{8}$ inch long, crescentic, with two lateral denticulate wings, which are separated from the narrow obtuse base by rounded deep sinuses. Bract as long as the scale, obtuse below, dilated above into a two-winged denticulate lamina, ending in a short mucro, slightly exerted and reflexed. Seed-wing very broad and short, scarcely the length of the body of the seed; seed with wing about $\frac{5}{8}$ inch long.

VARIETIES

Mayr distinguishes two forms of cones:—

1. Var. *typica*. Cones large, about $2\frac{1}{2}$ inches long; bracts exerted and reflexed.
2. Var. *Nikkoensis*. Cones small, 2 inches long; bracts scarcely visible, their fine points projecting only slightly between the scales.

Abies nephrolepis, Maximowicz,² has been united with *Abies Veitchii* by Masters, and is perhaps a geographical form of the latter species, occurring in Amurland. According to Maximowicz it differs in the leaves of cone-bearing branchlets being sometimes acute and not bifid, and in the smaller ovoid-cylindrical cones, the scales of which are longer than the bracts and less in size than those of the Japanese tree. This Manchurian tree has not apparently been introduced into cultivation and is still imperfectly known.

Abies Eichleri, Lauche, was supposed to have been raised from seeds sent from Tiflis to Potsdam; and was considered to be a new species from the Caucasus. Some error, however, had arisen, as the plants turned out to be identical with *Abies Veitchii*.

Abies Veitchii has been collected according to Beissner³ by Père Giraldi at

¹ Masters, *loc. cit.*
IV

² *Mtl. Biol.* vi. 22 (1866).

³ See *Journ. Linn. Soc. (Bot.)* xxvi. 557 (1902).
I

9800 feet elevation in the Peling Mountains in the province of Kansu in China. The identification of herbarium specimens of *Abies* is difficult, and the Kansu plant will probably turn out to be a new and distinct species.

IDENTIFICATION

This species, with leaves covering the branchlet on the upper side, which are very white beneath, truncate and bifid at the apex, and less appressed than is the case in *A. Nordmanniana*, is further characterised by its small resinous buds, median resin-canals in the leaves, and smooth branchlets with short erect pubescence. The distinctions between it and *A. Mariesii* are given under the latter species.

(A. H.)

HISTORY AND DISTRIBUTION

Abies Veitchii was discovered on Fuji-yama by J. Gould Veitch in 1860. According to Sargent¹ it was introduced by Mr. T. Hogg into Parson's nurseries in Flushing, New York, in 1876, and a plant raised there was 16 feet high in 1889. It was cultivated in the United States for a time under the name of *Abies japonica*. It was not known in England or on the continent until 1879, when seeds were sent home² to Messrs. Veitch by their collector Maries.

The best account of the distribution is given by Mayr, who considers the tree to be the typical silver fir of the cold region of Japan, a zone which does not occur in Kiushu, where there are no mountains high enough. In Shikoku, *A. Veitchii* is very rare, only about 200 trees being known, which grow on the summit (6600 feet elevation) of Ishituchi-yama. It extends in the main island of Japan over the central mountain chain, from Fuji-yama to lat. 39°, growing at elevations of 6600 feet and upwards. Mayr denies its occurrence beyond lat. 39°; and states that north of this line it is replaced by *Abies Mariesii*,³ which thus intervenes over three degrees of latitude between the southern region, occupied by *A. Veitchii*, and the northern region, occupied by *A. sachalinensis*, these two species not meeting at any point, and having no transitional forms. *A. Veitchii* either forms pure woods or is associated with *Picea hondoensis* and *Picea Alcockiana*, but never with *Picea polita*. Sometimes it is mixed with *Tsuga diversifolia* or with *A. Mariesii*.

Shirasawa gives its lower limit of altitude in the main island as 5000 feet, and states that it attains about 70 feet in height by 7 feet in girth.

According to Mayr and Matsumura, the Japanese name, which is exclusively applied to this species, is *Shirabiso*. *Shiramomi* is also another name for the tree.

So far as I could learn the tree is of no special economic value in Japan.

¹ *Garden and Forest*, ii. 589 (1889). In this journal, x. 511 (1897) the statement is made that Mr. Hogg introduced it some forty years earlier, evidently a mistake for twenty years. *A. Veitchii* is very hardy in the United States, where it has produced cones.

² *Hortus Veitchii*, 337 (1906).

³ Prof. Miyabe showed me, in his herbarium, a barren specimen with small leaves, from Samani, near Cape Erimo, in eastern Hokkaido, which he believed to be *A. Veitchii*. This was *A. sachalinensis*, Masters, var. *nemorensis*, Mayr.

CULTIVATION

It seems to grow fairly well though rather slowly on soils which contain no lime; but it will not live on the calcareous soil at Colesborne.

We have seen no trees of considerable size. One at Tregrehan near St. Austell, measured 27 feet by 2 feet in 1908; and another at Ochtertyre, Perthshire, measured 30 feet by 2 feet in the same year. Mr. Bean¹ noticed in 1906 a specimen 31 feet high at Murthly Castle, and another 20 feet high at Dalkeith Palace. Small specimens will be found in most collections of conifers; and the young trees at Kew at present appear to thrive better than most species of *Abies*.

(H. J. E.)

ABIES MARIESII, MARIES' FIR

Abies Mariesii, Masters,² *Gard. Chron.* xii. 788, f. 129 (1879), and *Journ. Linn. Soc. (Bot.)* xviii. 519 (1881); Mayr, *Abiet. Japan. Reiches*, 40, t. 2, f. 5 (1890); Shirasawa, *Icon. Essences Forest. Japon.*, text 15, t. 4, ff. 15-28 (1900); Kent, Veitch's *Man. Coniferae*, 520 (1900).

A tree, attaining in Japan about 80 feet in height and 6 feet in girth. Buds small, globose, resinous; terminal buds on strong shoots are girt at the base by a ring of ovate, acuminate, rusty-red pubescent scales. Young shoots densely covered with a rusty-red tomentum, retained more or less in older shoots, the bark slightly fissuring in the third year.

Leaves on lateral branches arranged as in *Abies Nordmanniana*, the median leaves on the upper side almost appressed to the stem in imbricating ranks, and about $\frac{1}{2}$ to $\frac{2}{3}$ the length of the lower leaves, which spread pectinately outwards and slightly forwards in the horizontal plane. Leaves linear, flattened, tapering at the base and gradually widening beyond the middle, so that their broadest part is in the upper third; about $\frac{3}{4}$ inch in maximum length, $\frac{1}{10}$ to $\frac{1}{12}$ inch wide; apex rounded and bifid; upper surface yellowish green, shining, with a continuous median groove and without stomata; lower surface with two white bands of stomata, each of eight or nine lines; resin-canals marginal. Leaves on cone-bearing branches all appressed more or less to the shoot, upturned, and shorter than on barren branches.

Cones sessile, deep blue with a velvety lustre before ripening, dark brown when mature, ellipsoid, with an obtuse apex, about 4 inches long by 2 inches in diameter. Scales fan-shaped; lamina 1 inch wide, $\frac{7}{8}$ inch long, upper margin undulate, lateral margins with two denticulate wings; claw broadly obtuse. Bract with a broad obtuse claw, expanding just above the base of the scale, into a broadly oval lamina, which is emarginate at the apex with a short mucro. Seed-wing nearly twice the length of the body of the seed; seed with wing about $\frac{7}{8}$ inch long.

The cones show that the tree is nearly related to *Abies Webbiana*; but it differs entirely from that species in the characters of the branchlets and foliage.

¹ Cf. *Kew Bulletin*, 1906, pp. 260, 268.

² *Abies Mariesii*, Masters, *Bot. Mag.* t. 8098 (1906), described from a tree at Dunphail, Morayshire, is referable to *A. Webbiana*, as mentioned in our account of the latter species.

IDENTIFICATION

This species is similar in the arrangement and size of the leaves to *A. Veitchii*; but is distinguishable from that and from all other species of *Abies*, by the rusty-red or chocolate colour of the densely tomentose branchlets. The leaves are shorter and broader in proportion than those of *A. Veitchii*, being widest in their upper third, with their apex rounded and not truncate as in that species. The two species differ also in the position of the resin-canals.

(A. H.)

HISTORY AND DISTRIBUTION

This species was discovered¹ in 1878, by Charles Maries, when collecting for Messrs. Veitch, on Mount Hakkoda near Aomori in northern Hondo; and for some years it was supposed to occur only in the main island of Japan, where Mayr gives its distribution as from lat. 36° to the extreme northerly point of the island. It has since been found, according to Sargent,² by Tokubuchi in 1892 in one place on the shores of southern Yezo;³ and Dr. Honda lately discovered it in Formosa on Mount Morrison at 10,000 feet elevation.

Sargent saw it on Mount Hakkoda, and says that it is common at about 5000 feet, scattered amongst deciduous trees, and is the only species of *Abies* in this locality, where it forms a compact pyramid, 40 to 50 feet high, with crowded branches and many large dark purple cones. Maries also found it on Nantai above Nikko, which I had not time to ascend; Mr. Tome Shirasawa, who was my companion in North Japan, says that it grows here in company with *Abies Veitchii* on the upper zone of the mountain at 7000 to 8000 feet. The tree according to Mayr is the smallest of all the Japanese silver firs, its maximum height being 80 feet, with a girth of about 6 feet. It is known in Japan as *Aomori-todo-matsu*, and, so far as I could learn, has no economic value.

CULTIVATION

Seeds were sent home by Maries in 1879, but gave poor results; and we have not found anywhere in this country a single tree of any size; but Mr. Bean⁴ has seen a small but healthy tree at Scone Palace in Perthshire. As seen in the nursery at Kew and Coombe Wood, it is very slow and feeble in growth, and apparently is not suited to the English climate, young plants usually having very small leaves and short shoots. There are, however, three flourishing young trees at Bayfordbury, which were obtained from Hesse's nursery at Weener, in Hanover. It seems to do very much better in America, where I saw a vigorous tree⁵ growing at Mr. Hunnewell's pinetum at Wellesley, Massachusetts. Reputed trees of *Abies Mariesii* usually turn out on examination to be *Abies Veitchii*.

(H. J. E.)

¹ *Hortus Veitchii*, 336 (1906).² But Prof. Miyabe told me in 1904 that he had seen no specimens from this place, and doubted its occurrence in Hokkaido. He had specimens in his herbarium from Nambu near Morioka.³ *Forest Flora of Japan*, 82 (1894).⁴ *Gard. Chron.* xli. 117 (1907).⁵ Reported to be 9 feet high, by Sargent, in *The Pinetum at Wellesley in 1905*, p. 13.

ABIES GRANDIS, GIANT FIR

Abies grandis, Lindley, *Penny Cycl.* i. 30 (1833); Masters, *Gard. Chron.* xv. 179, ff. 33-36 (1881) xvii. 400 (1882), and xxiv. 563, ff. 128-131 (1885), and *Journ. Linn. Soc. (Bot.)*, xxii. 174 (1886); Sargent, *Silva N. Amer.* xii. 117, t. 612 (1898), and *Trees N. Amer.* 60 (1905); Kent, *Veitch's Man. Coniferae*, 510 (1900).

Abies Gordoniana, Carrière, *Conif.* 298 (1867).*Abies amabilis*, Murray, *Proc. Roy. Hort. Soc.* iii. 310 (1863) (not Forbes).*Pinus grandis*, Hooker, *Fl. Bor. Amer.* ii. 163 (1839).*Picea grandis*, Loudon, *Arb. et Frut. Brit.* 2341 (in part) (1838).

A tree attaining in America in the coast regions 300 feet in height and 16 feet in girth; but on the mountains of the interior rarely more than 100 feet high by 6 feet in girth; often smaller and stunted at high elevations. Bark of young trees smooth, thin, and pale; of older trees in America, brownish, divided by shallow fissures into low flat ridges roughened by thick appressed scales; in cultivated trees fissuring into thin irregular plates, exposing the reddish brown cortex. Buds small, conical, obtuse at the apex, resinous, roughened by the raised tips of the scales. Young shoots olive-green, smooth, with a minute, erect, not dense pubescence.

Leaves on lateral branchlets pectinate, in two lateral sets in the horizontal plane, each set of apparently two ranks, the upper rank with leaves about half the length of those below. Leaves linear, flattened, up to about 1½ to 2 inches long, 1/10 to 1/12 inch in width, narrowed at the base, uniform in breadth elsewhere, with a rounded and bifid apex; upper surface dark green, shining, with a continuous median groove and without stomata; lower surface with two white bands of stomata, each of about eight lines; resin-canals marginal. Leaves on cone-bearing branches crowded, less spreading or nearly erect, blunt or bifid at the apex, shorter than on sterile branches.

Cones 2 to 4 inches long by 1 to 1½ inch in diameter, cylindrical, slightly narrowed towards the rounded or retuse apex, bright green in colour, with the bracts concealed. Scales resembling those of *Abies Lowiana*, but smaller. Bract situated a little above the base of the scale, quadrangular; upper margin broad, denticulate, deeply emarginate, and with a minute mucro. Seeds 3/8 inch long, light brown, with pale shining wings about 5/8 inch long.

IDENTIFICATION

Abies grandis is readily distinguished by the very flat pectinate arrangement of the leaves; those of the upper rank being about half the length of those in the lower rank. *Abies Lowiana*, when growing feebly, resembles it somewhat in arrangement; but in this species the upper surface of the leaves has stomatic lines, absent in *A. grandis*, and the leaves in the upper rank are only slightly shorter than those in the lower rank.

(A. H.)

DISTRIBUTION

On the north-west coast of America this magnificent tree has a wide range, from Vancouver Island, where it grows at low levels and is not, so far as I saw, a conspicuous feature in the forest; through Washington and Oregon as far south as Mendocino County in California, where it does not extend far from the coast, and grows in company with *Sequoia sempervirens* and *Picea sitchensis*.

Inland it is less abundant on the eastern slopes of the Cascade Mountains, but extends to the Cœur d'Alene and Bitter-root Mountains of Idaho and Montana. In the Flathead Lake Country it is a comparatively small tree, attaining only 12 to 15 inches in diameter, and ascending to about 3500 feet.

It reaches its maximum development in a damp climate and in sheltered valleys, where I have measured trees much over 200 feet in height, and where, according to Sargent and Sheldon, it sometimes reaches as much as 300 feet. So far as I saw, and Sargent confirms this observation, it never grows gregariously, but scattered among other species; and rarely forms an important element in the timber.

It is easy to recognise when young by the flat arrangement of the leaves, but when its branches are far above one's head I could not distinguish it from *A. amabilis* in the Cascade mountains, or from *A. Lowiana* which seems to take its place in southern Oregon and northern California.

It grows very fast in its own country, a specimen measured at 2500 feet altitude on the Cascade Mountains being 140 feet by 16 feet on the stump, at only 106 years old. Though the timber is not much valued by lumbermen, it is used for various purposes locally, and, according to Sheldon, makes the most durable shakes—a name used for large shingles cleft with the axe—used in Oregon.

The tree figured (Plate 218) was growing in 1904 on Swallowfield farm, about fifty miles north of Victoria, in Vancouver Island, and when I measured it, was 215 feet by 19 feet.

Abies grandis was discovered on the Columbia river by Douglas in 1825, though he does not seem to have sent seeds to the Horticultural Society until 1831 or 1832. Very few of these germinated, and it is doubtful if any of the original seedlings are still living.¹ The next consignment² of seed was sent by William Lobb in 1851 to Messrs. Veitch at Exeter; and about the same time seeds were received by the Scottish Oregon Association from their collector Jeffrey.

REMARKABLE TREES

There are many fine trees of this species in the warmer and moister parts of England, Scotland, and Ireland; and, with *A. nobilis* and *A. Lowiana*, it seems best suited of all the American firs to our climate.³

¹ Murray, *Proc. Roy. Hort. Soc.* 311 (1863), states that there were then living no authentic seedling specimens of *A. grandis* raised from the seeds sent by Douglas, but a multitude of young plants existed which had been raised from cuttings.

² *Hortus Veitchii*, 336 (1906).

³ The most vigorous of all the genus. Thrives admirably on gneiss, free from all trace of disease, is not susceptible to frosts or Chermes, and as a shade bearer has no equal amongst silver firs. Produces timber, which is white and

The tallest that I have seen in England grows in Oakly Park near Ludlow, the property of Lord Plymouth, on the rich flat by the river Teme, and measured 102 feet by 8½ feet in 1908. Other fine trees are at Fonthill Abbey, which was 98 feet by 8 feet in 1906; and at Madresfield Court¹ and Eastnor Castle, both of which are over 95 feet high and 7½ feet in girth. The latter is figured (Plate 217). I have seen several others over 90 feet, of which perhaps the one at Heanton Satchville is the largest, though it is too spreading to be a typical specimen. In 1903 it was about 94 feet by 9 feet 7 inches, and 56 yards in circumference of the branches. At Castlehill there are some fine trees, one of which measured 92 feet by 7 feet 10 inches in 1904. At Petworth there is a very tall but not a well-grown tree, 94 feet by 6 feet 6 inches. At Eridge Park a very handsome tree, planted by Mr. Disraeli in 1868, measures 76 feet by 6½ feet. At Youngsbury, Ware, in Herts, Mr. H. Clinton Baker measured a tree in 1907, which was 91 feet in height and 9 feet 8 inches in girth; and at his own place, Bayfordbury, there is another, 73 feet by 5 feet 9 inches in 1905. He also reports two good trees at The Heath, Leighton Buzzard, 98 feet by 8 feet 6 inches, and 88 feet by 7 feet 10 inches respectively. There is also a very large tree in a belt by the road at Flitwick Manor, near Ampthill, Bedfordshire, the seat of Miss Brooks, which is 95 feet by 10 feet. At Welford Park there are two trees which though only planted in 1878, are now about 90 feet high by 7 feet in girth.

At Barton a thriving tree, 68 feet by 4 feet 3 inches, is the best we know in the eastern counties, and this is sheltered and drawn up by tall trees around it.

At Golden Grove, Carmarthenshire, there is a fine tree which in 1892 was 60 feet by 7 feet 8 inches, and when I saw it in 1905 had increased to 80 feet.

In Scotland there are many fine specimens, of which one at Riccarton, in Midlothian, was reported at the Conifer Conference in 1891 to have been 83 feet 3 inches high and only 3 feet 8½ inches in girth, as carefully measured by the owner, Sir James Gibson Craig; and stated by him to have grown 53 feet in twelve years. Soon after this it was attacked by Chermes and was cut down.

At Glenlee, near New Galloway, Mr. T. R. Bruce informs me that there is a tree, planted by Mrs. Melville in 1864, which in 1905 measured no less than 95 feet by 10 feet, though, having lost its leader four years previously, it has now three leads. At Castle Kennedy this species grows much faster than any of the other numerous firs planted there. In 1904, one of two trees, nearly equal in size, was 78 feet high by 6 feet in girth. This tree² was only twelve years old in 1891, when it measured 30 feet by 1 foot 7 inches.

At Benmore, in Argyllshire, one of the wettest places in Scotland, a tree said to be only thirty-five years planted was, in 1907, 80 feet by 7 feet 4 inches; but the trunk was infested with scale and did not seem to be healthy when I saw it. At Poltalloch, there is a fine specimen over 80 feet high, and at Inveraray and somewhat soft, in great volume, and which is found useful in connection with box-making and other industries in Aberdeen. Specially adapted for cultivation for profit where a large volume of timber is a desideratum.—(J. D. CROZIER.)

¹ A note signed J. N. in the *Trans. Scot. Arb. Soc.* xx. 126 (1907) states that this tree, in Sept. 1906, was 114 feet by 8 feet 4 inches. When I measured it in 1904, I made it 96 feet by 7½ feet; and though owing to the ground I could not get a level base line, I can hardly believe that it is now so tall as stated.

² *Journ. Roy. Hort. Soc.* xiv. 547 (1892).

Ardkinglas, in the same county, are trees over 70 feet, which in that wet climate flourish exceedingly.

In the Keillour Pinetum, near Balgowan, in Perthshire, a tree growing in boggy soil was, in 1904, 90 feet high by 7 feet 3 inches. It is not well furnished above, and is perhaps beginning to suffer from the nature of the soil. At Keir, Dunblane, there is a tree which in 1904 measured 82 feet high by 9 feet 3 inches in girth. This tree¹ was twenty-eight years old in 1891, and then measured 55 feet by 4 feet 2 inches. At Abercairney, Perthshire, there is a fine tree, which in 1904 was 91 feet by 8 feet 4 inches. This tree² was about thirty years old in 1891, and then measured 58 feet by 4 feet 6 inches.

At Durriss, Aberdeenshire, there is a good tree, which Mr. Crozier measured in 1904 as 82 feet high by 9 feet 6 inches in girth. When I saw it in 1907 it had increased to nearly 90 feet.

The largest tree in Ireland was formerly at Carton, which was reported in 1891 to be 80 feet high by 6 feet in girth. The top was blown off by the gale of February 1903, and when seen by Henry in the autumn of that year, the tree measured 67 feet by 9 feet 6 inches. At Kilmacurragh, Co. Wicklow, a fine specimen was, in 1906, 86 feet by 7 feet 2 inches; and at Coollattin, in the same county, another measured 63 feet by 6 feet 4 inches. At Powerscourt I measured one in 1903 which was about 87 feet by 7½ feet.

Abies grandis thrives very well in north-western Germany, and according to Count Von Wilamitz-Möllendorf³ grows at Gadow faster than any other silver fir, a specimen figured being 25 metres by 1.40 metre when only twenty-five years old. It also succeeds in some parts of Denmark, where Hansen⁴ states that a specimen planted in 1864 had attained, in 1891, 53 feet by 6 feet. (H. J. E.)

¹ *Journ. Roy. Hort. Soc.* xiv. 531 (1892).

³ *Mitt. D. Dendr. Ges.*, 1907, p. 138.

² *Ibid.* 527.

⁴ *Journ. Roy. Hort. Soc.* xiv. 469 (1892).

ABIES CONCOLOR, COLORADO FIR

Abies concolor,¹ Lindley and Gordon, *Journ. Hort. Soc.* v. 210 (1850); Masters, *Journ. Linn. Soc. (Bot.)* xxii. 177, ff. 8-11 (1886), and *Gard. Chron.* viii. 748, ff. 147, 148 (1890); Sargent, *Silva N. Amer.* xii. 121, t. 613 (1898) (in part), and *Trees N. Amer.* 62 (1905) (in part); Kent, Veitch's *Man. Coniferae*, 501 (1900).

Picea concolor, Gordon, *Pinetum*, 155 (1858).

Picea concolor, var. *violacea*, Roehl, ex Murray, *Gard. Chron.* iii. 464 (1875).

Pinus concolor, Engelmann, ex Parlatores, in DC. *Prod.* xvi. 2, p. 427 (1868).

A tree attaining in America 100 to 125 feet in height, with a girth of 9 feet. Bark of old trees fissuring into small irregular plates. Buds, much larger than those of *A. Lowiana*, broadly conical, rounded at the apex, brownish, resinous, and slightly roughened by the raised tips of the scales. Young shoots smooth, yellowish-green, with a minute scattered pubescence, variable in quantity and often absent from the greater part of the branchlet. Second year's shoot greyish and irregularly fissuring.

Leaves on lateral branchlets irregularly arranged and not truly pectinate; most of the leaves extending laterally outwards and curving upwards, a few on the lower side directed downwards and forwards, some on the upper side directed upwards and forwards; those above shorter than those below. Leaves up to 2 to 3 inches long, 1½ inch broad, glaucous on both surfaces, linear, flattened, slightly tapering at the base, uniform in width elsewhere; apex acute or rounded and not bifid, though occasionally a slight emargination is discernible with a lens; upper surface slightly convex, not grooved, with fifteen to sixteen regular lines of stomata; lower surface convex with two bands of stomata, each of about eight irregular lines, not conspicuously white; resin-canals marginal. Leaves on cone-bearing branches shorter, thicker, falcate, all curving upwards.

Cones, 3 to 5 inches long, 1¼ inch in diameter, cylindrical, narrowed at both ends, rounded or obtuse at the apex; greenish or purple before ripening, brown when mature. Scales of native Colorado specimens much broader than long; lamina about 1 inch wide by ½ inch long, upper margin entire, lateral margins rounded and denticulate, gradually passing into the obtuse claw or with a slightly auricled truncate base. Bract, at the base of the scale, rectangular, denticulate, with truncate upper margin and a minute mucro; in some specimens deeply bifid above. Seeds ½ inch long, with broad shining pinkish wings, about ½ inch long. In cultivated specimens, both brown and purple cones occur.

The following varieties have arisen in continental nurseries:—

1. Var. *falcata*, Beissner,² leaves sickle-shaped, curving upwards.

2. Var. *glabosa*, Beissner,² globose in habit, with symmetrical short branches.

¹ According to the view taken here, *Abies concolor* includes only the tree found in Colorado, Utah, and Southern California. Sargent and other American botanists combine with this species the tree found in the Californian Sierras, which is considered by us to be a distinct species, *A. Lowiana*. The two forms differ remarkably in buds and foliage; and it is most convenient to regard them as distinct species.

² *Mitt. Dendr. Ges.* 1905, p. 112.

3. Var. *aurea*, Beissner,¹ young foliage golden yellow, gradually changing to a silvery grey colour.

4. Var. *brevifolia*, Beissner,¹ leaves short, thick, obtuse, twice as broad as in the typical form.

DISTRIBUTION

Abies concolor occurs in the Rocky Mountains of southern Colorado and extends southwards over the mountains of New Mexico and Arizona into northern Mexico, being the only silver fir in the arid regions of the Great Basin and of southern New Mexico and Arizona. It occurs also in Utah in the Wasatch Mountains, and in southern California, in the San Bernardino and San Jacinto Mountains. It is accordingly confined to dry regions, while *Abies Lowiana*, which is in all probability only a geographical form of it, occurs in the more rainy regions of the Sierra Nevada of California and the southern mountains of Oregon. According to some opinions, the three species, *Abies grandis*, *Abies Lowiana*, and *Abies concolor* are only geographical forms of one large species.

Sargent says, of *Abies concolor*, that it endures heat and dryness best of all the silver firs of North America, and its distribution is accordingly more southerly than that of the other species, which occur in the United States.

HISTORY AND CULTIVATION

This species was discovered by Fendler, near Sante Fé, in 1847, and was first clearly described by Parlato, who adopted for it Engelmann's MS. name, *Pinus concolor*. It does not appear to have been introduced² into cultivation until about 1872. Syme mentions³ two-year-old seedlings of it as a new species in 1875. Roehl, apparently in 1874, sent specimens and seeds, which were labelled *Picea concolor violacea*,⁴ from New Mexico to Messrs. Sanders and Co., St. Albans. This species has been much confused with *A. Lowiana*, which was introduced considerably earlier. It is probable that there are no trees of true *A. concolor* in cultivation, older than 1873 or 1874.

Abies concolor, according to Sargent, is the only American silver fir, which is really successful in cultivation in the eastern part of the United States, where it grows better than *A. Lowiana*.

We have seen few trees of large size, though one at Highnam Court, Gloucestershire, of no great age, was 44 feet by 2 feet 9 inches in 1908.

It is less common in cultivation than *A. Lowiana*, which it much excels in beauty of foliage. Mr. Crozier says that young trees growing at Durriss are quite healthy.

(A. H.)

¹ *Mitt. Deut. Dendr. Ges.* 1906, p. 144.

² Roehl sent a few seeds in 1872. Cf. Lavallée, *Nouveaux Conifères du Colorado et de la Californie*, in *Journ. Soc. Cent. Hort. France*, viii. (1875).

³ *Gard. Chron.* iii. 563 (1875).

⁴ *Ibid.* 464.

ABIES LOWIANA, CALIFORNIAN FIR

Abies Lowiana, A. Murray, *Proc. Roy. Hort. Soc.* iii. 317 (1863).

Abies lasiocarpa, Masters (not Nuttall or Murray), *Gard. Chron.* xiii. 8, f. 1 (1880).

Abies grandis, Lindley, var. *Lowiana*, Masters, *Journ. Linn. Soc. (Bot.)*, xxii. 175, ff. 6, 7 (1886).

Abies concolor, Sargent, *Silva N. Amer.* xii. 121 (1898), and *Trees N. Amer.* 62 (1905) (in part).

Abies concolor, Lindley and Gordon, var. *lasiocarpa*, Beissner, *Handb. Conif.* 71 (1887).

Abies concolor, Lindley and Gordon, var. *Lowiana*, Lemmon, *W. Amer. Cone-Bearers*, 64 (1895); Kent, Veitch's *Man. Conif.* 502 (1900).

Picea Lowiana, Gordon, *Pinet. Suppl.* 53 (1862).

Picea Parsonsiana, Barron, *Catalogue*, 1859, and *Gard. Chron.* v. 77 (1876).

Pinus Lowiana, M'Nab, *Proc. R. Irish Acad.* ii. 680 (1877).

A tree, attaining on the Californian Sierras 200 to 250 feet in height, with a trunk often 18 feet in girth. Bark in cultivated specimens as in *A. concolor*; in wild trees becoming, near the ground, on old trunks, very thick and deeply divided into broad, rounded, scaly ridges. Buds ovoid, blunt at the apex, brownish, resinous, roughened by the raised tips of the scales. Young shoots yellowish green, smooth, covered with a minute scattered pubescence.

Leaves on lateral branchlets pectinately arranged, each lateral set of about two ranks, directed almost horizontally outwards, or curving upwards and outwards, so as to assume above a V-shaped arrangement. None of the leaves are directed irregularly in the middle line; and those of the upper rank are only slightly shorter than those of the lower rank. Leaves, up to 2½ inches long, about ¼ inch broad, linear, flattened, slightly tapering at the base, uniform in width elsewhere, rounded and bifid at the apex; upper surface with a wide median furrow, usually not continued to the apex, and with eight lines of stomata in the furrow; lower surface with two white bands of stomata, each of eight to nine lines; resin-canals, marginal. Leaves on cone-bearing branches, upturned.

Cones, according to Sargent, not distinguishable from those of *Abies concolor*. Wild specimens, however, from California slightly differ, in having larger scales and broader bracts. Cultivated specimens in England bear cones which are chestnut-brown, and apparently never purple, as is often the case in *Abies concolor*.

IDENTIFICATION

Abies Lowiana is regarded by Sargent and other American botanists as a form of *A. concolor*. As seen in cultivation it is very distinct from that species: moreover, it has a different distribution in the wild state. We have kept it separate, as being more convenient to cultivators.

In practice it can only be confused with *A. grandis*, and true *A. concolor*. The characters distinguishing it from *A. grandis* are given under this species on p. 773.

In *A. concolor* the arrangement of the leaves is irregular, not being truly pectinate. Many of the leaves in the middle line, both above and below, are not

directed outwards, but point forwards parallel to the axis of the branchlet. In *A. concolor* the leaves are entire at the apex, and their convex upper surface shows sixteen lines of stomata, and is without a groove; whereas, in *A. Lowiana*, the apex of the leaves is bifid, and their upper surface is grooved, showing eight lines of stomata. The buds are smaller in the latter species. (A. H.)

DISTRIBUTION

Abies Lowiana is found on the Siskiyou Mountains in southern Oregon, and on Mt. Shasta and the Sierra Nevada ranges in California. Its northern limit is the dry interior of southern Oregon, near the divide between the headwaters of the Umpqua and Rogue rivers, which, according to Sargent, is the real northern boundary of the Californian flora.¹ With *Abies magnifica* it forms in great part one of the principal forest belts on the west slope of the Sierra Nevada Mountains for 450 miles, and extends from 4000 to 9000 feet above sea-level. Here I saw it on my way into the Yosemite Valley in 1888, but did not then measure any trees. I found it in September 1904 in company with *A. magnifica*, *Pinus ponderosa*, and *Pinus Lambertiana* abundant on Mount Shasta, from about 3000 to 6000 feet; and here it was of moderate size, the largest that I measured being 140 feet by 11 feet 8 inches. It attains, however, 200 to 250 feet on the Sierra Nevada, and as much as 200 feet in Oregon.

HISTORY AND CULTIVATION

Abies Lowiana was introduced from the Sierra Nevada of California by William Lobb in 1851; and about the same time seeds were sent from southern Oregon by John Jeffrey, who collected for the Scottish Oregon Association. The plants raised from Lobb's seeds were distributed by Messrs. Veitch of Exeter as *Picea lasiocarpa*, while those raised in Scotland from Jeffrey's seeds were distributed as *Picea grandis*.²

Messrs. Parsons of Flushing, United States, received seeds from California in 1853; and plants raised from these were imported to England in 1855 by Messrs. Low of Clapton. These passed into commerce as *Picea Parsonsiana*, a name which first appeared in Barron's Catalogue in 1859, and as *Picea Lowiana*, the name given by Gordon in 1862.

Of all the western silver firs this seems to be the most accommodating to the varied conditions of England, growing well on soils where *A. nobilis* will not thrive, and in a drier climate than *A. grandis* prefers. It is usually grown under the name of *A. lasiocarpa*, in the pineta which I have visited, and generally seen in good health and with a symmetrical top; as it is not so liable to become stunted by the production of cones as *A. nobilis*.

According to Sargent, the Californian form of *A. concolor* grows in the eastern

¹ The fir named *A. concolor* by Plummer in his Report on the Mt. Rainier Forest Reserve, p. 101 (Washington, 1900), is evidently *A. grandis*, which he does not mention, and all his references to white fir no doubt relate to that species.

² Cf. *Hortus Veitchii*, 39, 335 (1906).

States with less vigour and rapidity than the Colorado form; but is equally hardy, and has attained 40 to 50 feet in height in New England.

REMARKABLE TREES

Among the numerous trees that I have measured I find it difficult to say which is the finest specimen. The one at Linton Park was the largest recorded at the time of the Conifer Conference, when it was 64 feet by 8 feet 7 inches. In 1902 I found it to be 85 feet by 10 feet 6 inches, a great increase in ten years (Plate 219).

There is, however, a tree at Fonthill Abbey which I believe to be *A. Lowiana*, though I could not reach the branches in order to identify it, which, in 1906, measured 90 feet by 6½ feet, and resembled, by its short branches, the typical habit of *A. magnifica*.

At Highnam Court, Gloucester, there is a fine specimen which was figured by Kent; according to Major Gambier Parry, it measured 77 feet by 9 feet 2 inches in 1906. I made it 80 feet by 9½ feet in 1908. Another at Eastnor Castle is about 88 feet by 7 feet 4 inches.

In Herts there are several good trees, one at Essendon Place being 82 feet high by 5 feet 9 inches in 1907; another at Youngsbury, Ware, which was planted in 1866, being 68 feet by 5 feet 6 inches in the same year; and a third at Bayfordbury, which was 69 feet by 6 feet 9 inches in 1905.

A very remarkable specimen, narrow and almost columnar in habit, which was planted twenty-six years ago, was seen by Henry at Crowsley Park, Oxfordshire, the seat of Colonel Baskerville, and measured, in 1907, 71 feet by 6 feet.

In Wales there is a very fine tree at Hafodunos, which Henry measured, in 1904, as 87 feet by 7 feet 9 inches; and I saw one at Glanusk Park in Breconshire, which was over 80 feet high in 1906.

In Scotland this species is not usually so large as in the south, though it grows well even in the west, where I have seen good trees at Inveraray and Poltalloch; and in the reports of the Conifer Conference it is generally described as thriving, and several trees of 40 to 50 feet high are mentioned. The largest we have heard of is at Abercairney, mentioned by Mr. Bean¹ as 65 feet by 5 feet.

In Ireland the tree does not appear to have been often planted, and the largest reported at the Conifer Conference in 1891 was growing at Abbeyleix in Queen's County, and measured 45 feet by 6 feet 10 inches. At Coollattin, Co. Wicklow, another was, in 1906, 52 feet by 4 feet 9 inches; and, in the same year, a fine specimen at Castlewellan, Co. Down, measured 67 feet in height and 9 feet in girth.

(H. J. E.)

¹ *Kew Bulletin*, 1906, p. 258, and *Gard. Chron.* xli. 168 (1907), where it is named through inadvertence *A. concolor*.

ABIES AMABILIS, LOVELY FIR

- Abies amabilis*, Forbes, *Pinet. Woburn.* 125, t. 44 (1840); Masters, *Journ. Linn. Soc. (Bot.)* xxii. 171, t. 2 (1886), and *Gard. Chron.* iii. 754, f. 102 (1888); Sargent, *Silva N. Amer.* xii. 125, t. 614 (1898), and *Trees N. Amer.* 59 (1905); Kent, Veitch's *Man. Conif.* 489 (1900).
Abies grandis, Murray, *Proc. Roy. Hort. Soc.* iii. 308 (1863) (not Lindley).
Pinus amabilis, Douglas, *Comp. Bot. Mag.* ii. 93 (name only) (1836); Antoine, *Conif.* 63 (1846).
Pinus grandis, Don, in Lambert, *Pinus*, iii. t. (1837).
Picea amabilis, Loudon, *Arb. et Frut. Brit.* iv. 2342 (in part) (1838).

A tree sometimes attaining in America 250 feet in height and 18 feet in girth, but at high altitudes and in the north usually not more than 80 feet. Bark thin, smooth, pale or silvery white; becoming, on very old trunks, thick near the ground and irregularly divided into small scaly plates. Buds small, globose, resinous, smooth, with purple scales all immersed in the resin, except occasionally two or three, small and keeled, at the base of the bud. Young shoots grey, smooth, densely covered with short, loose, wavy pubescence.

Leaves on lateral branches arranged as in *A. Nordmanniana*, up to $1\frac{1}{4}$ to $1\frac{1}{2}$ inch long by $\frac{1}{4}$ inch broad, fragrant, linear, flattened, gradually tapering from the middle to the base, slightly broader in the anterior half, with a truncate and bifid apex; upper surface very dark green and lustrous, with a continuous median groove and without stomata; lower surface with two broad white bands of stomata, each of eight to ten lines; resin-canals marginal. Leaves on vigorous leading shoots acute with long rigid points, closely appressed or recurved near the middle. Leaves on cone-bearing branches upturned, acute or acuminate.

Cones ovoid-cylindric, slightly narrowing to the rounded apex, dark purple when growing, brown when mature; $3\frac{1}{2}$ to 6 inches long by 2 to $2\frac{1}{2}$ inches in diameter. Scales, 1 to $1\frac{1}{8}$ inch wide, nearly as long as broad, inflexed at the upper rounded margin, gradually narrowing towards the base. Bracts rhombic or obovate-oblong; lamina situated just above the base of the scale and ending in a long acuminate tip, which reaches half the height of the scale. Seeds light yellowish brown, $\frac{1}{2}$ inch long, with oblique pale brown shining wings about $\frac{3}{4}$ inch long.

Abies amabilis resembles *A. Nordmanniana* in the arrangement and size of the leaves; but is readily distinguished from it by the small globose resinous buds. The leaves are also much darker, shining above, more truncate at the apex; and emit, especially when bruised, a strong fragrant odour which resembles that of mandarin orange peel.

(A. H.)

DISTRIBUTION AND HISTORY

Abies amabilis occurs on mountain slopes and terraces from British Columbia southward along the Cascade Mountains to northern Oregon, and on the coast ranges of Oregon and Washington. According to Sargent, it attains its largest size on the Olympic Mountains, where it is the most common silver fir,

extending from 1200 feet up to timber line at about 4500 feet, and forming, with the Western Hemlock, a large part of the forest between 3000 and 4000 feet. In the Cascade Mountains it extends south to about 20 miles north of Crater Lake where Mr. Coville found it on the east side of Diamond Mountain. It occurs¹ in the extreme south-eastern end of Alaska, at the Boca de Quatre inlet, ranging from sea-level to 1000 feet altitude; but has not yet been found between this point and the northern end of Vancouver Island. It is the common fir² in south-western Vancouver Island, where it grows abundantly from sea-level up to the summits of the highest mountains. Near the sea it often forms groves of almost pure growth, the trees standing close together and having very tall slender trunks, about 3 feet in diameter at the base, and often unbranched to a height of 100 feet or more. At an altitude of 3000 feet it is a comparatively small tree, often clothed with branches to the base. Plate 220, taken from a photograph, for which I am indebted to Mr. J. M. Macoun of the Geological Survey of Canada, shows the tree as growing near Kamloops, in British Columbia.

Sargent says, "unsurpassed among fir trees in the beauty of its snowy bark, dark green lustrous foliage, and great purple cones, *Abies amabilis* can never be forgotten by those who have seen it in the alpine meadows covered with lilies, dog's-tooth violets, heaths, and other flowers which make the valleys of the northern Cascade Mountains the most charming natural gardens of the continent."

Engelmann in a letter, dated "Portland, Or., August 6," 1880, and quoted in *Gardeners' Chronicle* of December 4, 1880, says of it:—" *A. amabilis*, on the same mountain where Douglas discovered it, just south of the Cascades of the Columbia, is a magnificent tree, at about 4000 feet, attaining 150 to 200 feet high with a trunk 4 feet in diameter, branching to the ground and forming a perfect cone. The bark of old trees is $1\frac{1}{2}$ to 2 inches thick, furrowed and reddish grey, that of younger trees, less than 100 years, is quite thin and smooth, light grey or almost white. It is certainly very closely allied to *A. grandis*, but readily distinguished by its very crowded dark green foliage and its large dark purple cones. It has the purple cones and sharp-pointed leaves (on fertile branches) of *A. subalpina*, but this latter has much smaller cones, and not such crowded leaves."

Though I saw this tree in abundance on Mount Rainier I cannot say that I know how to distinguish it in the forest from *A. nobilis* without the leaves and cones. It has, according to Plummer, a wider range of elevation than that species, and grows from 800 up to 5500 feet. The cone is as large as that of *A. nobilis*, but without the projecting bracts. From *A. lasiocarpa*,³ with which it was mixed in the upper part of its range, it is distinguished by its habit, which is much less slender and spiry, by its greater size, and by its cones, which are nearly twice as large. Plummer says that it attains 200 feet in height by 15 feet in girth, but I saw none so large as this that I could identify. It is a slow-growing tree, one 20 inches in diameter having 288 rings.

¹ U.S. Forest Service, *Sylvical Leaflet*, 22, p. 1 (1908). Its most southerly point in the coast range is Saddle Mountain, 25 miles south of the mouth of the Columbia River.

² Cf. Butters, *Conifers of Vancouver Island*, in *Postelsia*, 187 (St. Paul, Minn., 1906).

³ Sargent, *Silva*, xii. 126, *adnot.*, mentions the occurrence in a wild state of a hybrid between these two species.

As there were no cones on any of the firs on this side of Mount Rainier in 1904 I was unable to procure seed of either of these species, though Prof. Allen sent me both of them in 1905.

The wood is yellowish and can, according to Plummer, be distinguished from that of *A. lasiocarpa*, by its darker colour. It is soft and perishable, and of no commercial importance at the present time.

Abies amabilis was discovered in 1825 by Douglas on a high mountain south of the Grand Rapids of the Columbia River; but it was not until 1830 that he succeeded in sending to England seed, from which a few plants were raised in the garden of the Horticultural Society at Chiswick; and of these original trees hardly any now survive. For many years afterwards the tree was not seen by any traveller or collector; and seeds of reputed *A. amabilis* sent to Europe invariably turned out to be some other species; and much confusion resulted in the nomenclature of the western American silver firs. In 1880 the tree was re-discovered by Sargent in company with Engelmann and Parry, who found it on Silver Mountain near Fort Hope on the Fraser River; and a few days later Sargent himself observed it on the mountain where it had first been seen by Douglas. Large supplies of seed were sent from Oregon in 1882, and young trees are not now uncommon.

REMARKABLE TREES

Of the original trees, those raised from seed sent home by Douglas, Kent knew only of two surviving in 1900, one at Dropmore and another at Orton Longueville. The latter, as I was told by Mr. Harding, was cut down in 1905, when it measured 5 feet 9 inches in girth.

The tree at Dropmore, which was received from the Royal Horticultural Society, and planted in 1835, was cut down four years ago. Mr. Page informs us that the trunk in the timber yard measured 36 feet long by 8 feet 4 inches in girth at 5 feet from the lower end. A cutting from the tree was raised in 1847 by the late Mr. Frost, and is now growing at Dropmore, and measures 50 feet high by 7 feet 3 inches. For a time, up to 1873, it promised to be a better tree than its parent; but it is now a miserable object, being badly affected by "knotty" disease.¹ This disease has attacked also all the young trees of this species at Dropmore, some fourteen or fifteen in number, which were planted a few years ago.

¹ Dr. Masters, in *Gard. Chron.* xvii. 812, xviii. 109, figs. 19, 20 (1882) states that Mr. Barron had proved the gouty swellings on branchlets of *A. amabilis* and *A. nobilis* to be due to a woolly aphid, and had succeeded in killing the pest, in his nursery at Borrowash, by applications of fir-tree oil. A petroleum emulsion is recommended in *Gard. Chron.* xxvii. 190 (1900). I am indebted to Prof. Borthwick of Edinburgh for a paper on the subject (in *Nat. Zeitschr. Forst. u. Landwirthschaft*, 1908, p. 151, figs. 1-4) by Dr. E. Wolz, who states that these swellings are caused by a Chermes which Cholodkovsky has named *C. piceæ*, var. *Bowvieri*. The life-history of this insect does not seem to have been fully worked out; and it may not be identical with the *Chermes piceæ*, which attacks the bark of silver firs, and is said by Gillanders (*Forest Entomology*, 333) to be common in the nursery on young plants of *A. pectinata* and of *A. Nordmanniana*. The figures given by Wolz, however, of *Abies nobilis*, attacked by the disease, represent exactly the swellings which I have seen on that species at Carlisle, and which is present on most of the trees of *A. amabilis* in England. E. R. Burdon, in *Journal of Economic Biology*, 1908, ii. 132, states that Cholodkovsky's drawing looks more like the effect attributed to *Aecidium elatinum*. Cf. Hartig, *Diseases of Trees*, 180, fig. 109 (1894), who states that no formation of spores ever takes place on these swellings.

We have, however, found several other old trees, none of which are fine specimens, and may have been planted later.

A tree at Bayfordbury, with a broken top, is about 20 feet high. At Brickendon Grange, Herts, there is a remarkable specimen, only a foot in height, with long branches spreading over the ground for about 12 feet. This curiosity is probably very old; and its peculiar form is possibly due to the leader having been repeatedly bitten by animals.

At Pencarrow, Cornwall, a tree is growing, which I made in 1905 47 feet high by 7 feet 10 inches in girth. Mr. Bartlett, in a letter dated February, 1906, gives the following interesting particulars concerning this tree:—"According to Sir W. Molesworth's catalogue of the trees at Pencarrow, the *Abies amabilis* was planted in 1843. The soil is well-drained loam, and the tree stands in a sheltered position. For many years it was a strikingly beautiful specimen, quite symmetrical and feathered to the ground. A few years ago it was attacked by Chermes, and is now in a poor state and likely to be completely ruined by the disease in a few years. The tree bore a few cones near the top, four years ago; but these contained no good seeds. The cones were resinous, dark blue in colour when growing, fading to a dull brown towards autumn. The bark of the trunk and branches is covered with resin-blisters, which exude a liquid resembling golden syrup in colour and consistency. The buds are late in unfolding." Mr. Bartlett states that there is, at Lamellan, in north Cornwall, a perfectly healthy but stunted example of *Abies amabilis*, growing on very poor soil on the edge of a quarry. This tree was probably raised from a cutting of the Pencarrow tree. At Menabilly, in the same county, there is another tree, the flowers of which have been figured.¹ In 1908 it measured 37 feet by 3 feet 7 inches.

At Brocklesby Park, Lincolnshire, Henry measured in 1908 a tree, 50 feet by 4 feet, the date of planting of which is unknown. Though very healthy in general appearance, some of the lower branches are beginning to suffer from knotty disease. The bark is very smooth and covered with numerous resin blisters, differing markedly from the rough bark of an *A. Nordmanniana*, of the same size, growing beside it.

At Smeaton-Hepburn, in East Lothian, there is a tree,² which was planted in 1843; but its top was blown off in 1859, and it is now only 31 feet high, but has a girth of 8 feet 10 inches. It produced staminate flowers in 1886.

At Castle Kennedy, *Abies amabilis* takes on a low creeping bushy habit, possibly due to the plants being raised from cuttings, and I saw a similar dwarf stunted plant at Moncreiffe, which I believe to be *A. amabilis*.

On the whole this species appears to be a failure in cultivation, in Europe; and does not succeed any better in New England, where, according to Sargent,³ it has proved rather tender and grows very slowly. (H. J. E.)

¹ *Gard. Chron.* iii. 755, f. 102 (1888).

² Cf. Sir Archibald Buchan-Hepburn's account in *Proc. Berwickshire Naturalists' Club*, xviii. 207, 210 (1904). It was 8 inches high at the time of planting, when it was supposed to be *A. grandis*.

³ Sargent, in *The Pinetum at Wellesley in 1905*, p. 12, mentions a small healthy specimen, which was raised in the Veitchian nurseries near London, from seeds collected in Oregon by C. S. Pringle in 1882.

ABIES NOBILIS, NOBLE FIR

Abies nobilis, Lindley, *Penny Cycl.* i. 30 (1833); Masters, *Gard. Chron.* xxiv. 652, f. 146 (1885), and *Journ. Linn. Soc. (Bot.)* xxii. 188 (excl. habitat Mt. Shasta, and var. *magnifica*) (1886); Sargent, *Silva N. Amer.* xii. 133, t. 617 (1898), and *Trees N. Amer.* 65 (1905); Kent, Veitch's *Man. Coniferae*, 521 (1900).

Pinus nobilis, Douglas, in *Comp. Bot. Mag.* ii. 147 (1836).

Picea nobilis, Loudon, *Arb. et Frut. Brit.* iv. 2342 (1838).

A tree, attaining in America occasionally 250 feet in height with a girth up to 24 feet, but more usually 150 to 200 feet high. Bark smooth on young trees, becoming on old trunks reddish-brown and deeply divided by broad flat ridges, irregularly broken by cross fissures and covered with thick closely appressed scales.

Buds concealed by the leaves at the tips of the branchlets, ovoid-globose; terminal bud resinous above and surrounded at the base by a ring of lanceolate acuminate or subulately pointed pubescent brown scales; lateral buds with ovate basal scales. Young shoots smooth, densely covered with minute rusty brown tomentum, which is retained in the second year.

Leaves on lateral branches pectinate below, extending outwards in the horizontal plane in two lateral sets; above, the leaves in the middle line, much shorter, completely cover the shoot, from which they arise curving upwards, after being appressed to the branchlet for a short distance near their bases, their tips usually having a slight inclination forwards. Leaves up to about $1\frac{1}{4}$ inch long, $\frac{1}{16}$ inch wide, linear, flattened, narrowed at the base, uniform in width elsewhere, rounded and entire at the apex; upper surface with a continuous median groove and variable as regards the stomata, which are sometimes in two definite bands each of six to eight lines or sometimes present as a few irregular lines, or rarely absent; lower surface with two narrow bands of stomata, each of five to six lines; resin-canals marginal.

Leaves on cone-bearing branches all upturned, thickened, and with sharp cartilaginous points.

Staminate flowers reddish. Pistillate flowers with broad rounded scales, much shorter than the nearly orbicular bracts, which are erose in margin and contracted above into slender elongated reflexed tips.

Cones cylindrical, but narrowing towards the full and rounded apex; 4 to 5 inches long by 2 inches in diameter on wild trees, 6 to 10 inches long by 3 to 4 inches in diameter on cultivated trees; pubescent, purplish-brown with green bracts when growing, the bracts becoming bright chestnut brown in the mature fruit. Scales: lamina, $1\frac{1}{4}$ to $1\frac{1}{2}$ inch broad, 1 inch long, variable in shape; gradually narrowing to the base with straight lateral margins, or rounded and denticulate on the sides above the middle and contracted below; claw short, clavate. Bracts exerted and strongly reflexed, covering the greater part of the scale next below; lamina, broad, full and rounded above, fimbriate in margin, and with a conspicuous midrib prolonged into a mucro about $\frac{1}{2}$ inch long; claw long and cuneate. Seeds pale brown, about $\frac{1}{2}$ inch

long, with similarly coloured obovate-cuneate wings, which in cultivated specimens are considerably longer than the body of the seed.

This tree can only be confused with *A. magnifica*, which has a different habit. The difference between these two trees in the shape and disposition of the leaves is given in the Key, p. 718. (A. H.)

DISTRIBUTION

According to Sargent, this species forms extensive forests on the Cascade Mountains in Washington, extending southwards to the valley of the Mackenzie River, Oregon. It also occurs on the coast ranges of Washington, and the Siskiyou Mountains of California. It is most abundant on the western slopes of the Cascade Mountains, and ranges from 2500 to 5000 feet above sea level, attaining its largest size at 3000 to 4000 feet. It is less abundant and of smaller size on the northern and eastern slopes of these mountains. It commonly attains 200 feet in height; and often grows to 250 feet; Sheldon says, even to 300 feet.

In the Cascade Range Forest Reserve¹ the noble fir forms about 6 per cent of the total, and is an important element in the mixed forests of the middle zone on the western slope, where it often comprises 15 or 20 per cent of the forest. It crosses the summit in lat. 45° where a moist climate prevails, but cannot compete with pine and larch in the drier areas. It is closely associated with the lovely fir, and among lumbermen both species are called larch. Some individuals attain as much as 8 feet in diameter, but the average size is about 150 feet high by 12 feet in girth at the base. Langille states² that this tree cannot hold its own against the lovely fir (*A. amabilis*) and hemlock, which are superseding it, and that a sapling is seldom seen. A tree growing at 6000 feet elevation was 163 years old and 125 feet in height, with a diameter of 4 feet 5 inches at the base.

In the forests of Mt. Rainier in Washington, Plummer says that the noble fir is the finest timber tree and is found from 1800 to 5200 feet. The largest that he measured was 225 feet by 18 feet. But when I ascended this mountain from Longmire's Springs I did not see it, or perhaps I did not distinguish it in the absence of cones from *Abies amabilis*. In the watershed of the Washougal and Rock Creek rivers, however, which are very heavily timbered, it forms, according to Plummer, 25 per cent of the timber. The cones here measure about $4\frac{1}{2}$ inches long by $2\frac{1}{4}$ inches wide, not so large as some I have seen in England.

I saw this tree at its best in the Cascade Mountains above Bridal Veil in northern Oregon in June 1904. In this district the tree is known to the lumbermen as larch, and grows in thick forest, more or less mixed with Douglas fir and hemlock; with *Acer circinatum* and other shrubs as underwood, where there is light enough for any to exist. The largest trees I saw here were above 200 feet in height, and were clear of branches for at least two-thirds of their height, as in the illustration, which was taken from a tree at this place which measured 210 feet by 13

¹ *Forest Conditions of the Cascade Range Forest Reserve, U.S. Geological Survey, Washington, 1903.*

² *Ibid.* p. 35.

feet. (Plate 221.) A stump close by showed 360 rings on a diameter of 4 feet, the first fifty being twice as wide as any of the later ones. I could find no seedlings of the noble fir in this part of the forest, and my guide said that he had seen none except at higher elevations.

The wood of this tree, though not of equal value to that of Douglas fir, is beginning to be more appreciated, and I saw it being cut up at the mill at Bridal Veil where the owner, Mr. Bradley, told me it was worth twenty to twenty-five dollars per 1000 feet, and was sent east to be used for the same purposes as white pine.

HISTORY

This tree was discovered by David Douglas on the south side of the Columbia river in September 1825, and introduced by him five years later on his second journey. Ravenscroft,¹ after quoting Douglas's account of the collection of the seeds, which was published in the *Companion to the Botanical Magazine*, vol. ii. p. 130, says that the seeds arrived in good condition, and were successfully grown and distributed among the Fellows of the Royal Horticultural Society for whom at that time Douglas was working. "Extravagant prices were paid for the plants, fifteen and twenty guineas being then no unusual price." As it usually does, the demand called forth a supply, but for a long time this supply was in a great measure obtained by making grafts and cuttings from the older plants. Plants grown from this source, however, seldom have the same beauty as seedling trees.

The next importation was a small package of seed sent by Mr. Peter Banks, who was drowned soon after. After him Jeffrey sent a quantity to the Oregon Association, but not a plant came up, as the seeds had been destroyed in the cone by the larva of a hymenopterous insect, *Megastigmus pini*, and the same thing happened to the greater part of the seeds sent by William Murray and Beardsley. Afterwards Lobb and Bridges sent more consignments.

Ravenscroft says that plants raised from home-grown seeds are not so strong and healthy as those from imported seed, and have often died from a fungoid attack.

CULTIVATION

Among the silver firs of North America none has had a greater success as an ornamental tree than this, but it is only after many years of cultivation that we are able to say with confidence, what are the conditions of soil under which it will preserve its beauty.

When first introduced it became so popular that seedlings could not be procured in sufficient quantity to supply the demand, and grafting was resorted to by nurserymen; the silver fir being usually the stock selected. These trees grew well for a good many years, and some grafted trees are still thriving; but the majority of

¹ In Lawson, *Pinet. Brit.* ii. 184.

them have shown a tendency to produce cones in such quantity and so prematurely, that the trees have ceased to produce a straight leader, and have often become unsightly and ragged. This applies specially to those which were planted on lawns or on pleasure-grounds, without much shelter.

An avenue of this tree was planted in 1868 at Madresfield Court, Worcestershire, with grafted trees of the glaucous variety from the Worcester nurseries. It was figured in Veitch's *Manual of Coniferae*, ed. 2, p. 524. Though every care has been taken by top-dressing, and removing the cones to keep these healthy, they do not seem likely to remain so, as the lateral branches are, in many cases, covered with the knotty swellings described under *Abies amabilis*, p. 784, note 1.

Mr. W. E. Gumbleton of Belgrove, near Queenstown, tells me that many years ago when *Abies nobilis* was still scarce, the Duke of Leinster, whose tree was one of the first to produce cones, sold the seed of it for £40. The cones were artificially fertilised by shaking out the pollen from the male catkins at the foot of the tree, and dusting it from a ladder on the female flowers at the top.

It is often stated that this is one of the few silver firs which grows well on limestone, but my own experience disproves this, and I have never seen a really fine tree where there was much lime in the soil. A deep sand resting on rock or a hill-side, where good drainage is combined with plenty of humus, seem to be the best conditions for the noble fir; and if the glaucous variety, of which seedlings are difficult to obtain, is desired, I would graft it on *A. Nordmanniana*, which is usually a most vigorous grower, and endures spring frosts better than the common silver fir.

In woods the noble fir is often healthier than in the open, and in some cases has reproduced itself, though not abundantly. I have raised numbers of seedlings from grafted trees, but they were always sickly and died young on my soil, and in any case their growth is slow at first, six to ten years being required to produce trees fit to plant out. But in Scotland seedlings raised from home-grown seed are healthy and vigorous.

The tree is quite hardy in all parts of the country, even in the severe climate of upper Deeside, where at Balmoral it thrives well, and has endured several degrees below zero without injury.¹ It enjoys a fairly wet climate, but will also grow well in the drier parts of England if the soil is deep and cool.

REMARKABLE TREES

The largest noble fir that I know of in England is at Tortworth, where, on a deep bed of sand sloping down to the lake, it had attained in 1901 a height of about 100 feet and 9 feet 6 inches in girth in forty-seven years from the date of planting.

¹ *A. nobilis*, one of the hardiest and best wind-resisting conifers in cultivation, thrives well on gneiss or granite, and may be planted on the most exposed sites. It is the most prolific of all silvers in seed bearing, and readily reproduces itself. Commercially it may be placed next to *A. grandis* amongst exotic firs. The timber, like all the west North American trees of the genus, is white, soft, and light, but closer in texture than *A. grandis*. Root formation ruined by frequent transplanting.—(J. D. CROZIER.)

This tree has suffered to some extent from an attack of Chermes, with which the trunk was covered in 1903, but when I last saw it this had mostly disappeared. Lord Ducie had the tree accurately measured by a man climbing it in May 1908, and informs me that it was then 103 feet 9 inches high, by 9 feet 11 inches in girth. It was planted in 1854, and was 7 feet high in 1855 and 23 feet in 1864.

At Highnam Court, Gloucestershire, there is also a fine specimen in the pinetum, measuring 75 feet by 8 feet, but the trees here seem, as they do in many other places, to have nearly exhausted the soil they grow in, and are beginning to go off. At Miserden Park, the seat of A. Leatham, Esq., in the same county, there is an avenue of grafted trees on dry oolite soil, which were so laden with cones in the year 1900 that they have suffered much in consequence, though hitherto they have borne the exposed situation well.

At Chatsworth Mr. Robertson has measured a tree 85 feet by 8 feet 5 inches with a fine clean stem containing 195 cubic feet. At Walcot, the seat of the Earl of Powis, in Shropshire, I measured in 1906 a very fine glaucous specimen which, though grafted, was 86 feet by 10 feet 9 inches. At Beauport, Sussex, there is a tree, also grafted, 86 feet by 8 feet 1 inch in 1905. At Linton, Kent, there is a tree 90 feet by 8 feet 6 inches in 1902. At Barton there is a tree 80 feet by 7 feet, sheltered in a high wood, and growing fast.

In Fulmodestone Wood, on the Earl of Leicester's property, there is a tree 74 feet by 9 feet 6 inches, from which a self-sown seedling has sprung up, which at eleven to twelve years old was, in 1903, 3 feet 6 inches high; another self-sown seedling in the same place was 20 feet high at about 23 to 25 years old.

At Sandringham there are two fine trees in a shrubbery near York House, the largest of which, in October 1907, measured 85 to 90 feet by 8 feet 10 inches.

At Twizell, Northumberland, once the property of Selby, the author of *British Forest Trees*, I saw in 1906 a tree 80 feet by 8 feet, the top of which, however, was damaged by wind.

In Wales it seems to thrive well both at Penrhyn and Hafodunos, in the north; and at Dinas Mawddwy in Merionethshire, where in 1906 I measured a very flourishing tree 75 feet by 5 feet 8 inches.

In Scotland¹ it generally succeeds better than in England, and where it has sufficient shelter seems likely to attain a great size and age. By far the finest that I have seen, are some trees growing at the foot of a sheltered bank on deep sandy soil, in the Dolphin walk at Murthly, four of which certainly exceed 100 feet in height, and the tallest was, as nearly as I could measure it, from 105 feet to 110 feet by 7 feet 11 inches in September 1906.

A tree growing at Ballindalloch Castle, Banffshire, the seat of Sir J. Macpherson-Grant, is said to be the finest in the north of Scotland, and is stated to have measured in August 1907, 94 feet by 9 feet 11½ inches, and to be only forty-seven years planted.¹

The next largest we have seen is at Keir,² Perthshire, which was, in 1905, 99

¹ *Trans. Roy. Scot. Arb. Soc.* xxi. 98 (1908).

² This tree was reported to be forty years old in 1891, and then measured 82 feet by 5 feet 8 inches (*Journ. Roy. Hort. Soc.* xiv. 531 (1892)).

feet high by 7 feet 5 inches in girth, remarkable for its clean stem and short branches occurring only on the upper half of the tree. Another tree at Keillour, in the same county, was 91 feet by 7 feet 1 inch in 1904; and at Castle Kennedy, Wigtonshire, another measured in the same year 80 feet by 7 feet 10 inches. Sir Archibald Buchan-Hepburn reports one at Smeaton-Hepburn, East Lothian, which measured, in 1908, 84 feet by 8 feet 10 inches. It was planted in 1843.

At Blair Castle, a tree planted by the Duke of Atholl about forty-two years ago was, in 1904, 70 feet by 5 feet; and at Balmoral, though of no great size, it seems to be the best of the silver firs, and has endured a temperature of -15° without injury.

In Ireland, *Abies nobilis* thrives well. At Churchill, Armagh, there is a magnificent specimen, which in 1904 was covered with cones, and measured 73 feet by 8 feet 4 inches. At Curraghmore, Co. Waterford, a tree measured, in 1907, 75 feet in height by 10 feet in girth. At Powerscourt, a tree in 1903 was 59 feet by 6½ feet. At Carton, in the same year, a tree measured 61 feet by 6 feet. At Birr Castle, King's County, there is a very tall tree, which was reported¹ in 1891 to be 83 feet high and 6 feet in girth. There is an avenue of this species at Woodstock, Kilkenny; and good specimens are growing at Castlewellan in Down. In a plantation behind the old deer park at Castle Martyr, Co. Cork, there is a very large tree of the glaucous variety, which, though I could not measure the height accurately, seems to be about 75 feet high and is 10 feet 4 inches in girth. (H. J. E.)

¹ *Journ. Roy. Hort. Soc.* xiv. 557 (1892).

ABIES MAGNIFICA, RED FIR, SHASTA FIR

Abies magnifica, A. Murray, *Proc. R. Hort. Soc.* iii. 318, ff. 25-33 (1863); Masters, *Gard. Chron.* xxiv. 652, f. 148 (1885); Sargent, *Silva N. Amer.* xii. 137, tt. 618, 619 (1898), and *Trees N. Amer.* 66 (1905); Kent, *Veitch's Man. Coniferae*, 516 (1900).

Abies nobilis, Lindley, var. *magnifica*, Kellogg, *Trees of California*, 28 (1882); Masters, *Journ. Linn. Soc. (Bot.)* xxii. 189, t. 5, ff. 19-21 (1886).

Abies shastensis, Lemmon, *Garden and Forest*, x. 184 (1897).

Picea magnifica, Gordon, *Pinctum*, 219 (1875).

Pinus magnifica, M'Nab, *Proc. R. I. Acad.* ii. 700 (1876).

Pinus amabilis, Parlatores, in *DC. Prod.* xvi. 2, p. 426 (in part) (1868).

A tree, attaining in America 200 feet in height and 30 feet in girth. Bark, buds, and branchlets similar in all respects to those of *Abies nobilis*.

Leaves on lateral branchlets arranged as in *A. nobilis*; but with the median leaves above not so densely crowded as in that species, portions of the branchlet being visible from above, whereas in *A. nobilis* the branchlet is completely concealed; moreover, these median leaves are appressed to the branchlet at their bases for a shorter distance than in the other species. Leaves longer than in *A. nobilis*, up to about $1\frac{3}{4}$ inch long, $\frac{1}{16}$ inch wide, tapering gradually to the base, uniform in width elsewhere; apex rounded, entire; obscurely quadrangular in section; upper surface with a central ridge and several (often eight) rows of stomata; lower surface with two bands of stomata, each of four to six lines; resin-canals marginal. Leaves on leading shoots erect and acuminate, with long rigid points pressed against the stem. Leaves on fertile branches much thickened, crowded, upturned, acute with short callous tips.

Staminate flowers dark reddish. Pistillate flowers with rounded scales much shorter than their oblong pale green bracts, which end in elongated slender tips.

Cones very large, 6 to 9 inches long, 3 to 5 inches in diameter, cylindrical, but slightly narrowing to the rounded, truncate or retuse apex; purplish-violet when growing, brown when mature, pubescent. Scales fan-shaped; lamina, $1\frac{1}{4}$ to $1\frac{1}{2}$ inch broad, 1 inch long, upper margin rounded and incurved, the sides gradually narrowing to a cordate base; claw nearly $\frac{1}{2}$ inch long, narrowly obcuneate. Bracts, in the usual form of the species, about two-thirds as long as the scale and not exserted; variable in shape; upper expanded part oval, acute or acuminate, terminated by a mucro; claw sharply contracted below the lamina. Seeds brownish, more than $\frac{1}{2}$ inch long, slightly shorter than their pink obovate-cuneate wings.

Var. *shastensis*, Lemmon, *West. Amer. Cone-bearers*, 62 (1895); Sargent, *Silva N. Amer.* xii. 138, t. 620 (1898), and *Trees N. Amer.* 67 (1905).

Var. *xanthocarpa*, Lemmon, *Third Report*, ex Masters, *Journ. Roy. Hort. Soc.* xiv. 193 (1892), and *Gard. Chron.* xli. 114, figs. 51, 52, 53 (1907).

Abies shastensis, Lemmon, *Garden and Forest*, x. 184 (1897); Coville, *Garden and Forest*, x. 516 (1897).

Abies nobilis robusta, Masters, *Gard. Chron.* xxiv. 652, f. 147 (1885) (not Carrière).

Abies nobilis, Lindley, var. *magnifica*, Masters, *Journ. Linn. Soc. (Bot.)* xxii. 193, Pl. 5 (1886).

This differs from the type only in the cones, which have much longer bracts, yellow in colour, rounded or obtusely pointed (not acute), exserted, usually reflexed, and covering about half the outer surface of the scales.

This variety, which is known as the Shasta Fir, occurs on the mountains of southern Oregon, in the cross and coast ranges of northern California and on the southern Sierra Nevada. In Oregon it is met with in the lower parts of the mountains; but in the other localities it only occurs at very high elevations.

It is rare in cultivation in England, or at any rate has been rarely noticed. A tree at the Cranston Nursery, near Hereford, produced cones¹ of this kind in 1878, which were figured² by Dr. Masters. Another is growing at Durris Castle, Aberdeenshire, where Mr. Crozier states that intermediate forms between this and *A. nobilis* exist.

IDENTIFICATION

This species is only liable to be confused with *A. nobilis*; but in large trees, as seen in cultivation, the difference in habit between the two species is remarkable. The formal arrangement of the branches in *A. magnifica*, though difficult to describe, when once seen can seldom be mistaken. The differences in the foliage are given in the Key, p. 718. (A. H.)

DISTRIBUTION

The most northerly point at which this tree has been found is on the mountains east of Odell Lake in about lat. 44° N. in southern Oregon, where Dr. Coville collected it in 1897, many miles south of where *A. nobilis* occurs; and it is not mentioned among the trees of the Cascade Forest Reserve, so that it really belongs to the Californian rather than to the North Pacific flora. It becomes common on the Trinity Mountains, and on Mt. Shasta is the only fir besides *A. Lowiana*. The tree extends along the entire length of the western slope of the Sierra Nevada, from 6000 to 9000 feet above the sea, and extends to the eastern slope at high elevations.

The northern form has been separated by Lemmon under the name of *A. shastensis*, on account of the bracts which protrude from the scales; being in this respect, as in its geographical distribution, midway between *A. nobilis* and *A. magnifica*;

¹ *Gard. Chron.* 1878, p. 343.

² *Journ. Linn. Soc. (Bot.)* xxii. 193, plate v. (1886).

but this character is variable, and I judged from the specimens shown me by Miss A. Eastwood, that the two forms cannot always be defined.

On the west slopes of Mount Shasta the tree occurs higher up than *A. Lowiana*, mixing with it at about 6000 feet, and at 8000 feet it is the only species of fir. It is not on Mount Shasta a very large tree, the biggest that I measured being not much over 100 feet in height, and 15½ feet in girth, the average being 80 to 100 feet high, by 6 to 8 feet in girth. I could not see very much difference in the bark; though *A. magnifica* is known as the red, and *A. Lowiana* as the white fir, but the very much larger cones of the former distinguish it at once. These were borne only near the summit of the trees, and could only be procured by shooting them off with a rifle, or by felling trees on purpose. They were fully formed but unripe in the first week of September. The soil here was very rocky, and drier than that of any mountain which I have ascended in this latitude; and there was little herbaceous vegetation, though the snow is said to lie deep from November until May or June.

INTRODUCTION

This species was introduced in 1851 by John Jeffrey, who believed it to be *A. amabilis*; and the seedlings were distributed under this name amongst the members of the Scottish Oregon Association. The tree in Scotland is frequently labelled *A. amabilis*, in consequence of this error.

W. Lobb¹ sent seed in 1852, also under the name of *A. amabilis*; but later on the plants were found to differ from that species, and were distributed by Messrs. Veitch as *A. nobilis robusta*.

REMARKABLE TREES

Though it is quite possible that larger trees exist, which have been mistaken for *A. nobilis*, yet we have identified none in England which at all approach that species in size, and all the best we have seen are in the eastern and southern counties. The largest perhaps is one at Fulmodestone, Norfolk, a handsome and well-shaped tree growing in a damp soil and well sheltered situation, which in 1905 was 61 feet by 5 feet 9 inches, and bore cones near the summit.

At Bayfordbury, on a much drier soil, it has flourished better than *A. nobilis*, and in 1905 was 56 feet by 5 feet 9 inches (Plate 222). Mr. H. Clinton Baker recently measured a good specimen, 61 feet by 4 feet 4 inches, at Flitwick Manor; and another, 60 feet by 4 feet 9 inches at High Leigh, near Hoddesdon. At Grayswood, Haslemere, a tree planted as recently as 1881, measured in 1906 56 feet by 4 feet 11 inches; and at Petworth, in 1905, there was a slender and less vigorous tree 47 feet by 3 feet 1 inch.

At Eridge Park, Kent, a tree planted in 1880 by Count Gleichen was, in 1905, 34 feet by 3½ feet.

In a pinetum close to Presteign, Radnorshire, planted about fifty years ago,

¹ *Hortus Veitchii*, 336 (1906).

now the property of Mr. J. H. Wall, I saw a good specimen of *Abies magnifica* in 1906, which measured 53 feet by 5 feet 7 inches.

The largest reported¹ at the Conifer Conference in 1891 was at Revesby Abbey, Lincolnshire, and then measured only 40 feet by 5 feet.

In Scotland it is more numerous and larger. The late Malcolm Dunn, who had an exceptionally wide experience in the cultivation of conifers in Great Britain, wrote of it as follows in a paper² which he sent to the Conifer Conference:—"It is in truth a stately tree and one of the handsomest of all the taller-growing conifers for ornamental purposes. It is one of the very hardiest of the firs, and is seldom affected by spring frost, and the timber being straight, clean-grained, and of good quality, it will no doubt be a useful forest tree." But this latter opinion has not so far received any proof so far as we know, for the tree is, and seems likely to remain, difficult to obtain, and like most of its congeners is slow and costly to raise from seed.

Probably the finest trees in Scotland are one at Durris,³ Aberdeenshire, which was, in 1904, 80 feet high by 6 feet 6 inches in girth, and when I measured it in 1907 had increased to about 85 feet; and another (Plate 223) at Bonskeid, near Pitlochry, of which Mr. J. Forgan has been good enough to send me a photograph, and which measured, in 1908, 87 feet by 8 feet. When he first knew it thirty-five years ago it was about 12 feet high; it has not produced cones. Mr. Bean⁴ noticed in 1906 a tree at Abercairney 70 feet high, and another at Blair Castle 60 feet high.

At Farthingbank, Drumlanrig, there is, growing on clay loam at 650 feet above sea-level, a tree 50 feet by 5 feet 3 inches in 1905, which was planted, according to Mr. Menzies, the forester, thirty-one years previously.

The tree is rare in Ireland, but there is a specimen⁵ at Castlewella, which was 47 feet by 6 feet in 1906; and at Powerscourt, a tree, planted thirty-five years ago, was 57 feet by 6 feet 8 inches in 1906, and is said to bear cones nearly every year.

(H. J. E.)

¹ *Journ. Roy. Hort. Soc.* xiv. 568 (1892).

² *Journ. Roy. Hort. Soc.* xiv. 83 (1892).

³ *A. magnifica* closely resembles *A. nobilis*, but in strong contrast as regards seed-bearing. It does not seem as if the tree is likely to become acclimatised in this respect as, although planted in considerable numbers throughout the policy grounds and plantations, and most of those trees now between fifty and sixty years of age, cones have been produced only on one occasion, and that on only a few trees. The timber when closely grown is closer in texture, richer in colour, and better in quality than *A. nobilis*. Like that species it is impatient of side shade and sheds its branches freely. Constitutionally it is less robust than its near relative, and also less accommodating in its demands on site and soil.—(J. D. CROZIER.)

⁴ *Kew Bulletin*, 1906, pp. 264, 267.

⁵ Figured in *Garden*, June 28, 1890, p. 591.

ABIES BRACTEATA, BRISTLE-CONE FIR

Abies bracteata, Nuttall, *Sylva N. Amer.* iii. 137, t. 118 (1849); Hooker, *Bot. Mag.* t. 4740 (1853); Masters, *Gard. Chron.* v. 242, f. 44 (1889), and vii. 672, f. 112 (1890); Kent, Veitch's *Man. Conifera*, 493 (1900).

Abies venusta, Koch, *Dendrol.* ii. 210 (1873); Sargent, *Silva N. Amer.* xii. 129, tt. 615, 616 (1898), and *Trees N. Amer.* 63 (1905).

Pinus venusta, Douglas, *Comp. Bot. Mag.* ii. 152 (1836).

Pinus bracteata, Don, *Trans. Linn. Soc.* xvii. 442 (1837).

Picea bracteata, Loudon, *Arb. et Frut. Brit.* iv. 2348 (1838); Coleman, *Garden*, xxxv. 12, with fig. (1889).

A tree attaining in America 150 feet in height and 9 feet in girth. Bark brown, smooth; becoming, near the base in old trees, slightly fissured and broken into thick appressed scales. Buds unique in the genus, elongated, fusiform, broadest near the base, and gradually tapering to a sharp point, about $\frac{1}{2}$ to $\frac{3}{4}$ inch long, brown in colour, non-resinous; scales thin, membranous, glabrous, loosely imbricated, obtuse at the apex, shorter at the base of the bud, gradually lengthening above. Young shoots glabrous, greenish, with slightly raised pulvini and inconspicuous furrows. Base of the shoots usually ringed with the scars of the previous season's bud-scales, which in most cases all fall off and do not persist in part, as is usual in other species.

Leaves on lateral branches pectinately arranged, those below spreading outwards in two sets in the horizontal plane; those above slightly shorter, falcate, directed outwards and slightly upwards and forwards, forming a shallow V-shaped depression on the upper side of the branchlet. Leaves, up to 2 inches long, $\frac{1}{10}$ inch wide, rigid, thin, flat, linear, ending in long spine-like cartilaginous points, never bifid; widest in the lower third, gradually tapering to the apex, and abruptly narrowed close to the base; upper surface dark-green, shining, slightly concave in the lower half and flat near the apex, no definite median groove being formed; lower surface with two wide white bands of stomata, each of 10 to 12 lines; resin-canals marginal. Leaves on cone-bearing branches upturned, falcate.

Male flowers, $1\frac{1}{4}$ to $1\frac{1}{2}$ inch long, cylindric, shortly-stalked, surrounded at the base by numerous lanceolate, fawn-coloured parchment-like scales, similar to those of the leaf-buds. Pistillate flowers, with oblong scales rounded above and nearly as long as the cuneate obcordate yellow-green bracts, which end in slender elongated awns.

Cones, remarkable for the long spiny rigid tips to the bracts, ovoid, rounded and full at the apex, 3 to 4 inches long, about 2 inches in diameter, glabrous,¹ resinous, purplish brown. Scales, about 1 inch broad by $\frac{1}{2}$ inch long, almost reniform; upper margin incurved, with a short obtuse denticulate cusp; claw obcuneate. Bracts oblong-obovate, adnate to the scale to beyond the middle and

¹ Remarkable, as all the other species of *Abies* have the scales of the cones pubescent.

deciduous with it, terminating in linear, rigid spines, 1 to 2 inches long, which in the upper half of the cone point towards its apex, and in the lower half are spreading and often recurved. Seeds dark reddish-brown, about $\frac{3}{8}$ inch long and nearly as long as their pale reddish-brown shining wings. (A. H.)

DISTRIBUTION AND HISTORY

Abies bracteata has perhaps the most restricted distribution of all the silver firs, as, according to Sargent, it only occurs in a few isolated groves along the moist bottoms of cañons at about 3000 feet elevation on both slopes of the western ridge of the Santa Lucia Mountains in Monterey County, California. The most northerly point where it is now known to grow is in Bear Cañon, twenty-five miles south of the Los Burros mines; the other localities mentioned by Sargent are in the San Miguel Cañon and in a gorge at the head of the Nacimiento river.

The discovery of this tree is assigned by Don, Sir W. J. Hooker,¹ and Sargent to Dr. T. Coulter, who, according to a letter² of Douglas to Hooker dated November 23, 1831, arrived at Monterey after he began the letter in question. Douglas also, in a letter³ dated October 1832, states⁴ that he found the tree, which he called *Pinus venusta*, in the preceding March "on the high mountains of California," and that it is never seen at a lower elevation than 6000 feet above sea-level, in lat. 36°, where it is not uncommon.

But Kent says,⁵ in a note, that a comparison of the dates shows that Douglas was the first discoverer, which, however, is not proved; as, according to Douglas's own showing, Coulter was at Monterey, near to the place where the tree grows, three months before Douglas found the tree himself. Prof. Hansen⁶ also has incorrectly stated the date of Douglas's discovery of this tree as March 1831 instead of March 1832.

William Lobb, when collecting for Messrs. Veitch in 1853, introduced it to cultivation, and in a letter in *Gardeners' Chronicle*, 1853, p. 435, describes it as "the most conspicuous ornament of the arborescent vegetation. On the western slopes, towards the sea, it occupies the deep ravines, and attains the height of from 120 to 150 feet, and from 1 to 2 feet in diameter, the trunk as straight as an arrow, the lower branches decumbent. The branches above are numerous, short, and thickly set, forming a long tapering pyramid or spire, which gives to the tree that peculiar appearance not seen in any other kind of the *Pinus* tribe. Along the summit of the central ridges, and about the highest peaks, in the most exposed and coldest places imaginable, where no other pine makes its appearance, it stands the severity of the climate without the slightest perceptible injury, growing in slaty rubbish, which to all appearance is incapable of supporting vegetation. In such situations it becomes stunted and bushy. The cones are quite as singular as the growth of the tree is beautiful; when fully developed the scales, as well as

¹ *Bot. Mag.* t. 4740 (1853).

³ *Ibid.* 151.

⁵ Veitch's *Man. Conifera*, 497, note (1900).

² *Comp. Bot. Mag.* ii. p. 149.

⁴ *Ibid.* 152.

⁶ *Journ. Roy. Hort. Soc.* xiv. 459 (1892).

the long leaf-like bracts, are covered with globules of thin transparent resin. Douglas was mistaken in saying that this tree does not occur below 6000 feet elevation; on the contrary, it is found as low as 3000 feet, where it meets *Taxodium sempervirens*."

In 1856 another expedition to collect seeds was made by W. Beardsley, who gives a good account of his journey, which is quoted from by Murray.¹ In the middle of October the seeds were already shed, and Murray says that Mr. W. Peebles, who went for the same purpose on September 17, 1858, found the cones so ripe that when the tree was felled they fell to pieces.

According to Beardsley, the soil on which it grows is "exclusively the calcareous districts, abounding with ledges of white, veined, and grey marble."

CULTIVATION

A. bracteata has never been a common tree in English gardens and, owing to the difficulty of procuring seeds in California, it is rarely to be had from nurseries. It seems to be quite hardy as regards winter cold, but susceptible to spring frosts; and all the good specimens I have seen are in sheltered and rather elevated situations on well drained soil.

The seedlings which I have raised from English-grown seeds have not thriven on my soil, though the tree does not appear to dislike a moderate amount of lime. All the best specimens we know of are in the south and west of England, and in Ireland. A list of them is given by Kent,² and they all are probably of about the same age, being raised from William Lobb's seeds by Messrs. Veitch in 1854.

REMARKABLE TREES

The finest trees in England are in the valley of the Severn, the largest being at Eastnor Castle (Plate 224), where two are growing. They were stated³ by the late Mr. Coleman to have been planted in 1865, and the best of them was 40 feet high in 1889. It first bore cones in 1888; when I measured it last in 1908, I found it to be 78 feet by 9 feet, and though very healthy and handsome in appearance, the top had become forked. It bore cones freely in 1900, from which I raised numerous seedlings, but these have grown very slowly, and do not seem able to make roots freely on my soil.

At Highnam Court, Gloucester, the seat of Sir Hubert Parry, there is another fine tree, difficult to measure on account of its situation, but, in 1908, I made it 64 feet by 6 feet 5 inches. It has several times produced cones, four being borne in 1907, from which seedlings were raised.

At Tortworth Court there is a tree which Lord Ducie believes to have been planted between 1858 and 1862, and in 1908 was 63 feet by 6 feet. It is growing on old red sandstone, about 250 feet above sea level in a situation much exposed to the south-west wind.

¹ *Edin. New Phil. Journ.* x. 1, pls. 1 and 2 (1859).

² Veitch's *Man. Conifera*, loc. cit.

³ *Garden*, 1889, xxxv. 12.

At Nevill Court, near Tunbridge Wells, I measured a tree which, though only 48 by 4½ feet in 1906, is one of the best shaped I have seen, with a very slender spire, as described by Lobb in California.

At Fonthill Abbey there is a tree about 72 feet by 5½ feet, in a sheltered though elevated situation on greensand. At Osborne, in the Isle of Wight, a tree was 60 feet by 5 feet 9 inches in 1908, but this does not appear to be thriving, on account perhaps, of the dry soil.

At Ponfield, Hertford, the seat of P. Bosanquet, Esq., Henry saw in 1906 a tree, very thriving and about 25 feet in height; and in the same district, at High Canons, near Shenley, Mr. Clinton Baker showed me a tree 53 feet by 4 feet which bore about twenty cones in 1907. At Pampisford, Cambridgeshire, there is a tree, about 25 feet high, growing in a sheltered position, and very thriving.

At Monk Coniston, in Westmoreland, the seat of Victor Marshall, Esq., I have seen a tree which has borne cones, and which measured, in 1906, 60 feet by 5 feet.

Several others are mentioned by Kent: at Kenfield Hall,¹ near Canterbury; at New Court, and at Streatham, near Exeter; at Upcott, near Barnstaple; and at Warnham Court, near Horsham. A large tree at Orton Hall, Peterborough, was, before it was cut down in 1905, 59 by 6 feet, but became unhealthy owing to the soil being too heavy.

In Wales, where the species should grow well, I have seen no trees of any size.

In Scotland the only specimens I have seen are at Castle Kennedy and at Cawdor Castle, neither of which are large, and the climate of Scotland generally seems to be too cold for it.²

In Ireland Henry has seen specimens at Fota, in the south-west, a fine young tree which, in 1903, was 48 feet by 4 feet; at Castlewellan, in the north-east, another, in 1906, was 35 feet by 3 feet 2 inches; and a smaller one also exists at Glasnevin.

On the continent of Europe this tree is very rare, the only fine one I have seen being a tree at Pallanza in the nursery grounds of Messrs. Rovelli, which, in 1906, was about 70 feet by 7 feet, but not very healthy and bearing no cones.

M. Pardé states that there is a fine specimen in the domain of the National Society of Agriculture at Harcourt (Eure); and I saw a small one in M. Allard's collection at Angers. (H. J. E.)

¹ This tree produced cones in 1886. Cf. *Gard. Chron.* xxvi. 85 (1886).

² The one specimen now remaining at Durris—between forty and fifty years of age—if it can possibly be taken as a fair example of the growth of the tree in this locality, proves it of little use for planting. It is quite healthy, but its growth is slow in proportion to that of *A. pectinata*.—(J. D. CROZIER.)

ABIES LASIOCARPA, ROCKY MOUNTAIN FIR

Abies lasiocarpa, Nuttall, *Sylva*, iii. 138 (1849); Masters, *Gard. Chron.* v. 172, ff. 23-27, 32, (1889), and *Journ. Bot.* xxvii. 129 (1889); Sargent, *Silva N. Amer.* xii. 113, t. 611 (1898), and *Trees N. Amer.* 61 (1905); Kent, Veitch's *Man. Coniferae*, 515 (1900).

Abies bifolia, Murray, *Proc. Roy. Hort. Soc.* iii. 320 (1863).

Abies subalpina, Engelmann, *Am. Nat.* x. 555 (1876).

Abies arizonica, Merriam, *Proc. Biol. Soc. Wash.* x. 115, ff. 24, 25 (1896).

Pinus lasiocarpa, W. J. Hooker, *Fl. Bor. Am.* ii. 163 (1839).

Picea bifolia, Murray, *Gard. Chron.* iii. 106 (1875).

Picea lasiocarpa, Murray, *Gard. Chron.* iv. 135 (1875).

A tree, attaining occasionally 175 feet in height, with a trunk 15 feet in girth, but usually not over 80 to 100 feet high. Bark of young trees smooth and silvery grey; of old trees shallowly fissured and roughened by reddish brown or whitish scales; in some trees becoming corky and white in colour. Buds small, about $\frac{1}{4}$ inch long, ovoid-conical, obtuse at the apex, brownish, resinous; scales embedded in the resin but roughening the surface of the bud by their raised tips. Branchlets swollen at the nodes, those of the first year ashy grey, smooth, and covered with a moderately dense short wavy pubescence. Branchlets of the second year retaining some pubescence, darker grey, smooth, with the bark slightly fissuring.

Leaves on lateral branchlets irregularly arranged; sometimes irregularly pectinate with some of the leaves above and below not directed outwards, but forwards at an angle with the axis of the shoot; usually with most of the leaves directed upwards, those in the middle line above covering the shoot and standing edgeways with their apices almost vertical, a few leaves in the middle line below pointing forwards and downwards. Leaves linear, up to $1\frac{1}{2}$ inch long by $\frac{1}{2}$ inch broad, uniform in width except at the gradually tapering base; apex rounded and either entire or with a slight emargination; upper surface with a shallow continuous median groove, and with four to five lines of stomata on each side of the groove in its anterior half, the lines fewer in number and broken in the basal half; under surface with two bands of stomata, each of six to eight lines; resin-canals median. The stomatic lines above give the foliage a glaucous appearance; the bands below vary very much in whiteness. Leaves on leading shoots closely appressed to the stem with their tips directed forwards, flattened in section, and ending in long slender rigid points. Leaves on cone-bearing branchlets upturned, directed forwards, usually acute and not more than $\frac{1}{2}$ inch long.

Cones sub-sessile, cylindrical; rounded, truncate or depressed at the slightly narrowed apex; 2 to 4 inches long by $1\frac{1}{2}$ inch in diameter, dark purple and tomentose, with the bracts concealed.¹ Scales very variable in size and shape, from $\frac{7}{8}$ inch long by $\frac{3}{4}$ inch wide to $\frac{1}{2}$ inch long by 1 inch wide: lateral margins rounded or with sinuses, usually auricled on each side of the short obtuse claw. Bract situated at the base of the scale or slightly above it, quadrangular or

¹ According to Piper, *Contrib. U.S. Nat. Herb.* xi. 93 (1906), cones on trees growing in the Olympic Mountains have exserted bracts.

orbicular, denticulate, emarginate with a long slender mucro. Seed $\frac{1}{4}$ inch long, with dark purplish shining wings, which vary in length according to the height of the scale which they cover almost completely.

Var. *arizonica*, Lemmon, *Bull. Sierra Club*, ii. 167 (1897); Masters, *Gard. Chron.* xxix. 86, 134, ff. 52, 53 (1901).

Abies arizonica, Merriam, *Proc. Biol. Soc. Wash.* x. 115, ff. 24, 25 (1896); Purpus, *Gartenwelt*, v. 4, 26 (1896).

This form occurs in the San Francisco mountains in Arizona, where it is common between 8500 and 9500 feet elevation, and occasionally ascends to 12,000 feet. It is remarkable for the creamy-white thick corky bark of the trunk. As seen in cultivation, young plants differ from the type, in the leaves being emarginate at the apex, whiter beneath, and more regularly pectinate in arrangement. Sargent¹ states that bark equally corky occurs in trees of *Abies lasiocarpa* in other regions, as in Colorado, Oregon, South Alberta, and British Columbia; and, as there is no difference in the cones, he does not assign even varietal rank to the Arizona tree.

The best account of this variety is by Prof. Purpus in *Mitt. D. D. Ges.*, No. 13, p. 47 (1904), who visited the San Francisco mountains in 1901, and introduced the tree to Europe. It seems to be a strictly alpine tree, growing on basaltic and trachytic rocks, where the soil is never quite dry, either scattered or mixed with *Populus tremuloides*, *Pinus flexilis*, *Pseudotsuga Douglasii*, and *Picea Engelmanni*. It attains a height of 60 to 70 feet with a girth of 6 to 9 feet. The bark is very corky and corrugated, in old trees milk-white or silver-grey in colour. It is replaced in these mountains at 7000 to 8000 feet by *Abies concolor*.

This form has only recently been introduced into cultivation. Plants were for sale in the Pinehurst Nurseries, North Carolina, in 1901; and Dr. Masters saw a stock of young plants in Moser's nursery at Versailles in 1903. It is too soon yet to form any opinion as to the suitability of this variety for ornamental gardening.

IDENTIFICATION

Abies lasiocarpa is perhaps most readily distinguished by the conspicuous bands of stomata on the upper surface of the leaf, which separate it clearly from the other species² with median resin-canals and long narrow leaves. The following points are also noteworthy:—the irregular arrangement of the leaves, which are usually quite entire at the apex; the ashy-grey pubescent shoots; and the resinous obtuse buds.

(A. H.)

DISTRIBUTION

This is essentially the alpine fir of the Rocky Mountains and higher ranges on the west coast of North America, and is the most widely distributed fir of the New World, occurring from about lat. 61° N. in Alaska to Arizona and New Mexico. It does not occur in California.³ In the west it extends to the summits of the Olympic

¹ *Silva*, xii. 113.

² As *A. sibirica* and *A. sachalinensis*, which it somewhat resembles in general appearance.

³ U.S. Forest Service, *Sylvical Leaflet* 1, Alpine Fir.

Mountains in Washington, and in the east to the mountains of Idaho, Montana (Plate 225), Wyoming, Colorado, and Utah. Everywhere it grows up to or very near the timber line, and on the shores of Lake Bennett in northern British Columbia descends to 2500 feet. In Colorado it reaches 10,000 feet.

Macoun states that it crosses the Rocky Mountains into the Peace River region, and the country between the Little Slave Lake and the Athabasca River; and that in the Rocky Mountains of Alberta it occurs with *Picea Engelmanni*, but is less common; and in a letter states that it is an enormous tree at Glacier, but becomes dwarfed at higher elevations, ascending to 7000 feet in that region.

Wilcox¹ writes of it as follows:—

“The balsam fir has about the same range as the white spruce (*Picea Engelmanni*) but is less common. At a distance it is hardly to be distinguished from the spruce, but the bark on branches and young trees is raised in blisters which contain a drop or two of balsam. This balsam exudes from the bark wherever it is bruised. At first it is a very clear liquid, regarded by old trappers and woodsmen as a certain cure, when brewed with hot water, for colds and throat troubles. On exposure to the air it hardens into a brittle resin, which the woodsman melts into pitch to seal boxes or mend leaky canvas. The camper-out makes his bed from balsam boughs, as they are more springy and less rigid than those of the spruce.”

I saw this tree in perfection in the Paradise valley on the south-west slopes of Mount Rainier in August 1904. An excellent illustration of this locality is given by C. O. Piper in *Garden and Forest*, vol. iv. p. 382, which shows the tall slender spiry habit of the fir. Here it lives in company with *A. amabilis* in the lower part of its range, and with *Tsuga Pattoniana*, and *Cupressus nootkatensis* higher up; growing in small clumps and groves, as shown in the illustration referred to. It seems to be a very slow grower, a tree felled by Plummer being only 15 inches in diameter at 125 years old. The tallest that I measured here was 77 feet by 5 feet 8 inches, but Sargent says that it occasionally attains 175 feet in height (probably in the Olympic Mountains). The seedlings, which I usually found growing on rotten logs, were very slow in growth, and must be often eight to ten years old before their roots reach the soil.

HISTORY AND CULTIVATION

Abies lasiocarpa was discovered by Douglas in 1832, and his specimen, which is the type of *Pinus lasiocarpa* of W. J. Hooker, the first name applied to the species, is preserved in the herbarium at Kew.

Seeds were first collected about 1863, by Dr. Parry in Colorado; but it is not known if any plants raised from these still survive. The first plants raised in the Arnold Arboretum date from 1873, the largest of them being now only 10 to 12 feet in height. Roehl collected seeds in 1874 in Colorado.² According to Syme,³ a small

¹ *The Rockies of Canada*, 62 (1900).

² Masters, *Journ. Bot.* xxvii. 135 (1889), refers these seeds doubtfully to New Mexico; but there is no doubt that they were collected in Colorado. Cf. Lavallée's article on *Nouveaux Conifères du Colorado et de la Californie*, in *Journ. Soc. Cent. Hort. France*, 1875.

³ *Gard. Chron.* iii. 586 (1888).

plant of this origin was alive in Perthshire in 1888; but it was only 2½ feet in height, forming a wide spreading bush, though it was growing in rich black loam.

No trees of this species are recorded by Kent; nor were any specimens sent to the Conifer Conference in 1891. It appears to be unsuitable for cultivation in this country. Young trees at Kew, a few feet in height, are stunted and dying. Waterer had a large stock of plants in 1889 in the nursery at Bagshot; but they all did badly and were thrown away, only one or two surviving and showing the same wretched appearance as the young trees at Kew. Plants cultivated some years ago at Glasnevin have since died. Henry, however, lately saw in the Pinetum at Hatfield, Herts, a tree, planted in 1893 when it was about 3 feet high, which is now 20 feet in height and 15 inches in girth. It has thriven well hitherto, but is slightly attacked by knotty disease. The best specimen we have seen is one at Bayfordbury, about 14 feet high, and fairly thriving. A small tree at Ochertyre bore cones in 1906. The tree appears to succeed better in Germany. I have raised seedlings from cones sent by Prof. Allen in 1905 from Mount Rainier. (H. J. E.)

ABIES BALSAMEA, BALSAM FIR

Abies balsamea, Miller, *Dict.* No. 3 (1768); Sargent, *Silva N. Amer.* xii. 107, t. 610 (1898), and *Trees N. Amer.* 58 (1905); Masters, *Gard. Chron.* xvii. 422, figs. 57-60 (1895); Kent, *Veitch's Man. Coniferae*, 492 (1900).

Abies balsamifera, Michaux, *Fl. Bor. Am.* ii. 207 (1803) (in part).

Pinus balsamea, Linnæus, *Sp. Pl.* 1002 (1753).

Picea balsamea, Loudon, *Arb. et Frut. Brit.* iv. 2339 (1838).

A tree, commonly 50 to 60 feet in height and 3 to 5 feet in girth, but sometimes larger, with spreading branches, usually forming an open broad-based pyramid. Bark, greyish brown and with numerous blisters; on old trees broken on the surface into small scaly plates. Buds small, globose or occasionally dome-shaped, reddish, shining and resinous. Young shoots smooth, ashy grey, with very short scattered pubescence; on the shoots of the second year some of the pubescence is retained, and the bark fissures slightly between the pulvini. The branchlets when cut have a very resinous odour.

Leaves on lateral branches pectinately arranged, in two sets directed outwards in the horizontal plane; upper leaves of each set shorter than the others, and directed also slightly upwards, thus forming a shallow V-shaped arrangement. Leaves linear, flattened, uniform in width except at the tapering base; rounded and slightly bifid at the apex, up to about 1 inch long and ½ to ⅓ inch wide; upper surface dark green, shining, with a median continuous groove, and with two or three broken rows of stomata in the middle line towards the apex; lower surface with two narrow, greyish bands of stomata, composed of six to eight lines; resin-canals median. Leaves on cone-bearing branches more or less upturned, stouter and broader than those on barren shoots, acute and not bifid at the apex.

Staminate flowers yellow, tinged with purple. Pistillate flowers with nearly orbicular purple scales, shorter than the serrulate greenish-yellow bracts, which are emarginate above and end in long, recurved tips.

Cones sub-sessile, ovoid-cylindrical, tapering both at the base and towards the round or flattened apex; purple¹ in colour, 2 to 4 inches long, about an inch in diameter. Scales, about $\frac{5}{8}$ inch wide and long; lamina fan-shaped, rounded and undulate above, lateral margins denticulate and curving to the truncate or auricled base; claw wedge-shaped. Bracts variable in length, exserted or concealed between the scales; claw oblong; lamina trapezoidal and denticulate, ending in a mucro. Seeds purplish, about $\frac{1}{2}$ inch long; wing about as long as the body of the seed.

In the wild state considerable variation occurs in the habit of the tree, which becomes a mere shrub at high altitudes. The cones vary both in size and in the length of the bracts, which are either slightly exserted, or quite concealed between the scales. Prof. Balfour found on the same tree at Keillour cones both with long and with short bracts.

Var. *Hudsonia*, Engelmann, *Trans. St. Louis Acad.* iii. 597 (1878).

Abies Hudsonia, Bosc. ex Carrière, *Conif.* i. 200 (1855).

According to Engelmann this is a sterile dwarf form which occurs above the timber line on the White Mountains in New Hampshire. Whether this is identical with the *A. Hudsonia*, which occurs in cultivation, is uncertain. The latter, according to Sargent,² is of unknown origin, but is probably, though it has never produced cones, a depauperate form of *A. balsamea*. It has densely crowded branches, short numerous branchlets, and small broad leaves, about $\frac{1}{4}$ inch in length; and is a dwarf spreading shrub, only a foot or two in height. It differs from *A. balsamea* in having marginal resin-canals.

Var. *macrocarpa*.³ This was discovered near the Wolf River, Wisconsin, and raised by Robert Douglas at Waukegan nursery; it is said to be a distinct and beautiful form with longer leaves and larger cones than the type.

DISTRIBUTION

The balsam fir extends far to the northward in the Dominion of Canada, its northerly limit being a line drawn from the interior of Labrador north-westward to the shores of the Lesser Slave Lake. It occurs in Newfoundland and in the provinces of Quebec and Ontario, and descends in the United States in the west through northern Michigan and Minnesota to northern and central Iowa, and in the east extends through New England and New York, along the Catskill and Alleghany mountains to south-western Virginia. It is common and often forms a considerable part of the forest on low swampy ground, while on well-drained hill-sides it is met with as single trees or small groves chiefly in the spruce forests. It ascends to 5000 feet on the Adirondacks. (A. H.)

¹ In cultivated specimens the cones are occasionally olive-green in colour, and rarely exceed 2 inches in length.

² *Garden and Forest*, x. 510 (1897).

³ *Ibid.* v. 274 (1892) and x. 510 (1897).

REMARKABLE TREES

The most noted trees of this species in cultivation were those growing in the Keillour Pinetum, Perthshire, now the property of Captain Black of Balgowan. This pinetum was visited by Prof. Balfour¹ in 1895, who found about 30 trees still living out of 200, which were planted in 1831. The largest tree was about 60 feet high with a girth of 5 feet 1 inch at three feet from the ground. There were several others over 4 feet in girth. In 1904, when Henry made a hurried visit to the Keillour Pinetum, where there was much of interest to be seen, he only saw one tree of *A. balsamea*, with the top broken and in a dying state. Mr. W. Causand informed him that in 1903 there was a tree 68 feet by 5 feet.

The finest specimen of which we have any account in Great Britain is recorded in the *Conifer Conference Report, Journ. Roy. Hort. Soc.* xiv. 511, as having grown at Saltoun Hall, East Lothian, the seat of A. Fletcher, Esq., until 1891, when it was swept away by a flood on the river Tyne. This tree was supposed to have been given by Bishop Compton, who introduced the species in 1697, to Bishop Burnet, formerly incumbent of the parish of Pencaitland, and was thus something like 190 years old. It was 68 feet high though it had lost its top, and at ten feet from the ground no less than 7 feet 10 inches in girth, and was said to have been healthy and growing vigorously up till the time of its destruction.

In England we have never seen a tree of any great size or age, the largest being at Bicton, 52 feet by 4 feet 4 inches in 1908; and this species seems to have been neglected and forgotten by modern planters, as it is only twice mentioned in the numerous reports sent to the Conifer Conference.

Loudon states that it arrives at maturity in twenty to twenty-five years, after which it soon dies, though he mentions trees of 30 to 40 feet high as then existing at Syon, Whitton, and Chiswick.

It appears therefore to be of no horticultural value in this country, though if the Saltoun report was correct it may be grown successfully in some parts of Scotland.²

In Norway, according to Schübeler, the Balsam fir succeeds better than here. He mentions three at Bogstad near Christiania, planted about 1772, of which the largest was 55 feet by 6 feet 4 inches, and another 8 feet 2 inches in girth; but when I visited this place in 1904 I could not find these trees, and do not know whether they are still living. Hansen³ states that specimens, about 50 years old and 40 feet high, are to be met with in Danish Gardens.

TIMBER, RESIN

Sargent describes the wood⁴ as being light, soft, coarse-grained, and perishable, and only used for cheap lumber. From the blisters on the bark, a straw-coloured

¹ See *Gard. Chron.* xvii. 422 (1895), which gives an interesting account of this remarkable pinetum.

² *A. balsamea* was planted at Durris freely about fifty years ago, the largest trees now being from 40 to 45 feet in height. Timber of good quality, and contains an exceptionally small percentage of water in a green state. I have seen no account taken of the latter fact, but it has been a continual surprise to me in handling timber in a green state.—(J. D. CROZIER.)

³ *Journ. Roy. Hort. Soc.* xiv. 458 (1892).

⁴ H. von Schrenk, in *Missouri Bot. Garden Report*, 1905, p. 117, describes and figures logs of this timber, felled in Maine for pulpwood, which show on cross-section irregular areas, perfectly smooth and shining as if they had been planed.

transparent resin, known as Canada balsam, is collected by Indians and poor whites in the province of Quebec. This resin, which was formerly largely used in medicine on account of its stimulating action on the mucous membrane, is now chiefly used for mounting objects to be examined under the microscope, for which, and kindred purposes, it is specially suitable by reason of its transparency. (H. J. E.)

ABIES FRASERI, SOUTHERN BALSAM FIR

Abies Fraseri, Poiret, in Lamarck, *Dict. Suppl.* v. 35 (1817); Forbes, *Pinetum Woburnense*, 111, t. 38 (1840); Sargent, *Silva N. Amer.* xii. 105, t. 609 (1898), and *Trees N. Amer.* 57 (1905); Masters, *Gard. Chron.* viii. 684, fig. 132 (1890); Kent, Veitch's *Man. Coniferae*, 509 (1900).
Pinus Fraseri, Lambert, *Genus Pinus*, ii. t. 42 (1837).
Picea Fraseri, Loudon, *Arb. et Frut. Brit.* iv. 2340 (1838).

A tree attaining in America 70 feet in height and 7 feet in girth, with rather rigid branches, forming an open symmetrical pyramid. Bark smooth and with numerous blisters in young trees, becoming on older trunks covered with thin appressed reddish scales. Buds small, broadly ovoid or globose, reddish, resinous. Young shoots smooth, yellowish grey, densely covered with reddish, short, twisted or curved hairs, the pubescence being retained on the older branchlets.

Leaves on lateral branches pectinately arranged, as in *A. balsamea*; linear, flattened, shorter than in that species, rarely exceeding $\frac{3}{4}$ inch long and $\frac{1}{10}$ inch broad, uniform in width except at the shortly tapering base, rounded and bifid at the apex; upper surface dark green, shining, with a continuous median groove and without stomata; lower surface with two broad conspicuously white bands of stomata, each of eight to twelve lines; resin-canals median. Leaves on cone-bearing shoots upturned, crowded, broader than on barren shoots, rounded and entire at the apex.

Staminate flowers yellow tinged with red. Pistillate flowers, with rounded scales, shorter than the oblong bracts, which are broad and rounded above, ending in long slender tips.

Cones sub-sessile, ovoid, cylindrical, slightly tapering at the base and towards the rounded or flattened apex, purple, about 2 inches long by $1\frac{1}{4}$ inch in diameter, with the bracts conspicuously exserted and reflected. Scales as in *A. balsamea*, but wider in proportion to their length. Bracts; claw oblong; lamina broad, trapezoidal, denticulate in margin and bifid above with a mucro in the emargination. Seed with wing about $\frac{1}{2}$ inch long; wing purplish, broadly trapezoidal, denticulate in the upper margin, about twice as long as the body of the seed.

IDENTIFICATION

This species can readily be distinguished from *Abies balsamea* by the different pubescence on the young branchlets and the shorter, more coriaceous leaves, which

Logs with this so-called "glassy" appearance are occasionally rejected; but examination showed that this peculiarity was simply due to the presence of ice, which follows the radial lines on the healed-over branches of the logs.

have broader bands of stomata than in that species—eight to twelve lines in *A. Fraseri*, usually only six lines in *A. balsamea*. The cones differ mainly in the larger bracts, which are much exserted and reflexed over the edges of the scales next below; whereas in *A. balsamea* the bracts are either concealed, or, if slightly exserted, are never reflexed. (A. H.)

DISTRIBUTION

Abies Fraseri is very restricted in its range of distribution, being only found in the Alleghany Mountains of south-western Virginia, North Carolina, and eastern Tennessee, where it often forms forests of considerable extent at elevations of 4000 to 6000 feet above sea-level. These forests are usually pure; but occasionally this species grows mixed with black spruce, birch, and beech. The tree averages about 40 feet in height; it only rarely attains 70 feet.

Sargent in an article¹ on this species gives a good illustration of a forest, at about 5000 feet altitude on the Black Mountain range, a spur of the Blue Ridge in North Carolina; which is very like some forests that I saw when I visited this most interesting region in 1895.

HISTORY AND CULTIVATION

Abies Fraseri was discovered by the Scotch traveller and botanist whose name it bears, John Fraser, in the first decade of the nineteenth century; and plants of it were first distributed from Messrs. Lee's nursery, at Hammersmith, in 1811. The excellent figure in *Pinetum Woburnense*, was taken from the original tree in this nursery, where it had then attained 16 feet in height, at about twenty-eight years of age.

The tree is short-lived, and the plants of the first introduction are probably all long since dead. According to Sargent,¹ seeds of *A. balsamea*, collected in Pennsylvania and Canada, where specimens are occasionally found, in which the tips of the bracts of the cone are slightly exserted, have been very generally sold as *A. Fraseri*. Seedlings of the Carolina tree were, however, distributed by the Arnold Arboretum a few years prior to 1889. We know of no trees of any size now living in this country. Some seedlings which I brought from N. Carolina in 1895 soon died.

(H. J. E.)

¹ *Garden and Forest*, ii. 472, fig. 132 (1889).

ABIES RELIGIOSA, MEXICAN FIR

Abies religiosa, Schlechtendal, *Linnaea*, v. 77 (1830); Lindley, *Penny. Cycl.* i. 31 (1833); Seemann, *Bot. Voy. 'Herald'*, 335 (1852-1857); Hooker, *Bot. Mag.* t. 6753 (1884); Masters, *Gard. Chron.* xxiii. 56, f. 13 (1885), and ix. 304, ff. 69, 70 (1891), and *Journ. Linn. Soc. (Bot.)* xxii. 194, t. 6 (1886); Kent, *Veitch's Man. Coniferae*, 536 (1900).

Abies hirtella, Lindley, *loc. cit.* (1833).

Pinus religiosa, Humboldt, Bonpland et Kunth, *Nov. Gen. et Spec.* ii. 5 (1817); Parlatore, in DC. *Prod.* xvi. 2, p. 420 (1868).

Pinus hirtella, Humboldt, Bonpland et Kunth, *loc. cit.* (1817).

Picea religiosa, Loudon, *Arb. et Frut. Brit.* iv. 2349 (1838).

Picea hirtella, Loudon, *loc. cit.* (1838).

A tree, attaining in Mexico 150 feet in height and 18 feet in girth. Bark¹ greyish-white, rough, divided into small roundish plates.

Buds shortly cylindrical, rounded at the apex, covered with white resin. Young shoots brown on the upper surface, olive green beneath, covered with minute erect pubescence; pulvini prominent. Second year's shoots reddish-brown, smooth, and striate between the pulvini, which are no longer raised.

Leaves on lateral branches, arranged as in *A. Nordmanniana*; but with the median upper leaves much fewer than in that species, covering the upper side of the branchlet, and pointing forwards and slightly upwards; lower leaves in two lateral sets, spreading outwards and slightly forwards in the horizontal plane. Leaves twisted above the base, linear, flattened, gradually narrowing in the anterior half to an obtuse apex, which is usually entire or rarely minutely bifid; upper surface dark green, shining, with a median groove (usually not continued to the apex) and without stomata;² lower surface with two greyish bands of stomata, each of eight to ten lines; resin-canals marginal. The upper leaves are about half the length of those below, the latter about an inch in length and about $\frac{1}{16}$ inch broad. Leaves on cone-bearing branches similar to those on barren branches.

Cones on short stout stalks, 4 inches long, 2 inches in diameter, conical, broadest near the base and gradually tapering to an obtuse and narrowed apex, bluish before ripening, dark brown when mature, the large reflexed bracts being then of a chestnut brown colour. Scales broadly fan-shaped, nearly $\frac{1}{4}$ inch wide by $\frac{5}{8}$ inch long; upper margin almost entire; lateral margins lacinate and denticulate; base broad with a sinus on each side of the short obtuse claw. Bract: claw wide, obtuse; lamina quadrangular, denticulate, emarginate with a short triangular cusp. Seed with wing about $\frac{3}{4}$ inch long; wing broad and $1\frac{1}{2}$ times the length of the body of the seed.

DISTRIBUTION

This species extends throughout the mountains of Mexico, from near Durango in the Sierra Madre range (lat. 24°), where it was collected by Seemann,³ to the

¹ In this tree, as in the other species with prominent pulvini on the branchlets, the bark of the trunk speedily becomes scaly and like that of a spruce, not remaining smooth for a considerable period, as in the common species of silver fir.

² On leaves towards the tip of the shoot, short irregular lines of stomata are present on their upper surface near the apex. Some of these leaves turn their ventral surfaces upwards towards the light.

³ *Bot. Voy. Herald*, 335 (1852).

mountains of northern Guatemala (lat. 15°), where it was observed by Hartweg¹ and collected by Skinner. It is known to the natives as Oyamel, and occurs mainly in forests at 8000 to 10,000 feet, though it occasionally descends to 4000 feet. It apparently reaches its best development on the Campanario, the highest point of the mountains of Anganguero, a range about 100 miles west of the city of Mexico. Here Hartweg found trees 150 feet in height and 5 to 6 feet in diameter. Parry and Palmer collected it in the province of San Luis Potosi in Central Mexico, and gave its range as from 6000 to 8000 feet. Linden found it on the peak of Orizaba, inland from Vera Cruz, growing between 9000 and 10,000 feet elevation.

Stahl, in Karsten and Schenk's *Vegetationsbilder*, 2 Reihe, Heft 3, gives a good account of this tree, which he found growing near Orizaba between 2600 and 3500 metres above sea-level, and in the higher mountains round the valley of Mexico, in pure forests or mixed with pines, oaks, and alders. He gives no dimensions, and the two excellent figures 17 and 18 taken in the Sierra de Ajusco, near Salazar, at about 9500 feet, show the trees to be smaller there than those which Elwes saw on Popocatepetl.²

Dr. Gadow³ found it growing in the mountains of Omilteme, at 8000 feet; and describes the trees as "veritable giants, from 5 to 6 feet in diameter, as straight as a mast, and may be 100 feet high."

Humboldt supposed that there were two species, one with glabrous and the other with pubescent branchlets; but Seemann and Hartweg were convinced that this distinction is unfounded; and the type specimen of *Pinus religiosa*, the supposed glabrous form, according to Bolle, has pubescent branchlets.

The branches of the tree, which are very elegant, are used in Mexico for decorating churches at the times of religious festivals.

This species was discovered in 1799 by Humboldt, who saw it near the city of Mexico in two localities, at 4000 feet elevation between Masantla and Chilpancingo, and near El Guardia at 8400 feet. It was introduced into cultivation in 1838 by Hartweg, who collected for the Horticultural Society of London.

REMARKABLE TREES

Abies religiosa is tender and will not live, except in the warmer parts of these islands, close to the sea coast, where the temperature never falls much below freezing point. Trees planted long ago at Kew and Bayfordbury, do not now survive. Murray mentions⁴ in 1876 specimens growing at Woodstock in Kilkenny, Highnam

¹ *Trans. Hort. Soc.* iii. 123, 138 (1848).

² I believe that this was the silver fir which clothes the lower slopes of the volcano of Popocatepetl, in Mexico, which I ascended to the limit of vegetation, about 13,000 feet, in March 1888, with my wife and Mr. F. D. Godman. The trees formed in some places dense forests at an elevation of 9000 to 10,000 feet, but though my recollection is that they grew to a great size, we took no measurements, being at the time engaged in collecting birds and insects. In the dry volcanic soil in which they grow we found abundantly *Pinguicula rosea*, one of the most charming ornaments of our greenhouses; and higher up lupins and pentstemons were the most conspicuous plants.—(H. J. E.)

³ *Through Southern Mexico*, 378 (1908).

⁴ *Gard. Chron.* v. 560 (1876).

810 The Trees of Great Britain and Ireland

Court in Gloucestershire, Munches in Kirkcudbright, and Hafodunos in Denbighshire, places which we have visited; but none of these trees can now be found.

There are several trees in Cornwall. Specimens with cones were sent to Kew in 1899 from Trevince, near Redruth, the residence of Mr. E. B. Beauchamp. There is also a tree¹ in Mr. Boscawen's garden at Lamorran, which produced cones in 1890.² There is a small tree at Mr. Rashleigh's garden, Menabilly, which was figured in the *Gardeners' Chronicle*;¹ and at Tregothnan, the seat of Viscount Falmouth, there is a large tree which Elwes measured in 1905 as 56 feet by 6½ feet. Though bearing cones, this tree did not seem healthy, and its top was broken by the wind.

A tree at Castle Kennedy is fairly large in size; but it was blown down some years ago, and then replaced in position. It is in consequence very irregular in shape. It produces cones freely, but the seeds are never fertile.

There were formerly two trees at Fota, which differed somewhat in colour of the foliage and hardihood; one³ has since been blown down. The surviving tree (Plate 226) is a handsome one, though its trunk was broken at about thirty-six feet up, and it has now four leaders: when measured by Elwes, in 1908, it was 66 feet high by 7 feet 3 inches in girth. It is branched to the ground, one very large branch coming off near the base. The foliage is variable in colour, being bluish-green towards the ends of the branchlets, and elsewhere of a light or dark green colour, so that there are three tints visible on the tree. It was bearing in August 1904 numerous cones and male flowers, scattered all over the tree. The cones exude a white resin; and are peculiar, as the scales do not all fall at the same time, some remaining at the base and apex of the axis for two or three years.

The tree does remarkably well on the shores of the Italian Lakes.⁴ Carrière says it is killed by frost at Paris; but at Cherbourg⁵ there was a tree 30 feet high in 1867. It seems, however, to be very rare if at all existing in France.

(A. H.)

¹ *Gard. Chron.* ix. 304, figs. 69, 70 (1891).

² This tree was the first in Britain to produce cones, which were exhibited at the Royal Horticultural Society in 1876.

³ This tree was much more tender than the other, and had the top and some lateral branches killed by frost in the winter of 1880-1881. See Osborne, in *Gard. Chron.* xxiii. 56 (1885).

⁴ Sargent, *Silva N. Amer.* xii. 97, adnot. (1898). But Elwes saw none that he could identify in the neighbourhood of Pallanza.

⁵ Hickel and Pardé, in *Bull. Soc. Dendr. France*, 1908, pp. 206, 224, state that the trees of this species in the neighbourhood of Cherbourg died in the severe winter of 1879-1880; and believe that there are now no living specimens in France.

PSEUDOTSUGA

Pseudotsuga, Carrière, *Conif.* 256 (1867); Bentham et Hooker, *Gen. Pl.* iii. 441 (1880); Masters, *Journ. Linn. Soc. (Bot.)* xxx. 35 (1893).

Abies, section *Peuceoides*, Spach, *Hist. Vég.* xi. 423 (1842).

Pinus, section *Tsuga*, Endlicher, *Gen. Pl. Suppl.* iv. Pt. ii. 6 (1847).

Tsuga, section *Peuceoides*, Engelmann, *Trans. St. Louis Acad.* ii. 211 (1863).

Abietia, Kent, Veitch's *Man. Coniferae*, 474 (1900).

EVERGREEN trees belonging to the tribe Abietineæ of the order Coniferae. Branches irregularly whorled. Branchlets of one kind; pulvini slightly projecting, persistent, and showing, when the leaves have fallen, an oval scar at their apex. Buds spindle-shaped, acute at the apex, brownish, shining, glabrous; one terminal larger, and one to four lateral and smaller in the axils of the uppermost leaves; scales numerous, imbricated, rounded and entire at the upper margin, increasing in size from below upwards; some of the scales persistent for three or four years at the base of the branchlets, ultimately falling and leaving ring-like scars. Leaves arising in spiral order; but on lateral branches, thrown by a twist of their bases into two spreading ranks; persistent for four to eight years; linear, flat, narrowed at the base; upper surface green and longitudinally furrowed; lower surface with a prominent midrib and two stomatic bands; fibro-vascular bundle single, resin-canals two on the under surface next the epidermis.

Flowers, arising from buds formed in the previous summer, erect, solitary, surrounded at the base by involucre scales. Male flowers axillary, scattered along the branchlets, cylindrical; pedicel short at first, ultimately elongated; composed of numerous spirally arranged short-stalked globose anthers, opening obliquely: connective surmounted by a short spur; pollen-grains globose, without air-sacs. Pistillate flowers, terminal or in the axils of the uppermost leaves, composed of numerous spirally imbricated rounded scales, much shorter than the acutely three-lobed bracts; ovules two on each scale, inverted. Fruit, a woody pendulous cone, ripening in the first season, ovoid-oblong, acute at the apex, rounded and narrowed at the base; peduncle short and stout; scales persistent on the axis after the fall of the seeds, small and sterile towards the base and apex of the cone, rounded, concave, rigid; bracts conspicuous, exserted, oblong, three-lobed at the apex, the middle lobe awn-like and longer than the two lateral lobes. Seeds, two in shallow depressions, which occupy about half the surface of the scale, triangular, without resin-vesicles, winged. Cotyledons, six to twelve, linear; with a prominent midrib and stomatiferous on the upper surface.

The genus comprises three species, two inhabiting western North America, and the third restricted to small areas in Japan and Formosa.

In the absence of cones, they are distinguishable as follows:—

1. *Pseudotsuga Douglasii*, Carrière. Western North America.
Branchlets usually pubescent, occasionally glabrous. Leaves straight, undivided at the apex.
2. *Pseudotsuga macrocarpa*, Mayr. Southern California.
Branchlets covered with short, stiff pubescence. Leaves curved, undivided at the apex.
3. *Pseudotsuga japonica*, Sargent. Japan, Formosa.
Branchlets glabrous. Leaves straight or curved, bifid at the apex.

The latter two species, not being yet introduced into England, will now be briefly dealt with.

PSEUDOTSUGA MACROCARPA, Mayr, *Wald. Nordamer.* 278 (1890); Sargent, *Silva N. Amer.* xii. 93, t. 608 (1898), and *Trees N. America*, 54 (1905).

Abies Douglasii, var. *macrocarpa*, Torrey, *Ives' Rep.* pt. iv. 28 (1861).

Abies macrocarpa, Vasey, *Gardeners' Monthly*, xviii. 21 (1876).

Tsuga macrocarpa, Lemmon, *Pacific Rural Press*, xvii. No. 5, p. 75 (1879).

Pseudotsuga Douglasii, var. *macrocarpa*, Engelmann, in Brewer and Watson, *Bot. Calif.* ii. 120 (1880).

Abietia Douglasii, var. *macrocarpa*, Kent, *Veitch's Man. Conifera*, 478 (1900).

A tree usually 50, rarely 80 feet high, with a trunk 3 to 4 feet in diameter. It differs from the common species in the following characters:—Branches comparatively larger and more remotely placed. Branchlets covered with a short, stiff, white pubescence. Leaves, $\frac{3}{4}$ to 1 inch long, resembling those of *P. Douglasii*, except that they are distinctly curved. Buds short and broad, usually not more than $\frac{1}{8}$ inch long. Cones very large, $4\frac{1}{2}$ to 6 inches long; scales $1\frac{1}{2}$ to 2 inches wide, thick, very concave, puberulous on the outer surface; bracts, only slightly exerted, short, narrow, with broad midribs produced into short flattened flexible tips. Seeds, $\frac{1}{2}$ inch long, dark brown or nearly black and shining above, pale brown below; wing $\frac{1}{2}$ inch long.

This species¹ occupies an isolated area in the arid mountains of southern California, at 3000 to 5000 feet elevation, forming open groves or growing in mixture with oak and pines on western and southern slopes. Its distribution extends from the Santa Inez Mountains near Santa Barbara on the coast to the Cuyamaca Mountains on the southern border of California.

PSEUDOTSUGA JAPONICA, Sargent, *Silva N. Amer.* xii. 84, adnot. 2 (1898); Shirasawa, *Icon. Ess. Forest. Japon.* text 21, t. 7 (1900).

Tsuga japonica, Shirasawa, *Tokyo Bot. Mag.* ix. 86, t. 3 (1895).

This species is not represented by dried material in European herbaria; but I have seen a specimen² recently sent from Japan by Capt. L. Clinton Baker, R.N.

¹ A view of a forest of this species is given in *Garden and Forest*, x. 24, f. 5 (1897).

² The buds on this specimen were not developed; but the scales of the previous season's buds remained persistent at the base of the branchlets, and resembled those of *P. Douglasii*.

It is distinguished from the other species by its glabrous branchlets and by its leaves bifid at the apex. The leaves are pectinately arranged, $\frac{3}{4}$ to 1 inch long, $\frac{1}{2}$ to $\frac{1}{10}$ inch wide, straight or curved, yellowish green above, conspicuously white beneath, broadest near the contracted base, and gradually tapering to an acute apex, which is minutely bifid. The cones are small, $1\frac{1}{2}$ to $1\frac{3}{4}$ inch long, 1 inch in diameter; scales few, about twenty in number, more woody in consistence than those of *P. Douglasii*, glabrous externally; bracts strongly reflexed, the central awn-like lobe only slightly larger than the lateral lobes. According to Shirasawa, its discoverer,¹ the tree attains a height of 100 feet and a diameter of 3 feet, and occurs at 1000 to 3000 feet elevation in the mountains of the provinces of Ise, Yamato, and Kii in Japan. It grows in mixed forests, composed mainly of *Tsuga*, Oak, Beech, Magnolia, and other broad-leaved species. Elwes, when at Koyasan, endeavoured to reach the habitat of this species, but owing to the distance, the heavy rain, and inability to find a guide, was unsuccessful. According to Hayata,² this species occurs also on Mount Morrison in Formosa. Its Japanese name is *Togasawara*.

Young plants are reported by Beissner³ to be in cultivation in Ansoerge's nursery, at Flottbeck near Altona, and in the Botanic Garden at Hamburg. Two small branches, recently sent to Kew from Flottbeck and from Herr Langen's nursery at Grevenbroich, are only distinguishable from those of the American species by some of the leaves being bifid at the apex. Apparently in the young stage, the leaves are acute or mucronate and entire, the bifid character only being assumed after two or three years.

Except for its botanical interest this species does not seem likely to have any value in this country.⁴ (A. H.)

¹ Shirasawa discovered this species in July 1893, on the road between Owashi (in Kii province) and Yoshino (Yamato province), about 10 miles from the coast. He states that the forests in which it occurs are small in area and very inaccessible.

² *Tokyo Bot. Mag.* xix. 45 (1905).

³ *Mitt. Deut. Dendr. Gesell.* 1902, p. 53, and 1906, pp. 84 and 144. Mayr, in *Fremdländ. Wald- u. Parkbäume*, 406 (1906), states that seeds of the Japanese species have never germinated in Europe. The young plants, however, referred to above, are unquestionably this species.

⁴ While the above was passing through the press, Mr. H. Clinton Baker writes that he had just received from Pallanza four plants of *P. japonica*, about 2 feet high, which are being planted at Bayfordbury. The buds on these plants are about $\frac{1}{4}$ inch long, shining brown, and without resin; and the leaves are nearly all bifid at the apex.

PSEUDOTSUGA DOUGLASII, DOUGLAS FIR

- Pseudotsuga Douglasii*, Carrière, *Conif.* 256 (1867); Mayr, *Fremdländ. Wald- u. Parkbäume*, 396 (1906).
Pseudotsuga Lindleyana, Carrière, *Rev. Hort.* 1868, p. 152, fig.
Pseudotsuga taxifolia,¹ Britton, *Trans. N. York Acad. Sc.* viii. 74 (1889); Sargent, *Bot. Gazette*, xlv. 226 (1907).
Pseudotsuga mucronata, Sudworth, *Contrib. U.S. Nat. Herb.* iii. 266 (1895); Sargent, *Silva N. Amer.* xii. 87, t. 607 (1898), and *Trees N. Amer.* 53 (1905).
Pseudotsuga glaucescens, Bailly, *Rev. Hort.* 1895, p. 88, fig.; André, *Rev. Hort.* 1895, p. 159; Bellair, *Rev. Hort.* 1903, p. 208, f. 85.
Pseudotsuga glauca, Mayr, *Mitt. Deut. Dendr. Ges.* 1902, p. 86, and *Fremdländ. Wald- u. Parkbäume*, 404 (1906).
Pinus taxifolia, Lambert, *Pinus*, i. 51, t. 33 (1803) (not Salisbury).
Pinus Douglasii, D. Don, in Lambert, *Pinus*, iii. t. (1837).
Abies taxifolia, Poirét, in Lamarck, *Dict.* vi. 523 (1804).
Abies mucronata, Rafinesque, *Atlant. Journ.* 120 (1832).
Abies Douglasii, Lindley, *Penny Cycl.* i. 32 (1833); Loudon, *Arb. et Frut. Brit.* iv. 2319 (1838).
Picea Douglasii, Link, *Linnaea*, xv. 524 (1841).
Tsuga Douglasii, Carrière, *Conif.* 192 (1855).
Tsuga Lindleyana, Roehl, *Cat. Conif. Mex.* 8 (1857).
Tsuga taxifolia, Kuntze, *Rev. Gen. Pl.* ii. 802 (1891).
Abietia Douglasii, Kent, Veitch's *Man. Conif.* 476 (1900).

A tree, attaining in the moist climate of the Pacific coast 250 to 300 feet in height and 40 feet in girth; but in the dry regions of the interior and at high altitudes rarely more than 100 feet high and 10 feet in girth. Bark of young stems thin, smooth, shining, grey; on older trunks, 2 to 12 inches in thickness, corky, divided by deep longitudinal furrows into broad oblong scaly ridges. Young branchlets usually pubescent, occasionally glabrous. Buds $\frac{1}{4}$ to $\frac{5}{8}$ inch long. Leaves $\frac{3}{4}$ to $1\frac{1}{4}$ inch long, straight, rounded or obtuse, rarely acute at the apex; variable in colour, the stomatic bands beneath either dull grey or conspicuously white.

Cones, 2 to $4\frac{1}{2}$ inches long; scales thin, slightly concave, rounded or slightly prolonged at the apex, about $\frac{3}{4}$ inch wide; pubescent on both surfaces; before ripening bluish below, purple towards the apex and bright red on the closely appressed margins, the bracts being pale green; scales and bracts brown when ripe. Bracts variable in length; the three-pointed apex always, however, extending beyond the scale, usually appressed, but occasionally reflexed. Seeds, about $\frac{1}{4}$ inch long, reddish brown and shining above, paler and with whitish spots below; wings longer than the body of the seed, dark brown, rounded at the apex.

VARIETIES

1. Var. *glauca*, Beissner, *Nadelholzkunde* 419 (1891), Colorado Douglas fir.

In the interior of the continent, the Douglas fir, growing in a dry climate at

¹ According to the rules of botanical nomenclature adopted by the Vienna Congress of 1905, *P. taxifolia* is the correct name for the species, as pointed out by Sargent, in *Bot. Gaz.* xlv. 226 (1907); but we prefer to use *P. Douglasii*, the name which is universally in use amongst foresters and arboriculturists.

high elevations in the Rocky Mountains, through Montana, Colorado, Utah, Arizona, New Mexico, and Mexico, is a smaller tree than the form which occurs in the moist climate of the Pacific coast region. It bears small cones, 2 to 3 inches in length, which in rare cases have the bracts reflexed, but resemble in all essential characters, except size, the cones of the coast form. The leaves are usually thicker in texture and are very glaucous beneath; but the bluish tint visible on the upper surface of the leaves, which is supposed to be characteristic, while common in certain localities, and in others occurring on scattered individual trees, is no more constant than the similar coloured variation which is met with in trees like *Picea pungens* and *Cedrus atlantica*. Mayr has separated the Rocky Mountain form as a distinct species, *P. glauca*; but the differences, being rather physiological than morphological, do not entitle it to rank as more than a variety. The main difference lies in the rate of growth and the hardiness of the tree, when seeds of it are raised in countries remote from its native habitat.

Dr. C. C. Parry discovered this variety of the Douglas fir in the outer ranges of the Rocky Mountains in 1862; and in the following year seeds were sent to the Botanic Garden of Harvard College, from which plants were raised, that have proved perfectly hardy and vigorous in growth in New England. In the north-eastern States the Pacific Coast form, whether introduced by seeds collected in Oregon or produced by trees growing in England, has not proved hardy.

The exact date of the introduction of the Colorado Douglas into Europe is uncertain; but it appears to have been unknown in 1884, when the first edition of Veitch's *Manual* was published, and was described as a distinct variety by Beissner in 1891. Seeds were apparently sent from Mexico by Roehl in 1856, and plants¹ raised from these on the continent do not seem to differ from the Colorado Douglas.

According to the experiments of Johannes Rafn, of Copenhagen, the germination of the seed of Douglas fir from Colorado is quicker and much better than that from the Pacific coast.²

In England young plants of the Colorado Douglas³ have ascending branches, and are more narrowly pyramidal in habit than the Oregon Douglas, which has wide-spreading horizontal branches. Owing to its slowness of growth, the Colorado variety has short internodes between the branches, which give it a bushy appearance. The blue tint of the foliage can scarcely be relied on as a distinctive character, as it is variable in intensity and often disappears with age. The leaves are usually thicker, but do not differ in length or shape from those of the Oregon Douglas, the sharp-pointed apex being characteristic of both forms in the young stage. The young branchlets of the Colorado variety are often either quite glabrous or show only a few minute hairs under the lens, whereas those of the other form are distinctly pubescent. In wild trees, judging from herbarium specimens, this distinction does not occur.

¹ *Pseudotsuga Lindleyana*, Carrière, raised from Mexican seed sent by Roehl, and *P. glaucescens*, Bailly, also probably from Mexican seed, belong to var. *glauca*, and bear cones with strongly reflexed bracts.

² *Trans. Roy. Scot. Arbor. Soc.*, xvi. 408 (1901).

³ The Colorado Douglas in cultivation in England has been supposed by Schwappach (cf. Richardson in *Trans. Roy. Scot. Arbor. Soc.* xviii. 195, with figure) to be *Pseudotsuga macrocarpa*; but there is no evidence to support this opinion.

The Colorado Douglas displays in cultivation well-marked peculiarities, which are mentioned in detail on pages 825, 826.

2. Lemmon¹ has described several other wild varieties, as var. *suberosa* from Arizona and New Mexico, var. *elongata* from the base of Mount Hood in Oregon, and var. *palustris* from swamps in the Lower Columbia Valley.

3. A considerable number of cultivated varieties have been distinguished by Carrière and Beissner, most of which are not worth mentioning, as their distinctive characters are trifling and inconstant. Fastigate and pendulous forms are known, but are rarely met with.

Var. *Stairii*, with yellowish foliage, originated² at Castle Kennedy.

Var. *Fretsi*, Beissner,³ is very peculiar in the foliage, as the leaves are short and broad, only $\frac{1}{2}$ inch in length, very obtuse at the apex, and resembling those of *Tsuga Sieboldii*. This originated in the seed-bed, and was sent out by Messrs. Frets & Sons of Boskoop, Holland. (A. H.)

Other varieties occur in cultivation which, though very distinct in habit, are not, in my opinion, worth naming. Among the best of the pendulous forms is one at Bury Hill, Dorking, the seat of R. Barclay, Esq., which in 1908 was 88 feet high.

I noticed in October 1907, near Boldrewood in the New Forest, on the north side of the drive, two trees, one of which was a typical Oregon Douglas fir with drooping branches, and leaves very silvery on the under side. Another close by had much narrower, stiffer, and darker foliage, and denser branches, the leaves much less silvery, and the cones closely packed near the summit of the tree in a manner unusual in this species. The former tree measured 70 feet by 6 feet 10 inches, the latter 66 feet by 5 feet 2 inches. Others of the latter type, standing near the gate leading into Mark Ash, bore no cones at all.

Near Eggesford House, in the higher walk, I saw a Douglas fir tree, so distinct in habit that it might be easily mistaken for another species. It had thin greyish foliage, pendulous branchlets, and very few cones, and measured 80 feet by 5 feet 7 inches, whilst ordinary Douglas firs planted close by were much thicker in proportion. I believe that by selecting such trees as seed-bearers we may ultimately succeed in obtaining distinct races which, for economic planting, will be much more valuable than trees of unknown origin. (H. J. E.)

DISTRIBUTION

The Douglas fir has an extremely wide distribution in western North America, extending from north to south over 33° of latitude, between the parallels of 55° and 22°, and ranging from the Pacific coast to east of the Rocky Mountains. It occupies practically all of this vast territory except the higher elevations of the mountains and the desert and prairie regions of lower altitudes, where the rainfall is slight. It is the dominant tree of the great western forest, always growing in mixture with other

¹ *West American Conebearers*, 57 (1895).

² This variety is fully described in *Gard. Chron.* 1871, p. 1481. I have seen the original, which is now a small unhealthy looking tree; as are all those we have seen elsewhere. The best, perhaps, is a large dense bush rather than a tree, growing in Wood's nursery, near Buxsted, Sussex.—(H. J. E.)

³ *Mitt. Deut. Dend. Gesell.* 1905, p. 74, f. 8.

conifers, which have a much more restricted distribution. In Montana it is associated with the western larch: in California it encroaches on the redwood belt; in southwestern Oregon it is mixed with the Lawson cypress; while in the rest of the great forest of this state, and of Washington and northern Idaho, *Thuja plicata* is usually its constant companion. The various silver firs, hemlocks, and the Sitka spruce also take part, in different localities, in the mixture of coniferous trees in the Douglas forest. Towards the edges of the prairie regions and in the drier parts of the mountains, the Douglas fir gradually gives place to *Pinus ponderosa*, which is the characteristic tree of dry soils, where a very moderate rainfall prevails.

The northern limit of the Douglas fir extends from near the head of the Skeena River, latitude 54°, in the coast range of British Columbia to Lake Tacla in the Rocky Mountains, latitude 55°, reaching its most easterly point near Calgary in Alberta. In the coast range, the tree grows at some distance inland north of latitude 51°; while south of this line it is common on the coast of the mainland and in the island of Vancouver; and in this region, and in Washington and Oregon, between the western foothills of the Cascades and the sea, it is most abundant and of its largest size. It attains its maximum development, 300 feet in height, in Vancouver Island and on the northern slopes of the Olympic Mountains in Washington, where the rainfall is excessive; whereas, on the Cascades and in the interior of the continent, it rarely exceeds 150 feet in height. It is common, but only of moderate size, in the forests of northern Idaho and of western Montana,¹ ascending to 6000 feet.

The Douglas fir extends southwards along the Rocky Mountains, in the Yellowstone Park in Colorado, where it grows between 6000 and 11,000 feet altitude; in Utah, to the east of the Wasatch range; in northern and central New Mexico and northern Arizona, where it is common between 8200 and 9000 feet, being rare and of small size in the southern parts of these two states, where it ascends to 6000 or 7000 feet; in the Guadalupe Mountains of western Texas, where it is abundant; and it spreads into Mexico, along the Sierra Madre range of Chihuahua and the mountains of Nuevo Leon, reaching its most southerly point near the city of San Luis Potosi.

In California it extends southward in the coast mountains² as far as Punta Gorda in Monterey county, but is not abundant, and is rarely over 150 feet in height; inland it extends to the Sierra Nevada,³ where it grows to a large size and ascends to 7000 feet. It does not occur in the arid tracts of Nevada and Utah, which lie between the Sierra Nevada and the Wasatch ranges. (A. H.)

So little seems to be known by British foresters as to the conditions under which the tree grows in America, that though I quite agree with the preceding account, it may be as well to add some of my personal experience of the tree as I saw it on my last journey in 1904. In the Blackfoot valley of Montana it is associated

¹ At Whitefish, Montana, an average tree, growing with the western larch, was 140 feet in height and 8 feet in girth, and showed 245 annual rings; the sapwood, $\frac{3}{8}$ inch wide, containing 45 rings; the bark was $2\frac{1}{2}$ inches in thickness.

² Jepson, in *Flora Western Mid. California*, 19 (1901) says that it is frequent in the Santa Cruz mountains; but is not known in the Mt. Diablo and Mt. Hamilton ranges, or in the Oakland hills.

³ Sargent in *Garden and Forest*, x. 25 (1897), says that it does not extend in the Sierras, south of the head of King's river, or within 100 miles of the territory occupied by *P. macrocarpa*. Jepson (*op. cit.* 20), makes its southern limit on the Sierras, about the head-waters of Stevenson Creek, which is not far from the head of King's river.

with *Larix occidentalis*, on the damper and shadier slopes of the mountains, at 4000 to 6000 feet, giving place to *Pinus ponderosa* in drier and sunnier situations, and never attains, so far as I could see or learn, more than 140 to 150 feet in height.

In Washington and British Columbia it is not seen in the dry country east of the Cascade range, but appears as soon as the forest begins to thicken near the watershed; and on the western slopes of the mountains, from about 6000 feet downwards, is almost everywhere, except in swampy land, the dominant tree of the forest, attaining 200 to 300 feet in height from sea level to about 2000 feet.

It grows usually in mixture with *Thuja plicata*, *Tsuga Albertiana*, *Picea sitchensis*, and *Abies grandis*; sometimes with a smaller proportion of *Pinus monticola*, and in drier situations with *Pinus ponderosa*;³ but in all the coast forests which I saw in Oregon, Washington, and British Columbia, including Vancouver Island, it outnumbered all the other conifers, except where forest fires have destroyed it, and its place is being to some extent taken by the hemlock, whose seeds seem able to germinate and grow in denser shade and in deeper humus than the young plants of the Douglas fir can endure. Wherever the soil becomes too dry and rocky for hemlock and *Thuja*, the Douglas fir is able to grow, climbing up to the dry ridges and sunny slopes until it meets the more alpine species of conifers. Its habit and size vary according to the soil and situation; but I never observed any trees even in the most open situations, whose branches extended so far from the trunk as they do in English parks and gardens, and it does not attain anything like its full size unless it has a deep soil, a sheltered situation, and has been drawn up in youth by the struggle for existence, which prevails everywhere in the forest.

I saw a section of bark in the Washington State exhibit at the St. Louis Exhibition, taken from a tree cut at M'Cormick in Lewis Co., Washington, in the spring of 1904; which was said by Mr. Baker, who was in charge of it, to have been 390 feet high. The same tree was recorded, however, in a Washington newspaper as having been 340 feet high and 42 feet in circumference (probably at three to four feet from the ground), and above 300 years old. The tree is said to have contained 79,218 feet board measure, equal to above 8000 cubic feet, quarter-girth measure. The discrepancy in the account of the height and that given me by Mr. Baker may arise, in part, from the tree in falling, having jumped some distance from its stump.

Another tree even more remarkable, though not so large, was cut by Mr. Angus M'Dougall of Tacoma for the Chicago Exhibition in 1893. This grew in Snohomish Co., Washington, and measured on the stump only 4 feet in diameter. In falling it broke off at a height of 238 feet, where it measured 17½ inches in diameter, and was nearly free from branches to a height of 216 feet, which length was sent to Chicago.

The largest tree I have ever seen myself, which is said to be perhaps the largest known in Vancouver Island, grows by the roadside at Mr. P. Barkley's farm at Westholme, about 40 miles north of Victoria and 4 miles south of Chemainus Station.

³ In the Bow river of Alberta it grows mixed with aspen (*Populus tremuloides*), and cottonwood (*P. balsamifera*).—Wilcox, *The Rockies of Canada*, p. 65.

What its height may originally have been is impossible to say, as it is broken off at about 175 feet. This tree has a very swelling base, which does not show so well as I could wish in the photograph (Plate 227). At the ground it measures 21 paces in circumference. Above the swelling, at about 6½ feet, I made it 41 feet 5 inches in girth. Assuming this tree to be 24 feet in girth at 100 feet high, and to have had a top at all in proportion to its girth, it must have contained 7000 to 8000 cubic feet of timber, or even more. The soil in which it grows is a deep fertile loam, and the timber standing in the valley is some of the finest in the island. Plate 228, from a photograph also taken in Vancouver Island, gives an idea of the forest, and shows on the right the trunk of a typical Douglas Fir; on the left, a trunk of *Thuja plicata*.

In the eastern part of the Washington Forest Reserve, Mr. Martin W. Gorman found this species up to 6000 feet, and measured a tree growing at 5500 feet, 132 years old, which was 18¾ inches diameter on the stump, with the bark 3 inches thick. Another tree at 1200 feet elevation, 244 years old, was 43 inches in diameter, with bark 6 inches thick. In the dry region the tree ranges from 70 to 120 feet high and from 20 to 50 inches diameter. He remarks that the species resists fire better than any other conifer of this region, and bears fertile cones at an earlier age than any other, a tree of only twelve years old having well developed cones.

Observations on the rapid growth of Douglas fir at various ages in its own country are given by Mayr.¹ In southern Oregon, on the best sandy loam, with a rich humus, he measured Douglas firs 130 feet high at eighty years old; a fallen stem, 100 feet high, contained 135 cubic feet.

The wood of the Douglas fir is known in the European, South African, and Australian markets as Oregon pine or Oregon fir, on the Pacific coast of North America as red fir or yellow fir, in Utah, Idaho, and Colorado as red pine, and in California is sometimes incorrectly called spruce or hemlock. It produces probably a larger quantity of commercial lumber than any other conifer in the new world, or at least on the Pacific coast; and is likely to continue the principal source of supply for most purposes, as the white pine (*P. Strobus*) of the New England states and Canada, and the long-leaved or pitch pine of the southern states become scarcer; and as its timber is likely in the future to become an important article of trade in Europe, both as an imported and home-grown product, I think it may be useful to give some particulars of the way in which the immense sawmills of Oregon, Washington, and British Columbia are managed.

First, as regards the growth of the timber, Prof. Sheldon, the Oregon State forestry expert, has published in the *Oregon Timberman*, May 1904, a valuable paper, which entirely confirms my own much more limited observations, and goes to show that the two forms locally known as red and yellow fir are not in any way distinct, but are simply the result of different conditions of growth.

When the trees grow in an open space, and have the annual rings, as is usually the case in youth, pretty far apart, they may attain at the butt 16 to 18 inches diameter at forty years. In such trees the thickness of the sap-wood is from 2 to 3

¹ *Fremdländ. Wald- u. Parkbäume*, 398 (1906).

inches, and the thickness of the bark, which under such conditions is comparatively smooth and greyish in colour, is about $\frac{1}{2}$ inch. The timber of such trees would be known as red fir. When the tree, however, becomes crowded by its neighbours, and its girth increment is much slower, all the energy of the tree being devoted to upward growth, the rings become much closer, and trees of fifty to sixty years of age may be only 1 foot in diameter. The bark in such cases is much thinner, and the quality of the timber from the point at which the slower growth began much better, so that it would be classed as yellow fir when sawn up. Prof. Sheldon gives figures showing sections of such trees, his Plate 6 showing the influence of light, room, and nourishment on the growing tree. The tree from which this section was made was 143 years old with a diameter of only $16\frac{1}{2}$ inches. For 116 years it had stood in a crowded forest with large trees 4 and 5 feet in diameter all round it. Twenty-seven years ago the large trees were felled, and the growth immediately became much more rapid. The sap-wood in this case is $3\frac{1}{2}$ to 4 inches and the bark $1\frac{1}{2}$ inch thick. He says, "The result of this study is to conclude that the rapid growth of Oregon fir in the open produces red fir, and the subsequent growth when the trees begin to crowd each other produces yellow fir. Trees grown in dense clumps crowded all their life produce solid yellow fir. The growth of the upper portion of the tree may show larger annual growths in the centre than are found near the butt of the same tree. This is of interest in accounting for the immense height of the Oregon fir in many places, as trees 300 to 350 feet high are found in the forests of Oregon and Washington."

I asked experienced loggers whether they could distinguish red from yellow fir as they grew, and my impression was that they could not, though they said a very few blows of the axe would soon show the difference in the hardness of the wood. With the object of finding out the age at which the tree comes to maturity, I measured the rings of several trees recently felled at the logging camps which I visited. I am much indebted to the managers of these mills, for the facilities which they gave me to see the whole operations of a modern west coast lumberman. Among them Mr. Bradley of the Bridal Veil Company, Oregon; Mr. Browne, president of the St. Paul and Tacoma Sawmills, Tacoma, Washington, and his logging contractor, Mr. M'Dougall; Mr. Palmer of the Chemainus Mills, Vancouver Island; and Mr. Kenneth Ross, manager of the Big Blackfoot Lumber Company, Montana, were all most obliging and hospitable.

I found that the average age of mature trees 4 to 6 feet in diameter on the stump is 300 to 500 years. At an age of from 400 to 500 years, and possibly much sooner in some cases, the trees begin to decline in health, and some of those felled are more or less hollow. In all cases the annual rings for the first fifty to seventy years are very much thicker than for the next 300 years, the best trees having from four to five rings to the inch at first, and afterwards as many as fifteen to twenty. The better class trees are clear of branches up to about 120 to 150 feet, and in such cases produce wood free from knots, or "clear lumber" as it is called in the trade. Such clear lumber, however, even when a large number of trees are rejected by the fellers, does not exceed 15 to 30 per cent of the total

product, and is worth a much higher price than the more or less knotty lumber known as "merchantable."

The business of lumbering which has been carried on for many years on a very large scale is, on the Pacific coast, as in most parts of North America, conducted in a way which, though perhaps necessary in order to meet the severe competition for price which everywhere prevails, would shock the feelings of any European forester, on account of its wastefulness and the absolute disregard which is paid to the future of the forest; which is in most cases abandoned to fire, as soon as the soundest, cleanest, and most accessible trees have been extracted.

A tract of land having been first surveyed, and its probable contents roughly estimated by the "cruiser," on whose judgment in selecting the best field of operations much of the success of the business depends, is purchased or leased from the owner on the basis of so much per thousand feet board measure. This estimate runs in most cases from 20,000 to 70,000 feet per acre, and as far as I could judge is rarely more than half, and often much less than half, of the actual contents, which in favourable situations amounts to as much as 300,000 to 500,000 feet per acre.

Unless the timber to be felled is near the sea,—in which case it is on Puget Sound often slid direct into the salt water, made up into rafts, and towed by steamers to the sawmill,—the next operation is to build a railroad up the valley to bring the logs from the forest to the sawmill. Sometimes the mill is in the forest itself, and a wooden flume of many miles in length is built, by which the sawn boards can be floated down to the nearest railway station. Sometimes the logs themselves are floated to the mill, where a large enough river exists; or a combination of railway, river, and flume may have to be adopted as the distance from the mill or station increases. The cost of extracting the logs from the forest and bringing them to their shipping point, governs the value of the growing timber, which is rapidly becoming less and less accessible as the best areas are cut over.

When the means of transport are completed, a "skid road" or a temporary tramway is built right up to where the trees grow, and powerful movable donkey engines are used, which are able, with a steel-wire rope, to drag logs of 40 to 50 feet long to a distance of 1000 yards or more from where they fall. Felling then commences and is managed as follows:—The most experienced man in the gang, having marked the trees to be felled, cuts a deep notch into one side at 4 to 6 feet from the ground, after carefully considering which way the tree should fall, so as to run least risk of lodging, or of breaking in falling. Both the undercutting and the sawing which follows, are done on spring boards fixed into a notch cut into the butt at 3 to 4 feet from the ground. When the two fellers, who sometimes make the notch themselves, have got within 5 to 6 inches of it, they insert large iron wedges in the sawcut, carefully watching the top of the tree to see where the wedges should be driven, so as to fell the tree with least danger to themselves and the log. After a few blows on the wedges the tree begins to lean and the men jump clear, calling out to warn others who may be near. There is some risk of large branches being torn off the falling tree or adjacent trees, and many accidents occur.

When the tree comes down, it is cross-cut by other men paid at a lower rate than the fellers, into such lengths as seem best. The smaller end of the log is then bevelled off and two deep notches cut, into which a pair of iron claws are fixed, and attached to the wire rope of the donkey engine. A signal is then given by wire from the men in charge of the log to the engineer, who commences winding up the rope, and with frequent stoppages caused by the log being jammed among stumps and other obstructions, it is at last dragged either to a prepared skid road, where another donkey engine hauls it to the loading point, or direct to where the trucks are able to load it. The loading is managed by building a rolling stage of heavy timbers down which the logs can be slid, or up which they are rolled by a donkey engine on to the trucks. Sometimes a dam is built and a pond formed, into which all the logs are dragged and rolled out on to the trucks. In fact there is no end to the ingenuity of the logging contractor in devising mechanical means for handling these great logs, often 4, 5, and 6 feet in diameter, with the least expense and trouble. Many logs which to an inexperienced eye would be thought valuable, are left either because they would cost more than they are worth to get out, or because they are more or less faulty; and in all cases that I saw, the work is done without the least regard to the younger trees, or to the future. Sometimes half the trees are left standing and as much is left after felling as is taken. The price per 1000 feet at the sawmill is the one governing idea.

When the logs reach the sawmill they usually go into a pond, from which they are hauled as required up an inclined plane to the saw bench. In the largest and modern mills the band-saw has replaced the gang-saws formerly used, and works at an incredible speed, saving a great deal of wood which was formerly eaten up by the saw. Some of the band-saws are double-edged; and after taking off the slabs and squaring the log, it is then converted into whatever sized lumber is wanted; the best quality being cut into vertical grained decking or flooring, 4 to 6 inches wide.

The ingenious arrangements by which everything in these great mills is arranged so as to save manual labour, must be seen to be appreciated. I found many of the men employed were Japanese, who are said to be excellent workmen and to possess both nerve and pluck.

When the boards are cut, the best are sorted out and sent to the drying kiln where they are dried for four or six days in order to prepare them for planing, tonguing, and grooving; which is usually done in another part of the same establishment by machinery, before the finished wood is put in cars for transport to the interior.

Much of it now goes to the middle states, and a great deal to South Africa, China, and Australia; but whenever very large-sized balks, masts, or piles are wanted, the Puget Sound mills are called on to fill the order, because no others in the world can supply timbers of such great size at so cheap a rate. Logs of 24 inches square and up to 100 feet long are regularly quoted.

The Douglas Flagstaff,¹ in Kew Gardens, came from Vancouver Island, and was

¹ Cf. *Journ. R. Hort. Soc.* xiv. 452 (1892).

presented in 1861 by Mr. Edward Stamp. It is 159 feet high, about 12 feet being underground, and is about $4\frac{1}{2}$ feet in girth at ground-level. It weighed 4 tons 8 cwt., and was about 250 years old. In the British Museum of Natural History there is a section cut in 1885, 7 feet 7 inches in diameter, including bark, on which 533 annual rings may be counted. There is also in the Timbers Museum at Kew a fine section, 8 feet in diameter, cut from a tree on Puget Sound.

A technical report on the strength, weight, and structural value of Douglas timber is given by Hatt in *U.S. Bureau of Forestry*, Circular No. 32 (1904), from which it appears that the possibility of obtaining long and large pieces, combined with the exceptional strength and stiffness of the material, compared with its very moderate weight, renders it an ideal timber for structural purposes, and durable on exposure to weather.

In a report on the Forest Products of the United States for 1906 (issued March 1908)¹ I find that this species now comes second in the quantity of timber produced, being only surpassed by "yellow pine," under which heading are included all the various pines of the south and east except white and Norway pine (*P. Strobus* and *P. resinosa*). The quantity cut in 1906 was estimated at 5 billion feet, valued at 70 million dollars, of which the state of Washington yielded 68.5 per cent, Oregon 27.2 per cent, and all the other states together less than 5 per cent. The increase in production was very rapid in the last few years, and the average value had increased from 8.67 dollars per 1000 in 1899 to 14.20 dollars in 1906.

I am informed by Mr. R. S. Kellogg of the United States Forestry Bureau, Washington, that on the Pacific coast all masts except the smallest, and on the east coast the largest masts, are made of Douglas fir, which is transported overland from the Pacific coast.

It is the opinion of Lieut.-Commander Williams of the Bureau of Construction and Repair, U.S. Navy Dept., that there is practically no difference in the strength of Douglas fir and long-leaf pine (*P. palustris*); the latter, however, is considerably heavier. This appears to be now generally recognised by yacht-builders in Europe who use Douglas fir in preference to any other timber for the masts of racing yachts.

A letter on the timber of this tree in *Gardeners' Chronicle*, 1862, p. 452, gives the results of experiments made at Cherbourg by M. Serres on twelve specimens of squared mast timber sent from Vancouver, which showed that in strength it was almost equal to Florida pitch pine, and stronger than Baltic or Canadian pine. The weight of a compound mast made up of pitch pine in the centre and Baltic or Canada pine on the outside was about 12,200 kilos., whilst a solid mast of the same dimensions, made of Douglas fir, weighed only 8900 kilos. The cost of material and workmanship of the latter was very much less.

Mayr's comparison² of the wood as grown in various parts of Europe, with that grown in America, and also with that of silver fir, spruce, and larch, is well worth studying; but the age of the trees was insufficient to make the comparison conclusive.

¹ *U.S. Dept. Agr. Forest Service Bull.* 77.

² *Fremdländ. Wald- u. Parkbäume*, 399, 400 (1906).

With regard to the future of the Douglas fir forests it is very hard to say to what extent or for what period the present supply will last. Axe and fire are certainly destroying them at a great rate, but the reproduction all over the coast region is so good, and the danger of fire in dense young growths of trees so small, that many places cleared twenty to forty years ago are already covered with healthy young trees; and though the size and quality of these will probably never equal those of the virgin forests, yet there is no reason why, with reasonable care, the forests should be devastated as they are now. On the drier mountains of the interior, the danger of destruction is greater; and it seems to me that whilst Douglas pine is the dominant tree of the coast region, *Pinus ponderosa*, owing to its thicker bark and greater adaptability to dry soils and climates, will replace it in the interior.

INTRODUCTION

The Douglas fir was discovered by Menzies at Nootka Sound in 1797. Seeds were, however, first sent home by Douglas in 1827, from which plants were raised by the Horticultural Society of London and distributed throughout the country. According to a note by Mr. Frost¹ the tree at Dropmore, which is usually considered to be the oldest in England, was raised from seed sown by himself in the winter of 1827-1828.

CULTIVATION

The best account² of the cultivation of Douglas fir yet written is by Mr. Crozier, forester on the Durris estate in Kincardineshire, who has paid special attention to this tree, and is one of the most experienced foresters in Scotland. He prefers to collect home-grown seed, and considers that much may be done to improve the type of the tree commercially, by selection of the best varieties as seed-bearers; and states that the production of seed in good years is enormous, no less than 15,000 cones having been counted on an outlying specimen tree about 40 years old.

The seed ripens about the beginning of October, when the cones should be gathered without delay before the seed escapes. After storage in a dry loft through the winter, the cones are exposed to sun heat, which causes them to shed the seed. In the beginning of May the seed is sown in beds 3 to 3½ feet wide, one pound being allowed to every 8 or 10 yards. The seedlings are transplanted at two years old, and Mr. Crozier prefers to plant them out in the month of April one year later by notching, or if the ground is liable to be covered with bracken or herbage, by pitting in plants a year older.

So far as my own observations go this tree will not grow well on clay or on the oolite formation, but it thrives on greensand, and on sandstone of the Llandovery group at Tortworth. If desired to grow to a large size, it should be planted in a well-sheltered situation, where the soil is of sufficient depth and fertility to keep the trees growing for a long period, but in exposed situations the tops are ruined by the

¹ *Gard. Chron.* 1871, p. 1360.

² *Trans. Roy. Scot. Arb. Soc.* xxi. 31 (1908).

wind. All attempts to grow this tree into timber on bare, exposed, or barren downs and hillsides will, I believe, prove futile.¹

The Colorado or glaucous variety has been so much spoken of, and is recognised so universally in cultivation as a distinct form, that we must speak of its peculiarities in full. It is usually supposed to be known by its colour, which is variable in all races of the tree; and I know of a case in which colour alone was considered by a forestry expert, to be sufficient to condemn as seed-bearing parents, a large number of vigorous healthy trees of great size, which were certainly of Pacific coast origin.

The Rocky Mountain forms, of which the Colorado one may be taken as typical, are constitutionally able to endure a continental climate; namely, one characterised by extremes of summer heat and winter cold; whilst the coast form is less hardy, though it will endure the extremes of climate in most parts of Great Britain, and is a very much larger, faster-growing, and, from a forester's point of view, more valuable tree.

They are at Colesborne equally liable to suffer from late spring frost after growth has commenced; but Mayr, whose experience of both is considerable, says that the Colorado form in Germany, does not suffer like the other, from the freezing of the immature shoots in autumn and early winter; and wherever this is a common cause of injury to the coast form, the mountain form should be tried instead. Such places, however, are rare in England; and on this subject I cannot do better than quote the opinion of Mr. Crozier. In a letter to me he says, "That there are two well-defined forms no one with practical experience of the tree will deny, but whether that known as 'Colorado' is confined to the state of that name seems doubtful. As a timber tree, however, my experience convinces me that in the north of Scotland at least it is a failure, and whatever advantages it may possess over the Oregon variety in its nursery stages, is really of no moment, as after a trial of between thirty and forty years, under the most favourable conditions of soil, shelter, etc., it has failed to make timber on this estate; while the Oregon variety, under much less favourable conditions, has never failed to make good headway. The cone² also differs from that of the Oregon variety in some important respects, being much smaller, with the bracts a great deal longer and reflexed."

"I made a further experiment with this tree some years ago, and may give you the dimensions of average specimens at the present time of Oregon and Colorado Douglas and Norway spruce, grown under exactly similar conditions side by side. The age of the Colorado Douglas and Norway spruce is twelve years, while the Oregon Douglas is ten years from sowing.

	Height.	Three last years' growth.	Girth at 6 inches high.
Oregon Douglas	15 feet 6 inches	8 feet 10 inches	9½ inches
Colorado Douglas	10 „ 11 „	5 „ 5 „	6¼ „
Spruce	8 „ 10 „	4 „ 5 „	5¼ „

¹ According to Mr. Bean, in *Kew Bulletin*, 1906, p. 268, this species is used as a hedge plant at Monzie Castle, and answers the purpose very well, being dense and well-furnished.

² The cones on cultivated trees are very variable. Cf. *Gard. Chron.* xxviii. 12 (1900).

These have been planted seven years, and though for a time the Colorado held their own with the spruce they are now being left behind."

"We have raised some millions of the Oregon variety and find it sufficiently hardy for all practical purposes. It does frequently make a second growth in the nursery stages, and these may be killed back, but the damage done in this respect is not serious. After being planted out and established in the plantation, they are capable of bearing a greater degree of exposure than the Norway spruce, and may be seen on the lower spurs of the Grampians easily beating the latter. In the treeless district of Buchan it does not do well, but neither does any other tree; but for general planting in Scotland, and with ordinary precautions, it is quite valuable."

"A member of an old firm of nurserymen informed me that it is about fifteen years since the Colorado variety first began to be sent to this country in quantity, and they only found out the mistake after the seedlings came up. To speak of the Colorado as 'glaucous' and the Oregon as the green variety would be incorrect, as both vary in colour. The Colorado may be found of all shades from green to a rich glaucous, while the Oregon runs from a dark bluish tint to a light green."

A most striking instance of the different rate of growth of the two trees may be seen in Dr. Watney's avenue at Buckhold in Berkshire, where Oregon Douglas about $3\frac{1}{2}$ feet high were planted in the winter of 1882-83, in trenched ground on a gravelly soil with some clay, underlaid at a depth of 10 to 12 feet by chalk. Five of the best of these average in 1908 59 feet 8 inches in height by 4 feet in girth. The largest was 65 feet by 5 feet 3 inches, showing $2\frac{1}{2}$ feet of annual height increase for twenty-four years. Colorado Douglas (so-called) planted on the same land at the same time, were, when I saw them, not above half this size.

In the Great Bear plantation, on the same estate, planted October 1895, and steam cultivated 15 inches deep, Dr. Watney has measured six average Colorado Douglas, planted about 3 feet high, now 13 feet by $6\frac{2}{3}$ inches; six average Scots pine, planted about $1\frac{1}{2}$ feet high, now 18 feet by 12 inches; six average larch, planted about 2 feet high, now 19 feet 7 inches by $9\frac{1}{4}$ inches. According to his experience the Colorado have many small branches which extend but a short distance from the stem, whilst the Oregon are distinguished by wide-spreading branches set much farther apart on the stem. He says that the latter is the fastest-growing tree he knows, whilst the former is probably the most useless of all the common conifers he has grown; and yet he is told by a leading nurseryman that about one-third of the seed he buys produces plants which are apparently of the Colorado variety. These trees are sold and planted somewhere, to the great ultimate loss and disappointment of the unwary planter.

The Douglas fir is usually healthy and little liable to insect or fungus attacks. However, of late years, a fungus, *Botrytis Douglasii*, Tubeuf, which is known as the Douglas fir blight,¹ has caused considerable danger to young trees growing in nurseries. The leaves, especially those on the upper shoots, wilt and fall off; and

¹ Fisher, Schlich's *Man. Forestry*, iv. 461 (1907).

the plants frequently die. There is an illustrated article on this fungus in the *Journal of the Board of Agriculture* for June 1903.

I am informed by Capt. the Hon. R. Coke that in January 1907 there was a bad attack of this fungus, on two-year-old plants in the nurseries at Weasenham, Norfolk, and on some trees of the same age which were planted out in the previous autumn. He was advised at Kew to burn all the affected plants, and spray the remainder with "Violet Mixture."¹ About 25 per cent of the infected plants died or were removed as worthless; the remainder outgrew the disease, and are now (June 1908) looking well, though the fungus has not entirely disappeared. Capt. Coke adds that, after trying the so-called Colorado variety, he will plant no more of them; and that as seedlings of the Oregon variety vary a good deal, he prefers those which show a tendency to stop growing in time to ripen their leader.

The seeds are liable to be destroyed by the larva of an insect,² *Megastigmus spermotrophus*, which has been introduced into Europe from Oregon. The eggs are laid by the insect in the young cones, and one larva develops in each seed and destroys it. This pest has been observed at Mariabrunn, and has done great damage in Denmark; and during 1905 and 1906 was so serious at Durriss in Aberdeenshire, that no seed was worth collecting there.

REMARKABLE TREES AND PLANTATIONS

The largest tree that we have heard of in Europe, is at Eggesford, in Devonshire (Plate 229). This tree must be as old as any existing, for it was reported³ in 1865 to be then about forty years old and 100 feet high. This, however, was an exaggeration, as three years later it was recorded⁴ by Mr. A. Spreadbury, as being 93 feet by 12 feet at three feet from the ground. I measured it carefully in company with Mr. Asprey, agent to the Earl of Portsmouth, in April 1908, and found it, by the mean of two measurements from opposite sides, to be 128 feet by $18\frac{1}{2}$ feet. About four feet from the ground two very large spreading branches come off, which at two feet from the trunk are 6 feet 9 inches and 5 feet in girth. At 30 feet from the ground, the stem is still 13 feet 5 inches round, and at 100 feet it girths 3 feet 3 inches; so that it must contain about 700 feet of timber. It grows on a lawn facing east, a little above the river Exe, on a soil which is evidently deep and fertile; and if the top is not broken may become a much larger tree, though it has only increased 35 feet in height in forty years.

The largest tree in the grounds at Endsleigh was reported by Mr. R. G. Forbes to be, in 1906, 100 feet high, with a quarter-girth of 26 inches in the middle; but in remeasuring it by climbing in 1908, he informs me that it is only measurable to a height of 87 feet. The quarter-girth over bark at $43\frac{1}{2}$ feet is $26\frac{1}{2}$ inches. Allowing

¹ This is composed of sulphate of copper, 2 lbs.; carbonate of copper, 3 lbs.; permanganate of potash, 3 oz.; soft soap, $\frac{1}{2}$ lb.; rain water, 18 gallons.

² Cf. *Gard. Chron.* xxxix. 57 (1906), *Trans. R. Scot. Arb. Soc.* xix. 52 (1906), and *Journ. Board Agriculture*, xii. 615 (1906), where an article on the insect with figures is given by Dr. R. Stewart MacDougall.

³ *Trans. Scot. Arb. Soc.* iii. 80.

⁴ *Gard. Chron.* 1868, p. 1189.

2½ inches for bark, its contents are therefore 87 feet by 24¼ inches, making 355 cubic feet, instead of 469, as stated in *Quarterly Journal of Forestry*, i. 107 (1907).

At the time of the Conifer Conference in 1891, a tree¹ at Dropmore was stated to have been then 120 feet by 11 feet; but I measured this tree in 1905 and could not make it more than 107 feet by 11½ feet, a considerable part of the top having been, as I was told, broken off by the wind. I measured it again carefully in June 1908, when it was 110 feet by 12 feet in girth.

At Walcot there is a very large tree planted in 1842, of which the Earl of Powis gave me a series of measurements. The first taken in 1860 was 74 feet by 7 feet; the second in 1872, 85 feet by 8 feet 10 inches; the third in 1892, 107 feet by 12 feet 9 inches; the fourth in April 1906, taken with a theodolite, was given as 122 feet by 15 feet 6 inches; all the girths taken at 4 feet. The cubic contents were 393 feet. I measured what I believed to be the same tree carefully from both sides, in March 1906, and made it 114 feet by 14 feet 2 inches at 5 feet, and noticed that the top had been somewhat broken. Thus it is evident in both these trees that after they had attained about sixty years old, the height increased much more slowly.

There are two trees at Powis Castle, one of which on the rabbit bank, near the park gate, I made from 112 to 115 feet by 11 feet 10 inches (this is the mean of two measurements from opposite sides as the tree² leans a good deal), and the other in a thick plantation, close to a pond, which, though I cannot, owing to its position, be confident that it is over 130 feet, may be 5 feet or more higher, and is more likely to increase in height than any Douglas fir that I have seen. It is only 9 feet 5 inches in girth and quite the finest timber tree of the sort I know in England.³

There is a tree at Highclere which, in 1903, was about 100 feet by 13 feet 8 inches. At Barton, Suffolk, a tree planted in 1831 measured in 1904, 107 feet high by 10 feet 1 inch in girth, and, while beautifully clothed to the base, was rather thin at the top with a divided leader. At Bury Hill, near Dorking, are perhaps the oldest and largest trees in Surrey, which, as Mr. R. Barclay told me, were planted by his father about 1832. The largest in 1908 measured 104 feet by 12 feet 2 inches, and appeared to have lost its leader recently.

At Albury, Sussex, there are two trees, which in 1904 measured 95 feet by 6 feet 2 inches and 82 feet by 8 feet 3 inches. At Cassiobury, Herts, there is another, which, according to the label, was planted in 1830, and had attained in 1904, 99 feet in height and 11 feet 3 inches in girth. This has now lost its leader, and has remarkably pendent branches, with leaves conspicuously white

¹ The tree at Dropmore, raised from seed, sown in the mid-winter of 1827, was planted out in 1829, and has shown the following growth:—

Measured	1837	1843	1846	1851	1853	1860	1862	1867	1868	1871
Height in feet	18	40	48½	62½	65	78	85	93	95	100

Cf. *Gard. Chron.* 1843, p. 808; 1846, p. 661; 1851, p. 246; 1853, p. 343; 1860, p. 854; 1867, p. 808; 1868, p. 465; 1871, p. 1360.

² Lord Powis had this tree measured in 1908, by a man climbing, as 127 feet by 12 feet 1 inch. I cannot account for the difference.

³ I measured this tree again in July 1908, and having found a spot from which I could see the top, am confident that it is more than 130 feet high. It had increased 5 inches in girth in two years.

beneath. At Fulmodestone, Norfolk, Sir Hugh Beevor measured, in 1904, a tree 98 feet high by 8½ feet in girth. Henry saw a tree there in 1905, which was 82 feet by 9 feet 4 inches.

Many other trees which approach if they do not exceed 100 feet in height, may be found in the southern and western counties.

At Endsleigh, in Devonshire, which was visited by the English Arboricultural Society¹ in August 1906, there is a very fine plantation of Douglas fir in Gunoak Wood, of which careful measurements were made by Mr. R. G. Forbes, forester to the Duke of Bedford, in November 1906, from which it appears that the three largest trees in this plantation measure as follows:—

No. 16.	120 feet high by 11 inches quarter-girth = 100 cubic feet.
No. 23.	100 " 13 " = 117 "
No. 30.	110 " 13 " = 129 "

Mr. E. C. Rundle, agent for the property, writes to me as follows: "The forester says that the trees must not be taken as a full crop, for there is space on the ¼ acre for forty trees instead of thirty-two. As to their age I believe they must be over fifty years, probably fifty-five, though an old man remembers their being planted. The quarter-girth was taken over bark at half the length of the tree, and an inch to the foot would be sufficient allowance. They are growing in an exposed position, but in the middle of a wood on high ground, and the soil is not at all good." The total contents of the thirty-two trees is 2857 cubic feet, an average of rather over 89 feet per tree. If 357 feet is deducted from the total for bark and small tops, it will leave a result of 10,000 feet per acre.

At Woburn, in a plantation called "The Evergreens," on a very light sandy soil, Mr. Mitchell, forester to the Duke of Bedford, showed me a plantation made in 1882, well sheltered by surrounding trees, and wrote me the following particulars:—

"The number of trees planted was 160, of which 132 are now left. I thinned them a few years ago, taking out only dead and suppressed trees. The area of land is as nearly as possible 2 chains square, and includes a few old Scotch and spruce fir. I measured the trees in three classes, as follows:—

72 trees:	50 feet by 6 inches quarter-girth = 900 cubic feet.
40 "	55 " 6½ " " 645 "
20 "	50 " 4 " " 111 "
	1656 "
	Deduct for bark at 8 per cent . 136 "
	Total contents of timber . 1520 "

This works out at 3800 cubic feet per acre at twenty-six years after planting," say thirty years from seed. I may add that though these trees were planted close enough to kill all their lower branches, yet none of these had fallen, and a good many of the stems showed the same want of straightness which is so often evident in this

¹ *Quarterly Journal of Forestry*, i. 64 (1907).

species in England, and which I attribute to the unripeness of their sappy leaders before winter.

In 1904 the Earl of Ducie showed me a plantation of Douglas fir on a steep bank called Ironmill Wood near Tortworth, which, though of insufficient area to give the best results, is a good illustration of the growth of this tree on sandstone (Plate 231). The plantation was made in 1868, and was therefore thirty-six years old when I saw it. The area, as measured by Mr. Harle, agent to Lord Ducie, was 1 acre 28 perches; the number of trees standing was 238; their average height was about 80 feet; and their average cubic contents I estimated at slightly over 20 feet, making a total of about 5000 feet per acre. Mr. A. P. Grenfell, who visited the same place in the same year, made a more careful estimate based on the measurements of the trees standing on $\frac{1}{10}$ of an acre, and came to the conclusion that the total volume, with allowance for bark, was 5250 feet, which gives an annual average increase of 150 cubic feet per acre, no allowance being made for thinnings.

Mr. G. F. Luttrell of Dunster Castle, Somersetshire, showed me, in August 1906, a plantation of Douglas fir which he made in 1880 on a piece of waste land, which was growing only furze, on gravelly soil close to the rock, which is on the Old Red Sandstone formation. In the following December he had this carefully measured, with the following result:—Broom Ball Wood, area 3 roods 10 perches, planted entirely with Douglas fir at about 10 feet apart. Number of trees now standing, 264. Total contents, allowing half an inch for bark, 2491 cubic feet. Of these, 158 trees contain less than 10 cubic feet each, and only 7 contain above 20 cubic feet, the largest tree measuring 42 feet timber length and 10 inches quarter-girth, equal to a volume of 29 cubic feet. The actual height of the tallest was 73 feet, of the shortest 48 feet.

The trees are valued as timber by Mr. Luttrell's forester at 6d. a foot, which amounts on the estimated quantity to £62:6s., equal to £76:13:6 per acre. Deducting from this sum, the expenses of planting and fencing, £6 an acre in 1880, equivalent in 1906, at 4 per cent. interest, to £16 12 6 and the annual deferred rent at 5s. an acre, from 1880 to 1906, equivalent to 11 0 0

£27 12 6

the balance, £49:1s., represents the actual profit per acre 49 1 0

£76 13 6

It seems to me that the price of 6d. per foot for trees of this size is somewhat excessive, as those of less than 10 feet are hardly fit for anything but pitwood or rough fencing; but the value of the trees over 10 feet might be somewhat higher.

From the appearance of this plantation, in which many of the smaller trees were already suppressed and not likely to grow much more, it seemed to me that either a heavy thinning or clean felling was the proper thing to do, but this must depend on the local demand for timber of this size and quality. And if the small area, exposed position, and inferior agricultural quality of the land be taken into

consideration, there can be no doubt that this has been an unusually profitable investment, and one which would fully justify planting Douglas fir on a large scale in this district. Mr. Luttrell states that where there is sufficient room and light the trees reproduce freely from seed.

In Scotland there are many Douglas firs exceeding 100 feet in height, but we cannot say which is actually the largest; and if we did, it would not hold good for many years to come. The tallest recorded at the Conifer Conference¹ in 1891 was at Lynedoch, on Lord Mansfield's property in Perthshire, which was then reported to be 92 feet by 12 feet, but had a fork at 60 feet from the ground² (Plate 230). Another tree at the same place, is the parent of the seedlings planted at Scone and Taymount, and was only 72½ feet by 11 feet 2 inches, though planted in 1834.

One of the oldest trees is in the grounds of Scone Palace, and bears the inscription "raised from the first seed, brought by David Douglas in 1827, planted 1834." In 1850 it was transplanted to its present position, and this has doubtless checked its growth. It measured, in 1904, 96 feet high by 10 feet in girth. Its foliage is conspicuously white beneath.

At Drumlanrig, in Dumfriesshire, there is also an original tree, which was sent by David Douglas to his brother, who was clerk of works at Drumlanrig about 1832. It is growing in shallow gravelly soil near the top of a hill, overlooking a glen, and in 1904 measured 90 feet high by 11 feet 4 inches in girth.

Mr. R. Macleod of Cadboll sends me the measurements of four trees taken in 1907 by Mr. C. E. Cranstoun at Corehouse, near Lanark, as follows:—

No.	Height.	Girth at 5 feet.
1.	70½ feet.	12 feet 5 inches.
2.	83 "	10 " 7 "
3.	85 "	12 " 4 "
4.	92 "	7 " 6 "

He adds that these were raised from the first seed sent to Scotland by Douglas; and that he finds by repeated measurements of several trees, that their rate of girth increase is about 2 inches per annum.

At Durris, in Kincardineshire, the original and largest tree, planted about seventy-two years ago, has now reached 114 feet by 12½ feet, and contains over 300 feet of timber. At Buchanan Castle, Stirlingshire, Mr. Renwick measured³ in 1900 an original tree 85 feet by 13 feet 2 inches. He informs us that the girth in 1908 is 14 feet 2½ inches.

At Murthly Castle there are probably more large trees of this species than anywhere in Scotland, the plantation below the castle being especially fine, and also the avenue called the Dolphin Walk, where the trees, planted about 8 yards apart,

¹ *Journ. Roy. Hort. Soc.* xiv. 537 (1892).

² An accurate measurement of this tree, made in January 1908 by Mr. A. T. Kinnear, makes it 108 feet high by 13 feet 9 inches at 5 feet. The main stem up to the fork, 60 feet from the ground, contains 415 feet, and the two tops together, 48 feet, making the whole 463 cubic feet.

³ *Trans. Nat. Hist. Soc. Glasgow*, vi. 256 (1900).

average about 90 feet by 8 feet, and grow at the foot of a bank, in deep sand with pebbles in it, which looks like an old bank of the Tay, which is not far off. In *The Garden* for 19th May 1900, some particulars are given of the trees here. One, planted in 1847, measured on 11th August 1892, 86½ feet by 8 feet 10 inches, and on 24th March 1900, 97 feet 4 inches by 9 feet 10 inches. A great many others were of about the same size. This proves the diminishing rate of increase, both in height and girth, after forty to fifty years' growth, even when the lower branches remain. Mr. Fotheringham states that all these measurements were taken by sending men or boys up the trees, and not with a dendrometer. He adds that the temperature¹ in February 1895 was for several days below zero, and on one night went down to -11°.

There is probably no plantation in Great Britain about which so much has been written as the Taymount plantation on the estate of the Earl of Mansfield, in Perthshire. It lies about seven miles north of Perth, one mile from Stanley Station, and may be seen from the Highland Railway, which passes close to the east of it. The plantation covers eight acres of flat land, which is locally known as "till," two feet of light loam over red clay, and which may be worth for agricultural purposes 12s. to 15s. per acre. This plantation was first fully described in the *Gardeners' Chronicle* of 10th, 17th, and 24th November 1888, by Dr. Schlich, than whom there can be no higher authority. It was planted by the late W. M'Corquodale in the spring of 1860, with Douglas firs, two-year seedlings, two years transplanted, at 9 feet by 9 feet apart, with larch four years old, between every two firs, and an additional line of larch between every two rows, so that the trees stood 4½ feet apart, and each acre contained 538 Douglas and 1613 larch. The latter were gradually thinned out, and were all removed by 1880. The first thinning of Douglas took place in 1887, when about half the trees had already disappeared, 277 per acre only remaining. Of these 75 per acre were cut, leaving 202 per acre.

Dr. Schlich made a careful estimate of a sample plot measuring $\frac{1}{10}$ of an acre of average appearance, and had a tree felled to ascertain its actual contents; and from these data came to the conclusion that the total per acre was 3738 cubic feet of wood over 3 inches diameter, exclusive of top and branches, which gives an annual increment of 133 cubic feet per acre. But this estimate being the gross volume, when reduced by about one-fourth, makes the quarter-girth measurement, as adopted in English practice, to be 2934 cubic feet.

After inspecting a sample area of Scots pine in the same district, Dr. Schlich goes on to say, "If grown in a well-stocked, overcrowded wood, and in localities of equal quality, Douglas fir is not likely to produce more solid wood, during the first thirty or forty years, than the larch, and probably also not more than Scotch pine." He then goes into careful estimates of the probable future increase of the Douglas, based on data taken from America, where Dr. Mayr found that in the most favourable localities in the Cascade Mountains the average height of mature Douglas

¹ At Balmoral, where there are 25,000 to 30,000 trees, planted in the 'eighties, on a northern aspect at 1000 to 1200 feet altitude, Mr. Michie informs me in a letter that this severe frost, when the temperature fell to -17½°, did no harm to the Douglas fir.

firs on the best soil was 213 feet, with a diameter of 6½ feet, whilst in Montana it only reached an average height of 148 feet, with a diameter of 2.6 feet, thus showing what an immense influence the soil and rainfall have on the growth of this tree.

From a cross section of Douglas fir grown in Washington and then in the museum at Cooper's Hill, Dr. Schlich remarks "that the rate of growth indicated in this section, up to thirty years old, resembles that of an average tree in the Taymount plantation in a striking degree, as follows: diameter of average tree at Taymount at 4½ feet, 12 inches; diameter of thirty years' growth on the section from America, 11.9 inches.

After visiting a second growth area of pure Douglas fir on Ladds farm, about four miles from Portland, Oregon, which was believed to be of about fifty years' growth; I came to precisely the same conclusion, and though I had not then seen Dr. Schlich's article, I wrote in my journal at the time, that the trees in Oregon were very similar in density to those at Taymount, but decidedly cleaner and better grown, and having regard to their greater age and better soil, they might average 100 feet by 4 feet, and I estimated their cubic contents at something like 6000 feet per acre.

When I first visited Taymount, in April 1904, I determined to estimate it for myself, without regard to what others had done. I therefore paced an area of 100 yards long by 50 yards wide in what I thought a fair average of the whole plantation, and found that there were on it ninety-nine trees of the first size, and fifty trees of the second. I did not reckon a number of other trees, which were so small, crooked, or poor, that they could not have been sold profitably with the better ones; and, judging from a fallen tree which I was able to measure accurately, which was 55 feet long by 10 inches quarter-girth, equal to 38 cubic feet, came to the conclusion that the total volume of saleable timber at forty-four years after planting, or forty-eight years from the seed, did not much exceed 5000 feet per acre.

Sir Hugh Beevor visited Taymount in the autumn after I was there, and made an estimate in a different way by taking three different areas of $\frac{1}{4}$ acre each, and measuring everything on those areas. He found 96 trees of 12 inches quarter-girth and upwards at six feet from ground; 44 of 10 and 11 inches; 44 of below 10 inches; and estimated the total contents per acre at 6226 cubic feet.

I revisited Taymount in September 1906 in order to compare it again with what I had seen since in America and in England. I measured twenty trees in the fifth row and twenty in the tenth row from the bank on the east side of the plantation nearest to the high road. I found that their average girth over bark at 5 feet was slightly under 4 feet, the largest being 7 feet 10 inches and the smallest 2 feet 3 inches. I estimated the average timber length of these trees at 60 feet, and the quarter-girth, under bark at half this length, at 8 inches. If this is approximately correct, their average contents would be 26 feet 8 inches, and their total per acre something like 5400 feet, which very closely agrees with my previous estimate, allowing for the increase of two years.

A very different estimate was made by Dr. Somerville in a paper on "Exotic Conifers in Britain," which was printed in the *Journal of the Board of Agricul-*

ture, December 1903, and of which an abstract appeared in *Transactions of Royal Scottish Arboricultural Society*, xvii. 269. This was based on measurements made in June 1903, by the late Mr. Pitcaithley, forester to the late Earl of Mansfield, who selected two typical areas of $\frac{1}{10}$ acre each, on which he counted and measured the trees, of which he found eighteen on one and twenty-five on the other area, and accurately measured the cubic contents of two trees, one of which contained 46.76 cubic feet and the other 39.49 cubic feet measured down to 3 inches diameter. Dr. Somerville, assuming Mr. Pitcaithley's measured trees to be average ones, brings out the total cubic contents per acre by quarter-girth measure as 7977 cubic feet, and comparing this with Dr. Schlich's estimate of 2934 cubic feet made fifteen years previously, comes to the conclusion that the average increase per acre in that period was no less than 336 cubic feet per annum.

This in my opinion is a mistaken calculation, and if compared with the annual increment of 150 feet per acre per annum in Lord Ducie's plantation and the results of the measurement of Gunoak wood, both on better land than that at Taymount, we must hesitate to accept it as even approximately correct.¹

The important point to consider is how long these trees will continue to maintain their rapidity of growth, and what will be the value of the timber? My own belief is that they fall off in their rate of increase; that the larger ones will continue to suppress and starve out the weaker ones, as they have already done to a great extent; and that the timber of Douglas fir grown in the country will never compare in quality or value with the imported timber, which, it must always be remembered, is from 200 to 300 years old, and selected both in the forest and the mill from a very much larger quantity.

Dr. Schlich writes me as follows:—"As to the quality of the Douglas fir timber, I merely quoted what the late Mr. M'Corquodale told me. Since then I have paid some attention to the subject and noticed that in timber from young Douglas firs there is a considerable difference between spring wood and summer wood; hence I am sure, and in this I agree with you, that only trees of considerable age will yield timber equal in quality to that of larch, if at all."

There are other causes, which tend to make the production of clean, straight timber difficult, in many situations and on many soils in this country, and which should be considered by all who contemplate planting this species largely for profit.

The first is its tendency to form large and spreading branches, which it shows in a very marked degree. In order to prevent this, the trees must be crowded to an extent which is only possible with success on soils of unusual depth, or on slopes composed of rock which is sufficiently disintegrated to allow the roots to penetrate deeply; in which case they may clean themselves when they attain a height of 60 to 80 feet; though I have never seen any in England which have naturally cleaned

¹ After this was in print I sent it to the Earl of Mansfield for his opinion, and am informed that in 1908 a careful measurement was made by his forester, Mr. A. T. Kinnear, of the whole of Taymount plantation, which now contains 1536 Douglas firs on the whole area=192 trees to the acre. These contain 51,456 cubic feet (under bark) or 6432 cubic feet per acre, being an increase of 3498 cubic feet per acre since it was measured by Dr. Schlich in 1888, equal to about 134 feet per acre per annum since it was planted, the rate of increase from 1888 to 1908 being about 175 feet. The largest tree is 93 feet high, and contains 118 cubic feet.

their trunks. In default of these conditions recourse must be had to pruning, which entails considerable expense, and must be repeated at frequent intervals.

The second is the tendency which I have observed in so many places for the trees to ripen their leading shoot prematurely in dry summers, and to make a fresh start in the autumn when wet warm weather sets in. The result is that the second shoot is weak, immature, and usually becomes crooked either from frost, wind, or the settling of birds on it. A double lead is then often produced, and the result is seen in many plantations, in the more or less crooked stems,¹ or in forks, which must seriously depreciate the value of the timber when brought to the sawmill.

A third is the effect of gales on the leading shoots, which owing to their great length and weakness, seems greater than on any other conifer, especially as owing to the rapid growth of the tree it overtops other species with which it may be mixed. Even if the tops are not broken they become crooked, and often forked, in places exposed to wind, and the taller the trees become the more they are liable to this source of injury.

For these reasons it seems to me that the most profitable way of utilising Douglas fir, is to cut it at a comparatively early age, and utilise the wood for pit timber and estate purposes, for which purposes I am disposed to class it as superior to spruce or silver fir and inferior to larch.

In Ireland the Douglas fir grows very fast, and has attained in many places a large size. The late Lord Powerscourt planted at Powerscourt in 1865, with his own hands a tree which measured in 1904 100 feet in height and $9\frac{1}{2}$ feet in girth. There are good trees at Fota, Queenstown, 84 feet by $9\frac{1}{2}$ feet in 1903; at Carton, 81 feet by $7\frac{1}{2}$ feet in the same year; at Stradbally Hall, Queen's County, 86 feet by 8 feet 3 inches in 1907; at Coollattin, Wicklow, 85 feet by 9 feet in 1906. At Coollattin there are a few natural seedlings,² and several trees bear cones profusely; but the forester has not been able to raise plants from their seeds, doubtless owing to the cones being attacked by the insect which has done so much damage at Durrish in Kincardineshire. At Castlewella, Co. Down, there are fine trees, about 80 feet in height, which I could not measure on account of heavy rain when I was there in 1908. One measured by the Earl of Annesley in August 1908 is 79 feet by 10 feet, but lost 12 feet of its top in a gale in 1902.

The late Mr. John Booth of Berlin was a great admirer of this tree, and for many years advocated its planting in Germany, where it is now beginning to be looked upon as one of the most valuable forest trees. The result³ of an experiment made by the late Prince Bismarck, on his estates at Sachsenwald near Hamburg, was sent me by Mr. Booth just before his death, and may be summarised as follows:—

An area of 1.16 acre, the soil being a coarse, somewhat loamy, diluvial sand, was planted in 1881, half with four-year old Douglas, 5 feet apart, and half with spruce, 4 feet apart. In 1906, the Douglas plot consisted of 869 trees, measuring 3300 cubic feet of timber; while the spruce plot, 1335 trees, only

¹ This defect is clearly seen in the Taymount plantation.

² Natural seedlings were seen by Henry, also at Dereen and at Powerscourt.

³ Published in detail in *Zeitschrift für Forst- und Jagdwesen*, 1906, p. 8, of which a translation appeared in *Trans. Roy. Scot. Arbor. Soc.* xx. 104 (1907).

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measured 1700 cubic feet. The market value of the timber, which could be used for poles and pit-props, worked out at about 1000 marks for the Douglas, and about 360 marks for the spruce. Thus, growing on the same soil, the Douglas, as compared with the spruce, had yielded about twice the amount of timber, with about three times the value. I visited this plantation in August 1908, and measured two of the largest trees, which were 74 feet high by 3 feet 8 inches, and 2 feet 7 inches; but the average was considerably less. I noticed that the lower branches, though dead for several years, were not falling off; and that many of the trees showed the same irregularity in straightness that I have noticed elsewhere. My impression was that unless heavily thinned, a large proportion of the trees would soon be suppressed by their more vigorous neighbours, and that such close planting was neither economic nor desirable.

TIMBER

I have said so much about the timber of this tree in its own country that it only remains to speak of its probable future value here, and as this subject has been ably dealt with in a recent paper by Mr. J. D. Crozier,¹ I cannot do better than summarise his opinions.

He agrees with me that we cannot hope to compete with the imported timber in size, age, or quality, and thinks that in a young state it is not so dense in fibre or so tough as larch of the same age. "For standing in contact with soil, and for such purposes as gate-making, fencing, etc., where the ability to stand wear and tear is a desideratum, it is inferior to larch, but there are many other purposes for which it is infinitely superior, and for the supply of which an infinitely greater volume of timber is required. For constructive purposes of all kinds it is especially suited, and owing to the beauty of its grain and the ease with which it can be worked, it is valuable for the finished work of interiors. The timber stains well, and when varnished, takes on and retains a beautiful gloss. Outlying and badly-grown trees, when sawn up are liable to warp, but this defect is not apparent when dealing with trees of clean straight growth; and with home timber more freedom may be used in regard to nailing. In a younger state it has been tried and found useful as curing-barrel staves and headings, and for box wood, for which in this locality there is an unlimited demand."

"What the most profitable length of rotation may be is a question which will have to be determined by trade demands, but to provide timber of a class fitted for house construction, any period short of 100 years need not, I feel convinced, be contemplated, and on deep rich soils, probably other ten or twenty years will require to be added to that period."

"As a pitwood tree the Douglas fir is well adapted, and is deserving of consideration wherever crops cultivated for that purpose are found to pay. Crowded together in pure plantation, by the time they have reached their thirtieth year, they will be found capable of yielding an amount of pitwood almost incredible to those who have not seen the tree so grown. For this purpose the planting should not be done at more than 3 feet apart."
(H. J. E.)

¹ *Trans. Roy. Scot. Arb. Soc.* xxi. 31 (1908).

CASTANEA

Castanea, Adanson, *Fam. Pl.* ii. 375 (1763); Bentham et Hooker, *Gen. Pl.* iii. 409 (1880); Dode, *Bull. Soc. Dendr. France*, 1908, p. 140.
Fagus, Linnæus, *Gen. Pl.* 292 (in part) (1737).
Casanophorum, Necker, *Elem. Bot.* iii. 257 (1790).

TREES or shrubs, belonging to the order Fagaceæ. Bark furrowed. Buds all axillary, no true terminal bud being formed, as the tip of the branchlet falls off in early summer, leaving a small circular scar close to the uppermost axillary bud, which prolongs the branchlet in the following year. Buds alternate, arranged on the long shoots in two ranks; scales numerous, two or three of which are visible externally, lowest pair lateral and each composed of two connate stipules, next pair each corresponding to a stipule and with or without a leaf-rudiment, following pairs of single stipules each covering a young leaf; all the single stipules accrescent and marking in their fall the base of the shoot with ring-like scars.

Leaves deciduous, alternate, simple, stalked, dentate with slender glandular teeth, penninerved, each lateral nerve ending in a tooth. Stipules ovate or lanceolate, scarious, deciduous, their scars visible in winter on each side of the leaf-scars, which show three groups of bundle-dots, and are placed on prominent pulvini, from which decurrent lines descend along the branchlet.

Flowers monœcious, strong-smelling,¹ fertilised by the wind, unisexual, in slender elongated erect catkins, of which those arising in the axils of the lower leaves of the branchlet open early and are entirely composed of male flowers, while the catkins arising in the axils of the upper leaves are shorter and bear female flowers at their base and male flowers on their upper part, the latter not opening until after the female flowers have been fertilised. Staminate flowers three to seven, in a cyme in the axil of a bract, and surrounded by minute bracteoles; calyx campanulate, deeply divided into usually six segments, stamens twice or thrice as many as the calyx lobes; filaments filiform; anthers two-celled, dehiscing longitudinally; ovary aborted. Pistillate flowers, sessile, solitary or two to three together, placed within an involucre of closely imbricated scales, subtended by a bract and two bracteoles; calyx-tube urn-shaped, divided above into six short lobes; ovary adnate to the calyx tube, six-celled, each cell containing two ovules, surmounted by six simple styles, which are exerted out of the involucre.

¹ Cf. Kerner, *Nat. Hist. Plants*, Eng. trans. ii. 200 (1898), concerning the nature of the odour of the flowers.

Fruit, ripening in one season, one to three nuts, ovoid, plano-convex or compressed, enclosed in an involucre, which is tomentose within and is covered externally with branched spines fascicled between deciduous scales, the nuts escaping by the ultimate splitting of the involucre above into two to four valves. Nut crowned by the styles, marked with a scar at the base, its shell lined with tomentum. Seed usually solitary, occasionally two to three in each nut, the aborted ovules, two to eleven in number, remaining at the apex of the seed. Albumen absent. Cotyledons thick, fleshy, undulate, sweet, farinaceous, remaining under ground on germination.

The genus¹ is confined to the warmer parts of the northern temperate zone, and much difference of opinion exists as to the various forms² which are met with. Formerly only two species were recognised, viz. *C. sativa* and *C. pumila*; but the former, widely spread over North America, Europe, and Asia, exists in certain well-marked geographical forms, which it is convenient to treat as distinct species. A small shrub, occurring in North America, near the coast in the South Atlantic states and in Louisiana and Arkansas, is considered by American botanists to be another distinct species, *Castanea alnifolia*, Nuttall, and will not be further alluded to. Four species have been introduced into cultivation and are distinguished as follows:—

I. Leaves without stellate tomentum, acute at the base.

1. *Castanea dentata*, Borkhausen. N. America. See p. 856.

Leaves tapering at the base, long acuminate at the apex, green and glabrous beneath, pendulous. Petiole glabrous.

II. Leaves with stellate tomentum, rounded or cordate at the base.

2. *Castanea sativa*, Miller. Europe, N. Africa, Asia Minor, Caucasus, Persia. See p. 839.

Leaves green beneath, always showing some trace at least of tomentum, not pendulous, coarsely serrate. Petiole and young shoots scurfy pubescent.

3. *Castanea crenata*, Siebold et Zuccarini. China, Japan. See p. 854.

Leaves green beneath, tomentum variable in quantity, shallowly and crenately serrate, the teeth often reduced to bristle-like points. Petiole, young shoots, and midrib densely pubescent with short hairs.

4. *Castanea pumila*, Miller. N. America. See p. 857.

Leaves silvery white and always tomentose beneath. Petiole and young shoots strongly pubescent.

¹ In *Castanea*, the leaves are deciduous, no terminal bud is formed, and the fruits ripen in one season. In *Castanopsis* the leaves are persistent, a terminal bud is present, and the fruits ripen at the end of the second season.

² Dode enumerates twelve species, some of which are alluded to in our accounts of *C. crenata* and *C. pumila*.

CASTANEA SATIVA, SPANISH OR SWEET CHESTNUT

Castanea sativa, Miller, *Dict.* ed. 8, No. 1. (1768).

Castanea vulgaris, Lamarck, *Dict.* i. 708 (1783); Willkomm, *Forstliche Flora*, 428 (1887); Mathieu, *Flore Forestière*, 325 (1897).

Castanea vesca, Gaertner, *Fruct.* i. 181, t. 37 (1788); Loudon, *Arb. et Frut. Brit.* iii. 1983 (1838).

Castanea Castanea, Karsten, *Pharm. Med. Bot.* 495 (1882).

Fagus Castanea, Linnæus, *Sp. Pl.* 997 (1753).

A tree, attaining over 100 feet in height and an immense girth. Bark of very young stems smooth and olive green, soon becoming greyish white, after fifteen to twenty years gradually changing into a thick brown bark, which is deeply and longitudinally fissured. Young branchlets green, covered with a minute scattered pubescence above, and with longer hairs near the base; in the second year grey, glabrous.

Leaves (Plate 202, Fig. 11) not pendulous, oblong-lanceolate; broad, unequal, rounded and often auricled at the base; acuminate at the apex; with about twenty pairs of parallel nerves, raised on the under surface of the blade, each ending in a triangular tooth, which is prolonged into a long fine point; upper surface dark green, shining, covered with minute scattered pubescence; lower surface lighter green, with dense appressed stellate pubescence.¹ Petiole scurfy pubescent, $\frac{1}{2}$ to 1 inch long. Stipules $\frac{3}{8}$ inch long.

Nut, variable in size, abruptly and shortly acuminate at the apex, usually three in each involucre, in wild trees.

An elaborate description of the fruit is given by Lubbock.² The cotyledons are fleshy, occupying nearly the whole of the seed, undulate, and interlocking with each other at the margins. When sown, the pericarp, owing to the swelling of the cotyledons, splits in the soil at the apex, so that the shoot and rootlet emerge, the cotyledons remaining enclosed in the pericarp and being gradually absorbed. The germination thus resembles that of the oak; and the young stem similarly bears several scales (two to six in number) below the primary leaves, which resemble in shape those of the adult plant and bear deciduous stipules.

IDENTIFICATION

In summer the leaves are unmistakable and can only possibly be confused with certain species of oak, like *Quercus serrata* and *Q. castaneaefolia*, which have, however, very different buds. From the other species of the genus, it is distinguished by the characters given in the key.

In winter the following characters (Plate 200, Fig. 1) are available:—Twigs stout, reddish brown or olive green, shining, conspicuously angled, glabrous for the most part but showing remains of glands and pubescence towards the base, which is conspicuously ringed by the fall of the previous season's bud-scales. Leaf-scars

¹ This pubescence often wears off, so that the leaves are glabrescent or even glabrous, when gathered in summer.

² *Seedlings*, ii. 537 (1892).

obcordate or semicircular, with three groups of bundle-dots, and set parallel to the twig on prominent pulvini, distichous on the long shoots. Stipule-scars long, linear. Buds ovoid, slightly rounded and not acute at the apex, those nearest the apex of the twig the largest; three scales visible externally, first scale small and short, second scale longer, both glabrous and ciliate; third scale clothed with appressed pubescence and appearing at the apex of the bud.

The twigs and buds of the chestnut resemble those of the lime tree. The pith affords a good mark of distinction, being greenish and five-rayed in *Castanea*, and whitish and round in *Tilia*.

In France, single trees have been noticed¹ in several localities, which bore catkins entirely formed of pistillate flowers. Such trees, according to Dode,² bear a large quantity of fruit; but the presence in the neighbourhood of a tree with staminate flowers is necessary for fertilisation. Mr. Lynch informs me that an isolated tree in a garden at Cambridge never bore fruit, until branches, with staminate flowers from another tree, were laid upon it; but it is uncertain whether this tree bore only pistillate flowers, or whether its own pollen was ineffective. Dode also mentions² a tree in the department of the Loire which never bore fruit, as its catkins were entirely composed of staminate flowers.

The number of seeds in the nut is also variable; and a single chestnut with three seeds has been known to germinate and produce three plants.¹

VARIETIES

The chestnut varies very little in the wild state, though the amount of pubescence which occurs on the leaf is remarkably different in many specimens. At the Scientific Committee meeting of the Royal Horticultural Society on 6th November 1900, some remarkable leaves were shown, consisting of but little more than the midribs, which had issued from the stump of a tree that had been felled; and it is possible that some of the narrow-leaved varieties originated in this way.

Schelle³ enumerates nineteen varieties, which have been obtained in cultivation. Seven of these are forms with variously coloured and variegated leaves, viz.—*argentea*, *marginata*, *argenteo-marginata*, *argenteo-variegata*, *aureo-maculata*, *aureo-marginata*, and *aureo-variegata*. These are sufficiently explained by their names; and of those we have seen *aureo-marginata* is the best.⁴

Var. *heterophylla*.⁵ Leaves variable in shape, some with irregularly-shaped teeth and occasional deep sinuses, others repand in margin and with few teeth.

Var. *asplenifolia* (var. *laciniata*). Leaves with long narrow teeth, ending in long subulate points.

¹ Clos, in *Bull. Soc. Bot. France*, xiii. 96 (1866).

² Dode, in *Bull. Soc. Dendr. France*, 1908, p. 147.

³ *Laubhols-benennung*, 63 (1903).

⁴ There are small trees of the silver and golden variegated forms at Aldenham which are very handsome and well worth growing. A curious purple-leaved variety is described on p. 852.—(H. J. E.)

⁵ At Verrières, near Paris, there is a tree, 28 feet high and 5 feet in girth, which has a few branches with normal foliage, all the others bearing leaves deeply and irregularly lobed. These two different kinds of branches bear fruit, which reproduces, when sown, seedlings with the form of foliage from which the nuts have been derived. Cf. *Hortus Vilmorinianus*, 56 (1906). There is a fine specimen of this variety at Murthly Castle; and Mr. Renwick has sent us specimens from a large tree at Finlayson, Renfrewshire, a few of the leaves of which are of the *heterophylla* type.

Var. *cochleata*. Leaves small, irregularly cut, hollow or with swellings in the middle.

Var. *prolifera*. Some of the leaves, usually the uppermost ones, remaining whitish tomentose beneath.

Var. *glabra*. Leaves thin and shining.

Var. *rotundifolia*. Leaves small, not exceeding 2½ inches in length, oval in shape.

Var. *pendulifolia*.¹ Branches pendulous.

Many varieties of the fruit, which are propagated by grafting, are cultivated in France and Italy. In France, the name *marron* is given to the best varieties, in which the fruit is large, globular, broader than long, and usually single in the involucre. According to de Candolle,² the Romans in Pliny's time already distinguished eight varieties, but it is impossible to discover from the text of this author whether they possessed the variety with a single kernel. Olivier de Serres³ in the sixteenth century praises the chestnuts, *Sardonne* and *Tuscane*, which produced the single-kernelled fruit called the *marron de Lyons*. He considered that these varieties came from Italy; and Targioni⁴ states that the name *marrone* or *marone* was employed in that country in the Middle Ages (1170). In England, the cultivation⁵ of special varieties of the chestnut for its fruit is so little in vogue that it is not even mentioned in a late and comprehensive book on fruit culture, *The Fruit Garden*,⁶ by Bunyard and Thomas.⁷

DISTRIBUTION

The chestnut occurs wild throughout the whole of southern Europe, in Algeria, Tunis,⁸ Asia Minor, the Caucasus, and northern Persia. It has not been found in the Himalayas where there are several species of *Castanopsis* occasionally known in India⁹ as chestnuts, and is replaced in China and Japan by a closely allied species.¹⁰

Its northern limit in Europe is difficult to trace with accuracy, as the original area of distribution has been much extended by cultivation since the time of the Romans; and it has become naturalised in many parts. According to Willkomm the northern limit runs along the edge of the Jura and is continued through Switzerland to the south Tyrol, Carinthia, Styria, and Hungary, where it reaches Pressburg

¹ Lavallée, *Arb. Segrez*, 113, t. 33 (1885).

² *Origin of Cultivated Plants*, 353 (1886).

³ *Théâtre de l'Agric.* p. 114.

⁴ *Cenni Storici*, p. 180.

⁵ Hogg, in *Fruit Manual*, 224 (1875), says that the chestnuts produced even in the southern counties are so inferior to those imported from Spain and the south of France, that no one would think of planting the chestnut for its fruit alone. He mentions two varieties, *Devonshire Prolific* and *Downton*, which succeed in hot seasons. Lord Ducie, however, informed Sir W. Thiselton-Dyer that he had once sent a sack of chestnuts to Covent Garden market, which realised £3; and was asked to send more, as they were the first on the market.

⁶ In Country Life Library, 1904.

⁷ W. A. Taylor, in Bailey, *Cycl. Amer. Hort.* i. 296 (1900), enumerates and describes seventeen varieties of the European chestnut which are in cultivation in the United States.

⁸ Battandier et Trabut, *Flore de l'Algérie*, 819 (1888); wild in forests of Edough near Bône in Algeria, and in Tunisia near Ain-Drahm. Though cultivated near Tangiers and Tetuan it has not yet been found wild in Morocco. Cf. Ball, in *Journ. Linn. Soc. (Bot.)* xvi. 666 (1878).

⁹ The chestnut has been planted at Bashahr, in the Punjab, where trees fifteen years old are 30 feet high and 4 feet in girth. *Kew Bull.* 1897, p. 113.

¹⁰ The chestnut has been erroneously supposed, mainly on philological grounds, not to be a native of Europe, but to have been introduced at an early period from Asia Minor. The best discussion on this subject is by De Candolle, in *Geog. Bot.* ii. 688 (1855). A learned paper on the classical names of the oak and chestnut by H. L. Long appeared in Loudon, *Gard. Mag.* 1839, pp. 9-20. Dr. Bettelini's excellent account of this tree in *Flora Legnosa del Sottoceneri*, pp. 83-112 (1904), should also be consulted. He describes sixteen varieties, cultivated for their fruit in Switzerland and Italy.

in the west and the Bihar Mountains in Transylvania. According, however, to Fliche,¹ it is not truly wild in any part of France nor even in Corsica, as it never forms part of the real forests and is generally found either as coppice or as isolated trees planted by man rather than as a true forest tree.

In France it is common in Provence, Dauphiné, the Cevennes, Perigord, Limousin, and all the central plateau, and it fruits abundantly in the environs of Paris. As in England, it was long supposed that there were large forests of chestnut in ancient times, and it is popularly believed that the severe winter of 1709 caused their destruction in the region of the Loire. This is, however, an error, and the wood supposed to be chestnut, occurring in ancient churches and other buildings at Troyes, Reims, Sens, Chartres, and in Notre Dame at Paris has been conclusively proved to be oak.² The chestnut in France is rarely cultivated in high forest, as the timber is very liable to shake and to rot at the heart, so that sound pieces of considerable size are rarely obtained. It is, however, often cultivated as coppice, for use as vine props and hoops for casks. Mathieu mentions a tree growing near Sancerre in the department of Cher, which is 30 feet in girth and appears to be perfectly sound. Mr. Chaumette³ saw a chestnut in 1851 near Evian in Savoy, which had a girth of 54 feet, was 85 feet high, wide-spreading and well-shaped, but the trunk was perfectly hollow.

The chestnut is truly wild in Spain,⁴ and appears to attain there a greater development than in any other country. In the north, as in the provinces of Galicia, Asturias, and Biscaya, it constitutes forests of great extent, growing in company with *Quercus Toza*, *Q. sessiliflora* and *Q. pedunculata* or occasionally with the beech, and ascends from sea-level up to 2500 feet. It abounds in the mountains near Avila; and between Baños and Bejar there are vast woods in which it occurs mixed with *Quercus Suber*. It also occurs in the mountains of Toledo and of Estremadura and in the Sierra Morena. In the northern parts of Navarre and Aragon, it ascends in the Pyrenees to 3000 feet. In the extreme south of Spain, it no longer descends to sea-level, but forms a zone between 2700 and 5400 feet altitude in the Serrania de Ronda and the Sierra Nevada; and small woods also occur on the Alpujarras. The chestnut is also common in Portugal, and various localities are mentioned for it by Colmeiro.

In Italy the chestnut occurs throughout the Apennines and also in Sicily, rising to 3000 or 4000 feet elevation; and pure woods are found, especially in Tuscany. The most celebrated tree of this species, the *Castagno di Cento Cavalli*, growing on Mount Etna, was visited by Brydone⁵ in 1770, who found it to be a hollow shell, which looked rather like a group of five trees growing together than a single tree. Brydone made its girth 204 feet. This ruin has lately been seen by Mr. Druce⁶ of Oxford, who found four distinct parts still remaining, three of which

¹ Cf. Fliche, in *Bull. Soc. Bot. France*, liv. 132 (1907), concerning the recent discovery of chestnut charcoal at a prehistoric station in the department of Dordogne. Dr. Christ, in *Flore de la Suisse*, snpl. 48 (1907), discusses the question of the distribution of the chestnut, and now agrees with Engler (*Ber. Schweiz. Bot. Ges.* xi. 81) that it is not truly wild in Switzerland, either in the Jura or in the Alps.

² Mathieu, *Flore Forestière*, 328, 329 (1897).

³ *Phytologist*, iv. 71 (1851).

⁴ Cf. Willkomm et Lange, *Prod. Fl. Hispanica*, i. 246 (1861); and Willkomm, *Forstliche Flore*, loc. cit.

⁵ Brydone, *A Tour through Sicily and Malta*, i. 119 (1790).

⁶ Cf. *Pharmac. Journ.* Feb. 27, 1904, p. 258.

looked like mighty trees, though not over 70 feet in height. It still fruits freely, and bears on its branches several bunches of the southern species¹ of mistletoe. Besides this great tree, there are four other enormous trees on Mount Etna, mentioned by Parlatore and Tornabene, viz. the *Castagno della Nave*, 22 metres in girth; the *C. della Navota*, 18.7 metres; and the two *C. di Santa Agata*, 22.6 and 26.3 metres, all sound and much more beautiful than the *C. di Cento Cavalli*.

The chestnut forms a part of the forests in the south of Germany, but is not indigenous, being introduced, it is supposed, by the Romans, as in Alsace, where it forms large woods, ascending to 2000 feet, on the slopes of the Vosges, and in the plain, as around Sulzmatt and Rohrbach. Along the foot of the Vosges in Alsace, chestnut coppice, treated on a fifteen years' rotation, is very common, the wood being used for vine-props. The chestnut is cultivated largely in southern Germany as a fruit tree, and as an ornamental tree in parts of north Germany, where in favourable situations, as near Brunswick and at Blankenburg, it ripens its fruit perfectly.

It is planted in southern Sweden and on the coast of Norway between Christiania and Christiansand, and occasionally ripens its fruit. According to Schübeler, it exists in Norway as a bush as far north on the coast as lat. 63°.

In Austria it is commonly planted, as in Bohemia and Moravia, while farther south it is supposed to be often wild. There is a remarkable wood of chestnut, on the domain of Mokritz in lower Carniola, which lies between 500 and 1500 feet elevation. In Carinthia, the chestnut constitutes 10 per cent of the mixed forest on the Neuhaus estate, ascending to 1800 feet; and at Bleiburg it is still a fine tree at 3100 feet elevation.

On the eastern side of the Adriatic,² from Fiume to Castelnuova, the chestnut forms a part of the forest, which is composed mainly of oak and laurel; while in the interior it is a considerable element in the oak forests of western Bosnia and Croatia. It occurs also mixed with the beech in Croatia, Bosnia, Herzegovina, and Montenegro. Wilkomm speaks of grand woods of chestnut in southern Hungary, Slavonia, Croatia, and Dalmatia; and mentions large wild forests in the Etsch valley in the Tyrol. Velenovsky³ states that in the western Balkans, not far from the town of Berkovitz, there are extensive woods of chestnut, which are apparently wild, and have an undergrowth of the common hazel. Elsewhere in Bulgaria the chestnut appears to be planted, and is not a common tree.

The chestnut⁴ is very common in the mountains of Greece, and is met with also in the islands of Keos, Naxos, and Crete. It occurs either solitary or gregariously, and in some parts of the mountains forms extensive woods.

In Macedonia,⁵ Thrace, Albania, and Bithynia, the chestnut often forms the lower border of the deciduous forest, at 1200 to 3000 feet, occurring above the region of ever-green shrubs; but here and there it descends to sea-level. Chestnut woods occur on Olympus, in the peninsula of Mount Athos, and on Mount Kortiach near Salonica.

¹ This appears to be, judging from an imperfect specimen kindly sent by Mr. Druce, *Viscum laxum*, Boissier et Reuter. Cf. Nyman, *Consp. Fl. Europ.* i. 320 (1878).

² Cf. Beck von Mannagetta, *Veg. Verh. Illyrischen Ländern*, 147, etc. (1901).

³ *Flora Bulgaria*, Suppl. i. 254 (1898).

⁴ Halácsy, *Consp. Fl. Græca*, iii. 125 (1904).

⁵ Grisebach, *Fl. Rumelica*, i. 339 (1843).

In Asia Minor the chestnut has been found wild in northern and western Anatolia; but it appears to be absent from the Taurus and Lebanon. In the Caucasus¹ it is found throughout the whole territory, and also in the Talysch, up to 6000 feet elevation; and it extends into north Persia.

A large chestnut grew in Madeira, on the estate of Count Carvalhal, at Achada, 23 kilometres from Funchal, and was reported by M. Joly² to have been about 160 feet in height with a girth at 3 feet 4 inches from the ground of 38 feet 8 inches. It was burnt down three years ago, and no trace of it now exists. The chestnut is not indigenous³ in Madeira, although formerly many large planted woods existed there, most of which have disappeared.

The chestnut was probably introduced into England by the Romans. Charcoal, supposed to be of chestnut, was discovered by Mr. H. N. Ridley⁴ associated with palæolithic implements and the bones of the rhinoceros in a brick-earth pit between Erith and Crayford in Kent. Mr. Clement Reid⁵ has not found any evidence corroborating the possibility of the tree being a native of Britain in prehistoric times, and Mr. Ridley's specimen may be capable of some other explanation.

The tree⁶ is mentioned in Anglo-Saxon literature as the *cisten* or *cyst-beam*. The modern name *chestnut* is a shortened form of *chesten-nut*, the fruit of the *chesten*, the early English name of the tree, representing the old French *chastaigne*, from the Latin *castanea*. King Henry II., in a grant to the Abbey of Flaxley in the Forest of Dean, says:⁷ "*de eadem foresta dedi eis decimam castanearum mearum*"; and it is probable that the chestnuts here referred to were cultivated at this early time for their fruit and not for their timber.

Natural seedlings⁸ are common in the southern counties, as in Kent, Surrey, Sussex, and Hampshire; and the chestnut may be considered to be naturalised in some places. Briggs states that it is naturalised in Cotehele wood near Plymouth; but as Bromfield remarks, it does not spread over waste places in the way that oak and pine commonly do. (A. H.)

CULTIVATION

The Sweet or Spanish Chestnut, as it is usually called, is on soils and situations which suit it one of the largest trees in England, and both from an ornamental and an economic point of view one of the most important of exotic hard-woods.

It is most at home in the southern counties, for though hardy in almost any part of Great Britain, it loves a warm soil and a warm summer climate, but will grow to a large size where the rainfall is as much as 60 inches per annum.

¹ Radde, *Pflanzenverbreit. Kaukasusland*, 182 (1899).

² Cf. Vahl, in Engler, *Bot. Jahrb.* 1905, p. 307.

³ *Origin British Flora*, 146 (1899).

⁴ Cf. Murray, *New English Dictionary*, ii. 329 (1893). The village of Cheshunt does not take its name, as has been supposed by Ducarel and others, from the chestnut. Skeat, in *Place Names of Hertfordshire*, 37 (1904), proves that Cheshunt is a corruption of Cestrehunt, derived from Anglo-Saxon *ceaster*, a camp, and *hunta*, a huntsman.

⁵ Ducarel, in *Phil. Trans.* 1771.

⁶ There are numerous natural seedlings in Windsor Park, especially amongst the tall pines near Virginia Water. They are also common in Norfolk, at Fulmodestone and at Hargham.

⁷ *Note sur un Chataignier Colossal.*

⁸ *Journ. Bot.* 1885, p. 253.

With regard to soil, the chestnut is rather fastidious, as, though it will exist for a time, it rarely thrives on soils of a chalky or limy¹ nature, and will not grow in stiff clay or in peaty soil.

All the largest I have seen are on greensand or old red sandstone; and when cultivated for coppice-wood, which is probably its best economic use, it requires a better soil and climate than any other tree usually so treated. It is propagated by seed, which ripens in the southern counties abundantly in good seasons, though the fruit is inferior in size and quality to what is imported from Spain and France. The largest nuts should be chosen and kept dry in sand until spring, as they are devoured by mice, and if sown in autumn are liable to rot if exposed to much frost and wet. They should be transplanted when one year old and kept rather crowded in the nursery until they are 5 to 6 feet high, as they are liable to become very bushy if they have room to spread. They are not difficult to transplant, if grown in light soil, but must not be left more than two years before transplanting.²

A remarkable instance of the grafting of the chestnut on the oak³ was shown me in the Botanic Garden of Dijon in France by M. Genty, the professor of botany there. The history of this tree is given in full by M. A. Baudot, in a pamphlet published at Dijon in 1907, from which I gather that in 1835 some acorns of the pedunculate oak were sown by M. Meline, five of which were grafted in 1839 with scions from the chestnut. Three of the grafts failed to take, another was injured by wind, the fifth pushed a shoot in the first year about 4 feet long, and grew so vigorously that it is now nearly 40 feet high with a girth of 4½ feet. The tree bore small fruit in 1852; and in 1903 some were sown, which germinated and produced three young plants, of which two are now planted out in the garden at Dijon, and a third was sent to M. M. de Vilmorin at Les Barres.

The varieties of the chestnut grown for fruit are usually grafted in French nurseries, but are rarely planted in England at present so far as I have seen.

As coppice-wood the chestnut is principally found in the hop-growing districts of Kent, Sussex, and Hants, where, until wiring was introduced, it was one of the most valuable products of English woodland, being cut at intervals of 8 to 12 years and realising frequently £2 to £3 per acre per annum. But now, though still more valuable than ash or hazel, it has fallen so much in price that these coppices are not as carefully managed as they used to be; and the split poles, which are so largely used for fencing, are said to be imported from France. In such coppices the stools are at 5 to 6 feet apart, because the thinner a hop pole is in proportion to its height the

¹ Fliche and Grandeau (*Ann. Chémie et Physique*, 1874, p. 354) proved by experiments, that the presence of a considerable amount of lime in the soil causes the chestnut to languish or to die, as too little iron is absorbed by the tree, and the normal function of the chlorophyll is deleteriously affected. Alphonse de Candolle, in *Nuovo Giorn. Bot. Ital.* x. 228 (1878), states that the chestnut is never found growing in Switzerland on limestone, and that in places where it is believed to occur on limestone, careful examination shows that the roots are surrounded by siliceous soil. However, he brings forward evidence to show that in the climate of south-eastern Europe, as in Hungary and Istria, the chestnut is occasionally found thriving on pure limestone.

² Sir H. Maxwell recommends sowing the best foreign nuts, but these produce seedlings which in my nursery are much more tender when young, than those raised from smaller English-grown seed, and when required for timber trees I should prefer the latter.

³ M. Trabut, in his pamphlet, *Le chataignier en Algérie*, published as bulletin 37, by the Department of Agriculture in Algeria, states that he saw at the Villa Thuret in Antibes, a fine chestnut, which had been grafted on *Quercus Mirbeckii*.

more valuable it is, the young hop shoots, according to Cobbett, disliking a thick pole to twine round.

At Welbeck the chestnut is considered by Mr. Michie,¹ forester to the Duke of Portland, to be the most profitable tree to grow on sandy soil, as it grows much faster than oak and realises about 1s. 2d. per foot at a much earlier period. He showed me a plantation on Tressless Hill thirty-eight years old in 1903, in which the trees averaged about 65 feet high by 3 feet in girth, and stood about 150 to the acre. He said that they should not be grown without underwood, because in severe winters the unprotected trunks were liable to be cracked by frost near the ground.²

We have no exact records of the amount of timber per acre that may be produced by the chestnut when grown for timber in England, but I think that in the south on good land it would probably be greater than that of any other tree. One very remarkable case is a grove of 34 chestnuts and 9 oaks by the drive leading to Bicton House, Devonshire, which average about 100 feet high, by 6 to 7 feet in girth in the middle of the grove, and 9 to 12 feet on the outside (Plate 232). I estimated that this area was about half an acre, and the cubic contents of the timber on it about 5000 feet. At my request the late Mr. Mark Rolle had it carefully measured and wrote me on December 19, 1903, that the exact area on which the trunks stood was 1 rood 32 poles, though, of course, the branches extended over much more. The cubic contents were 7300 feet and the age of the trees about 150 years. We may therefore take at least 10,000 feet per acre as the result here.

Another very striking instance of the same character is a grove called "The Chestnut Tole"³ in Mr. Ashley Dodd's park at Godinton, Kent, where a great number of fine trees, having clean boles of 50 to 70 feet high by 8 to 10 feet in girth, grow mixed with ash. One of the chestnut trees was 86 feet to the point where the branches began, and I think that the timber in this grove would produce as great

¹ Mr. Michie has sent the following note:—

"Sow seed in March, collected from sound, healthy, straight-growing trees, forty-five to fifty-five years of age, as I find that seeds from trees of that age produce stronger seedlings than seed from younger or older trees, or than foreign seed. At one year old I lift the seedlings, shorten the tap-root, and plant in nursery lines. Care must be taken to plant in fresh, sweet soil, as the root is very liable to malformation if in contact with fresh manure. In the following year cut them down to within one inch of the ground, which will cause them to throw out a strong and straight stem from 2 to 3 feet long; after which, at three years old, they can be planted out with safety. Without this treatment before planting out, they generally require cutting off close to the surface, which is not always desirable in the planted area, owing to rank grass, bracken, etc., which smothers the young shoots.

I am greatly in favour of pure chestnut woods, very little thinning, and the encouraging of as much undergrowth as possible, especially on the outsides of plantations, to prevent cold and frosty winds blowing through. At sixty years of age the trees should stand no more than 16 feet apart, which equals 170 per acre, and taking them at the low average of 50 cubic feet per tree, means £425 (at 1s. per foot) when the crop is realised.

The above crop can be grown on a sandy soil, which is of little value for ordinary agricultural purposes; for instance, in Birklands Wood, adjoining Budly Forest, where the soil is very sandy and light, oaks covering an area of about 100 acres, although from sixty to eighty years of age, are long and slender, and contain on an average not more than 6 cubic feet of timber each; whereas some Spanish chestnuts, planted less than sixty years ago, contain fully eight times as much timber as the oaks.

On this estate the timber is used for making gates, gate-posts, and all kinds of fencing; also for window-sills of farm buildings, etc. Timber merchants buy it to supply the Sheffield trade (strickle handles, etc.), and also to put in the inside of threshing machines, for coffin boards, etc. The timber should be slowly and thoroughly dried before being used.

² The same thing has occurred at Kew; and, as Sir W. Thiselton-Dyer pointed out, the cracks occur on the south side, and are the result of too rapid thawing by the sun.

³ Tole seems to be a local name for a clump of trees standing on the crown of a hill.

a quantity per acre and of better quality, than the grove at Bicton. But, however attractive such plantations may be from an ornamental point of view, there is no doubt that the timber is worth much more if cut young; and, as a matter of fact, most of the old chestnut trees in the south of England are so shaky that a great part of their timber is only fit for firewood or fencing.

The chestnut is a good avenue tree in those parts of England where the soil and climate suit it, and there are fine avenues at several places. One of the best known to me is at Cowdray Park where there is an avenue about a mile long, commencing at the bottom of the hill, where the trees are very large, and running up to an elevation of 500 feet or more. According to Loudon this avenue contained 300 trees. Another very fine one at Thoresby is supposed to have been planted by Evelyn, many of the trees in which are about 20 feet in girth. I noticed here that the spiral twist in the trunk of the chestnut is variable in direction. Of three trees standing together in this avenue, one was twisted from left to right, one from right to left, and one had no twist at all; but this twisting of the trunk is commonest on light sandy soil and usually indicates shaky timber.

Another fine avenue of chestnuts is at Newhouse Park, on the property of Sir Robert Newman, near Mamhead, Exeter. This is 24 yards wide, with the trees 12 yards apart, which seems to be the correct distance for this tree in an avenue, as it requires more room than the lime or elm. These trees average about 15 feet in girth and are 70 to 80 feet high. The largest that I measured was 18 feet 8 inches in girth.

REMARKABLE TREES

The number of large chestnut trees is so great that it is quite possible we may omit some of them, but there is no doubt that the most celebrated, and perhaps the oldest planted tree in England, is the Tortworth chestnut, which has been frequently described, and is figured by Strutt, plate xxix., and by Loudon, p. 1988. Strutt says that in 1766 it measured 50 feet in circumference at 5 feet from the ground, had a stem 10 feet high to the fork, and had three limbs, one of which was at that time 28½ feet in girth. It was said by Sir R. Atkyns, in his *History of Gloucestershire*, p. 413, to have been growing in King John's reign, and to have been "197 yards in compass." It has since been mentioned and described by almost every writer on trees, but I am informed by Lord Ducie that a good deal of its history is more or less mythical. At present it is by no means a beautiful tree, and so much of its original trunk is decayed, that no measurement is of much value. I think that no one would recognise the existing tree as having formed the subject of Strutt's plate; but notwithstanding its age it still produces nuts, from which several trees have been raised and planted.

Another very large and celebrated chestnut, also figured by Strutt, plate xiii., and by Loudon, p. 1989, grew at Cobham Hall,¹ Kent, and must have been a finer tree than the one at Tortworth. It measured in 1822, according to Strutt, 29 feet in

¹ The finest chestnut now existing in this park grows at Ashenbank, and measured, in 1906, 93 feet in height and 13 feet 10 inches in girth, with a good bole 40 feet in length.

girth at the narrowest part 3 feet from the ground, 33 feet at 12 feet up, and 40 feet at the point where the trunk divided. It was "called the four sisters, from its four branching stems closely combined in one massive trunk," though the figure does not show this clearly. It has now entirely decayed.

Another historic tree, the "Monmouth Tree,"¹ at White Lackington, in Somerset, was destroyed by the severe storm of Ash Wednesday in 1897. It was reputed by tradition to have been the tree under which the Duke of Monmouth had a famous banquet in 1680. It was 25 feet in girth with a total height of only 49 feet, and had a very venerable appearance. Lord Petre measured in 1758 in Writtle Park, three miles from Ingatestone in Essex, a chestnut 45 feet in girth at 5 feet from the ground.²

In Waldershare Park, Kent, the seat of the Earl of Guilford, there are some remarkably fine chestnuts, the largest in girth being 23 feet 3 inches, but not a well-shaped or tall tree. The finest, in my opinion, is a tree 112 feet high with a straight and clean bole 50 feet long by 15 feet 2 inches at 5 feet, and carrying its girth well up. I estimated the contents of the first length alone at 50 feet by 36 inches quarter girth, making 450 feet of clean timber.

Fredville Park, the seat of H. W. Plumtre, Esq., in the same district of Kent, contains some splendid chestnuts, the largest of which is about 80 feet by 26 feet 3 inches. Another is called the Crows' Nest, from the fact of its having a platform, with benches and a table large enough to seat about twenty people, built in the crown at about 12 feet from the ground and reached by a ladder.

An immense but very ill-shaped chestnut tree dividing at 5 feet into three main limbs grows at Sunninghill Lodge, near Ascot, the seat of Percy Crutchley, Esq., of which a photograph was shown by him at the Lincoln Exhibition of the Royal Agricultural Society in 1907. This tree was carefully measured in 1816 by T. Luff, who estimated its contents at 716 cubic feet. A measurement made June 15, 1907, by M. C. Squires, gives its contents as 1282 feet, an allowance for bark of 1½ to 2 inches being made.

The finest chestnuts growing near London are those in Kew Gardens, the largest of which measures 75 feet high, and 20 feet 10 inches in girth. These were probably planted early in the eighteenth century.

In Herts, there is a large chestnut at Lockleys Park near Welwyn, which the Hon. Arthur Bligh informs us is 21 feet in girth; and at Broxbournebury, Mr. H. Clinton Baker measured a tree in 1908, 65 feet by 23 feet 9 inches.

At Betchworth Park, part of the Deepdene estate, near Dorking, Surrey, there are many splendid chestnuts,³ the finest though not the largest round, being 21 feet 5 inches in girth and 90 feet in height. For girth alone I know of few trees in England equal to one measured here by Henry, which, though its bole is only 8 feet long, is 26½ feet in girth at the narrowest point.

¹ Cf. H. Norris in *Proc. Somerset Archaeological Society* (1897), where a figure of the tree is given.

² Ducarel, *Phil. Trans.* 1771.

³ An interesting article on the chestnut trees in Betchworth Park appeared in *Gardeners' Chronicle*, 1841, p. 4. At that date there were about 80 trees, all of large dimensions. Dr. Aikin, in *Monthly Magazine* for 1798, mentions the rows of old chestnut trees in this park.

At Petworth Park, Sussex, there are several very fine chestnuts, of which one measured by Sir Hugh Beevor in 1904, was no less than 118 feet high by 19 feet in girth, with a trunk clean to about 70 feet, and estimated to contain 800 feet of timber. It grows on the west side of the drive on the west side of the park, about two miles from the house. Another in a clump close to the house I found to be about 100 feet high by 21 feet 9 inches in girth.

At Steventon, North Devon, there is a very large tree in the garden, which Mr. Barrie measured as follows in 1890:—height 86 feet, bole 22 feet 6 inches, girth 16 feet 11 inches, spread 100 feet in diameter, contents 833 feet.

At Tyberton Court, Herefordshire, near the place where the big oak formerly grew,¹ and on soil heavier than the chestnut usually likes, there is a very fine twin tree, which looks as if two stems had started together from the same root. At the base the two measure 31 feet round and are about 95 feet high, one trunk being 20 feet, the other 17 feet 6 inches in girth.

At Highnam Court, Gloucestershire, there is a chestnut stool, which girths 32 feet at 3 feet from the ground, giving off four great stems 80 to 90 feet in height.

At Croft Castle, Herefordshire, there is a row of fourteen trees which were described in the *Transactions of the Woolhope Society*, 1871, p. 306, where their respective girths are given, and average about 17 feet, the two largest being then 20 feet 3 inches and 20 feet 5 inches. They seemed, when I saw them in 1904, to be long past maturity.

Below Warwick Castle, on the banks of the Avon, there is a chestnut having a large branch resting on the ground, where it has taken root and thrown up a large vertical stem, the only instance of self-layering² I have seen in this tree. The trunk in 1907 measured 16 feet 3 inches in girth. This tree is figured in *Gardeners' Chronicle*, 1873, fig. 222.

In Ashridge Park there are many fine chestnuts, one of which has its trunk covered with great burrs and is 24 feet in girth. At Chatsworth there is a chestnut tree of which Mr. Robertson, forester to the Duke of Devonshire, has been good enough to send me a photograph. He makes it 86 feet high, with a bole 45 feet by 15 feet 10 inches, and the cubic contents about 700 feet.

At Harleston, near Althorp, on Lord Spencer's property, are some immense chestnuts growing in a field near the church, on rich red sandy soil, the survivors of a row of which many were blown down many years ago. The largest measures 90 feet by 22 feet 6 inches, and was estimated by Mr. Mitchell, now forester at Woburn, to contain 1200 feet of timber (Plate 233). Another of about the same height has a bole 27 feet by 21 feet 6 inches and contains about 887 cubic feet.

If the length of clean trunk be considered, I have seen no chestnut equal to one at Thoresby (Plate 234), which has been drawn up in a thick wood of beech trees called Osland, and has a clean bole as straight as possible, 70 feet long by 11 feet 3 inches in girth, and a total height of about 110 feet. This was planted about 1730, and is on a sandy soil overlying the Bunter beds of New Red Sandstone.³

¹ Cf. vol. ii. p. 310.

² Henry saw a self-layering tree at Riccarton. Cf. p. 851.

³ For further particulars of this remarkable plantation see our article on the oak, p. 322.

At Euston Park, Suffolk, the property of the Duke of Grafton, Mr. Marshall showed me, in 1905, in a wood called Barnham Springs, a remarkable growth of chestnut from a stool cut forty-two years previously. Sixteen straight stems about 60 feet high, and $2\frac{1}{2}$ feet in girth, had sprung up from the outer edge of the stump, and collectively measured 30 feet in circumference. This growth seems to show how such trees as the one on Mount Etna have been originally formed, as in another 50 or 100 years these stems will probably seem like one tree. At Merton Hall, Thetford, Norfolk, a chestnut, planted about 1660, is 87 feet high, with a clean bole, 40 feet in length and 11 feet 4 inches in girth.

At Shrubland Park, Ipswich, the property of Lady de Saumarez, there are some very large chestnut trees in the grounds. The largest of these, according to Mr. Taylor, measures at ground line 47 feet; at 3 feet 31 feet; at 6 feet $27\frac{1}{2}$ feet. Having had its top blown off some years ago, it is now only 55 feet high.

The finest existing chestnut, if height and girth together are considered, that I have seen, is a tree in a valley called Mackershaw, near Studley Royal, which seems to be the one figured by Loudon, p. 1986, of which he gives the height as 112 feet and the girth at 1 foot as about 23 feet. When I measured this splendid tree in 1904 I made it 112 feet by 20 feet at 5 feet from the ground, and it seemed to be in perfectly sound condition.

At Rydal Hall, Westmoreland, there is a very fine tree, girthing $26\frac{1}{2}$ feet at 5 feet and 37 feet at the ground, of which the owner, Mr. S. H. le Fleming, has kindly sent me a photograph (Plate 235).

In Wales the finest tree I have seen is one which grows just outside the garden at Dynevor Castle, and measured in 1908 about 113 feet by $16\frac{1}{2}$ feet, with a clean bole about 30 feet high. A photograph which was taken proved unsuccessful owing to its being surrounded by other trees.

Notwithstanding its southern origin, the chestnut grows with great vigour in many parts of Scotland, and, according to Loudon,¹ who quotes from Walker's *Essays*, p. 29, the first exotic tree planted north of the Tweed was a chestnut, of which in 1760 a part of the trunk remained, at Finhaven, an ancient seat of the Earls of Crawford. This was measured in 1744, and, as attested before two justices, was 42 feet $8\frac{1}{2}$ inches in circumference close to the ground.

The largest tree I have seen myself is in the Cherry Park, near the stables at Inveraray Castle, and measures about 77 feet by 20 feet, with a bole about 16 feet long. This tree was said in the *Old and Remarkable Trees of Scotland* to have been in 1867 the largest in Scotland, though one at Tynninghame was as tall; and there are two fine ones, both over 16 feet in girth, at Ardkinglas, in the same neighbourhood. Lord Kesteven informs us that there is a chestnut 25 feet in girth, growing at Stonefield, near Tarbert, Argyllshire. At Kirkconnell, south of Dumfries, Henry measured in 1904 a fine tree, 73 feet high and 18 feet in girth, with a bole of 25 feet. At Kirkmichael House, Ayrshire, a tree measured $18\frac{1}{2}$ feet in girth in 1892; and at the Auld House, near Glasgow, two trees, about 60 feet high in 1904, were 16 feet 3 inches and 14 feet 11 inches in girth respectively.

¹ *Arb. et Frut. Brit.* i. 34, 90 (1838).

At Castle Menzies in Perthshire there are several very large trees, perhaps over 300 years old, one of which, in the washing-green, is about 20 feet in girth. Another in the park at Murthly, though not remarkable for height, has a trunk about 15 feet high and 19 feet 7 inches in girth, twisting from left to right. At Dupplin Castle, Perthshire, there are some very fine trees in a sheltered dell below the castle. One of these has a short bole no less than 21 feet 4 inches in girth; another is about 70 feet high by 17 feet 9 inches in girth. Many other large chestnuts in this county are recorded by Hunter; but as a rule they are remarkable rather for their age and girth than for their height, which rarely exceeds 80 feet in Scotland.

Sir Herbert Maxwell says¹ that the tallest recorded in Scotland is at Marchmont House, Berwickshire, which in 1878 measured 102 feet by $14\frac{1}{2}$ feet, with a bole of 32 feet; but Sir Archibald Buchan-Hepburn tells us that a tree at Yester House, Haddingtonshire, is 112 feet high by 18 feet 8 inches in girth, according to careful measurements, taken in 1908 by Lord Tweeddale's forester.

The chestnut at Riccarton, near Edinburgh,—which was described and figured in 1829 by Monteath, *System of Draining*, 209, as an old tree remarkable for layering, had two stems in 1905, one 17 feet in girth and the other, very decayed, 12 feet in girth, both giving off branches which had layered and become independent trees.

From Castle Leod in Ross-shire Mr. Wotherspoon sends me a photograph of a tree, which is probably the largest of the species existing so far north. It is 76 feet high and girths 28 feet close to the ground, 21 feet 4 inches at 5 feet, with a bole 14 feet long.²

In Ireland the chestnut thrives remarkably well, and, growing fast, might in many places be cultivated for its timber. At Fota the chestnuts in a plantation much exposed to the strong winds from the sea, withstood without injury the severe gale of 1903, when many other species were blown down.

The most remarkable chestnut in Ireland is the famous tree at Rossanagh, Wicklow, which was planted, according to Colonel Tighe, who has the family records, in 1718 (Plate 236). This tree is of the large spreading type with a short bole which divides into three mighty limbs. The girth of the main stem close to the ground was in 1903 49 feet, at 3 feet up $27\frac{1}{2}$ feet, and at 5 feet $29\frac{1}{2}$ feet. The height of the tree is about 80 feet, the spread of the branches being 100 feet in diameter. The three limbs girth respectively 12 feet 8 inches, 11 feet 2 inches, and 10 feet.

A very fine tree is growing at Powerscourt which was 84 feet high in 1905, with a good trunk carrying its full girth up to 18 feet and giving off the first branch at 20 feet up. It was $28\frac{1}{2}$ feet in girth at the ground, and $22\frac{1}{2}$ feet at 5 feet up.

At Clonbrock, Co. Galway, there is a tree growing on limestone, planted in 1801. It was 8 feet 6 inches in girth at 3 feet up in 1871, and 12 feet 9 inches in 1904. The chestnut grows at Clonbrock, where rhododendrons refuse to grow; and in the case of the tree just mentioned there is undoubtedly a large proportion of lime in the forest soil on which it stands. At Shannongrove, near Limerick,

¹ *Green's Encycl. Agric.* i. 373 (1907).

² This is probably the same tree which Loudon mentions, p. 2001, as growing at Castle Send (*sic*) in Cromarty.

there are some large trees, more remarkable for girth than for height, one being $24\frac{1}{2}$ feet round at two feet from the ground.

At Rostrevor House, Co. Down, the seat of Colonel Sir J. Ross of Bladensburg, a chestnut, about 25 feet high, is remarkable for the large size and colour of the young leaves, which were purplish when I saw them in July, and are said to turn copper colour in autumn. This variety is of unknown origin, and I have seen nothing like it at Kew or elsewhere.

TIMBER, MISCELLANEOUS PRODUCTS

A great deal has been written as to the use of chestnut wood for the beams and roofs of ancient buildings, both in England¹ and France, but it is now pretty generally admitted that most of the supposed chestnut wood is really that of the oak, which it slightly resembles.² This subject has been so well discussed by Loudon (pp. 1787, 1989, and 1992) that I need not further allude to it; but the properties and uses of the wood were apparently much better known formerly than now, and Mr. N. Kent, in 1792, wrote an excellent paper on the subject from which Loudon quotes largely (p. 1993). The pith of it all agrees with what I have been able to learn from various practical men—that the wood when young is as good or better than oak (because it has much less sapwood) for fencing, gate-posts, piles, and hop-poles; but that if allowed to become more than 3 to 4 feet in girth it is so apt to be shaky, that its value rapidly diminishes, and very old trees are usually only fit for firewood.

The timber in some cases remains quite sound to a great age and becomes mottled and streaked with dark brown like brown oak. I found the butt of an old tree of this nature, in a small timber yard in Wilts, where it had been lying seventeen years without any use being found for it. I had it cut into boards, from which the stiles and rails of an overmantel, and the frames of some doors have been made; and these, when polished with oil, were both in grain and colour of remarkable beauty. But even after this long period the wood was not dry, and shrank considerably after it was cut up, so that care must be taken not to put such wood together in a hurry.

Mr. T. Roberts, forester to the Earl of Egmont, at Cowdray, informs me that chestnut is used on that estate for joists, window-sills, door-jambes, and other purposes, and is found to last quite as long as oak and to be much easier to work up; he also thinks it less liable to insect attacks than oak (presumably sappy oak). But the trees when a hundred years old are all more or less inclined to be shaky,

¹ Sir George Birdwood in *Reports on the Cultivation of the Spanish Chestnut*, p. 9, note (India Office, 12th March 1892), states that the late Mr. T. Blashill, who was architect to the London County Council, pointed out in a letter to the *Times*, that the only instance he knew of chestnut wood in English mediæval carpentry is that of the chancel screen of the church, formerly of the Knights of St. John, at Rodmersham in Kent. The Rev. A. H. J. Massey, Vicar of Rodmersham, tells me, however, that the chancel screen is a modern one of oak, with portions of an ancient screen of chestnut wood worked into it; but the screen separating the Lady Chapel from the chancel, is composed entirely of chestnut wood.

² Mr. Blashill, in *Sessional Papers of the Royal Institute of Architects*, No. 12 (1877-78), has finally settled any lingering doubts which may exist. On the question of oak or chestnut in old timber roofs, he says that in some specimens of English oak, particularly in the variety called *sessiliflora*, the medullary plates are very thin and wide apart, and such specimens are often mistaken for chestnut, but a very clean transverse section will always render the plates visible. Though usually lighter than the rest of the wood, they are often dark, and such specimens have also been mistaken for chestnut. He goes on to say that the clean grain and pleasant working of chestnut make it very suitable for joinery, and there is no fear of its durability

which prevents their being cut into small scantlings. Mr. Weale tells me that it is used extensively in London for making coffins instead of oak. For making hoops, poles of chestnut are considered the best; and the wood is also largely used for making wine casks in France and Spain.

A section from the butt of a chestnut tree, said to be two hundred years old, was shown by the Marquis of Exeter at the Forestry Exhibition of the Royal Agricultural Society at Lincoln in 1907. This tree measured 7 feet in diameter at the butt and was fairly sound and free from shakes. I am informed by Mr. Danson that this tree was grown on a clay soil overlying ironstone, with a north-west exposure, about 230 feet above sea level.

At Shobdon Court, Herefordshire, the seat of Lord Bateman, I saw the trunk of a large chestnut, measuring $19\frac{1}{2}$ feet in girth, lying on the ground. It was quite sound, with the exception of two small ring-shakes, and by counting the rings I found that it was 207 years old.

Such poles as are too thick for hop-poles make, on account of their durability, one of the best forms of park fencing that I know, of which many instances are quoted by Loudon. It is said that a park fence, erected in 1772 by Mr. Windham of Felbrigg, of oak and chestnut thinnings, was taken down in 1792, when the chestnut was found as sound as when put down, while the oak was so much wasted at the ground level that it could not be used again without support.

The Earl of Ducie exhibited at the Stroud show of the Gloucestershire Agricultural Society in June 1907 specimens of fencing posts made from chestnut, planted by himself in 1855, and cut in 1885, which had been in use for twenty-two years, and were still quite sound.

The walking- and umbrella-sticks, which are known in the trade as "Congo sticks," are saplings of the chestnut, which are easily manipulated when growing, the knots or markings for which these sticks are valued being produced by lacerating the bark through to the wood. They were formerly obtained from the north of France, but are now almost exclusively produced near Carlstadt in Croatia.¹

The fruit of the chestnut is so well known that I need say little about it, and though in the colder parts of England it is often so small as to be of little use for human food, it is eaten by pheasants and deer. The large chestnuts eaten at dessert are imported, and are known under the name of "marrons" in France where they are preserved in sugar and form a very favourite sweetmeat.²

being equal, and probably superior to that of any wood (presumably he meant English wood) except oak. He spoke of a large bridge having been built about 1858 of chestnut timber, over the river Wye at Hoarwithy near Hereford. The bridge after nineteen years was taken down in a crippled condition, which he attributed partly to the design of the bridge, and partly to the decay of the timber at the numerous joints where water could lodge. Yet the great bulk of the wood was perfectly sound; and seemed to show that for ordinary work not subject to damp, the timber may be very useful. Although he could not admit its occurrence in ancient roofs, it might be very suitably used in preference to deal or pitch pine; and in church furniture it would probably, in course of time, take a colour which would be far better than that of the stained woods now so much used.

¹ *Kew Bulletin*, 1899, p. 53.

² In some parts of Spain and Italy, and in the south of France, chestnuts are ground into flour; and in the form of cakes, soup, and porridge, form a considerable part of the food of the poorer classes during winter. Specimens of chestnut flour and cakes are exhibited in the museum at Kew; and in *Kew Bulletin*, 1890, p. 173, an analysis of the flour is given by Professor Church, who considers that it is easily digestible and probably useful as food for children. Further interesting particulars concerning the use of the chestnut are given in *Reports on the Cultivation of the Spanish Chestnut* (India Office, 12th March 1892).

A tanning material,¹ extracted from chestnut bark, is prepared near St. Malo in France, and is largely exported to Belgium and to Glasgow. It is said to be used to modify the colour produced by hemlock extract obtained from *Tsuga canadensis*.²

(H. J. E.)

CASTANEA CRENATA, JAPANESE CHESTNUT

Castanea crenata, Siebold et Zuccarini, *Abh. Akad. Muench.* IV. iii. 224 (1846); Schneider, *Laubholzkunde*, i. 804 (1906).

Castanea japonica, Blume, *Mus. Bot. Lugd. Bat.* i. 284 (1850).

Castanea vesca, Gaertner, var. *pubinervis*, Hasskarl, *Cat. Hort. Bog. Alt.* 73 (1844).

Castanea vulgaris, Lamarck, var. *japonica*, A. DC. *Prod.* xvi. 2, p. 115 (1864); Shirasawa, *Icon Forest. Japon.*, text 63, t. xxxiv. ff. 14-25 (1900).

Castanea vulgaris, Lamarck, var. *yunnanensis*, Franchet, *Journ. de Bot.* 1899, p. 196.

Castanea sativa, Miller, var. *acuminatissima*, von Seeman, in Diels, *Flora von Central China*, 287 (1901).

Castanea pubinervis, Schneider, *Laubholzkunde*, i. 158 (1904).

A tree, usually smaller in size than the European species, but occasionally attaining large dimensions. It is probably only a geographical form of that species, but can readily be distinguished and may be kept separate, as it probably differs in growth and in cultural requirements.

The leaves are borne on shorter petioles, but resemble those of the common chestnut in shape, being rounded or cordate at the base and having about twenty pairs of nerves; but they are smaller in size and have much shallower serrations, with very long and fine spine-like points. The main difference lies in the pubescence,³ which is short and dense on the young branchlets, on the petioles, and on the midrib of both sides of the leaf. In the common chestnut this very distinct pubescence is either absent or replaced by a scurf, very different in appearance. The catkins of the eastern tree are more slender and the fruits of wild trees smaller than in the common species. *Castanea crenata* also comes into flower, when still very young, and often bears fruit when quite a small shrub.

In China *Castanea crenata*⁴ occurs wild, mainly in the mountains of the central provinces, as a tree about 40 feet in height; and is nowhere abundant, and so far as I have seen never forms woods of any extent.

¹ A similar extract, prepared from the wood of the chestnut, is largely manufactured in Corsica. Mr. Southwell, Vice-Consul at Bastia, gave me some interesting particulars about this industry, when I visited Corsica in December 1906. There are four factories near Bastia, which produce about 25,000 tons of extract annually. The bark is not employed in Corsica, as the dark colour of the extract produced from it is objectionable. Four tons of wood yield about one ton of extract. The wood is cut into chips, which are soaked under pressure in hot water, which extracts all the tannin and some of the colouring matter. The resulting liquor is concentrated *in vacuo*. Practically the whole of this extract is used in England and Germany for sole-leather. Mr. Southwell informed me that certain trees in Corsica had brown-coloured wood, which produced an unsaleable extract. He had found by experiment that this brown colour in the wood is due to the presence of iron in the soil.—(A. II.)

² *Kew Bulletin*, 1893, p. 229.

³ The pubescence over the lower surface of the leaf is similar to that of the European tree, and is very variable in quantity and persistence.

⁴ The large chestnut tree occurring wild in China is considered by Dode to be distinct from the Japanese tree, and has been named by him *C. Duclouxii* and *C. Fargesii*, in *Bull. Soc. Dendr. France*, 1908, pp. 150, 158.

The low grassy hills of the Yangtse valley and the hills in Chekiang are often covered in places with a scrubby growth of chestnut bushes, scarcely ever over 5 feet in height. This is a distinct species,¹ and corresponds in many respects to *C. pumila* of America, the branchlets and petioles being covered with a dense, bristly pubescence, and the fruits extremely small, usually three in each involucre. This has been supposed to be *Castanea mollissima*, Blume,² an imperfectly known species.

The Chinese have distinguished from the most ancient times two kinds of chestnut, classically known as the *li* and the *erh*. The former, now known as the *pan-li* is the cultivated tree, the latter, known as the *mao-li*, is the wild form of the species, which produces remarkably sweet small fruit. These have been noticed by many observers, as by Abel³ at Tatung on the Yangtze, by Père David⁴ at Kiukiang, and by Fortune⁵ near Ningpo, who introduced the small-fruited chestnut into England⁶ in 1853; but we are unacquainted with any trees raised at that time. Similar small-fruited chestnuts are known in Japan, and were exhibited in London⁷ in 1873.

(A. H.)

The chestnut is widely distributed in Japan where it is called "kuri," from Kiusiu and Shikoku, through the greater part of the mountain forests of Hondo, and in the plains as far north as central Hokkaido. It is usually mixed with other deciduous trees, but in some places forms pure forests of small area. Its wood is preferred for railway sleepers to any other timber, but is not much valued for building purposes. Though, according to Sargent,⁸ it does not attain any great size, yet I measured an old tree in the Atera valley which was 15 feet in girth (Plate 237).

The tree is commonly seen on dry and barren hillsides in the form of coppice, which is cut every few years for firewood. It is also cultivated for its fruit, and several large-fruited varieties are grown which Sargent⁸ says are equal in size to the best in southern Europe, and are largely consumed as food in the towns, and also exported from Kobé to San Francisco. These varieties are more precocious than the European tree, bearing abundant fruit when only 10 or 12 feet high, and he recommends their introduction from Aomori in the north of Hondo, as being more likely to endure cold winters than the French or Kobé varieties.

The Japanese chestnut was introduced into the United States⁹ about 1891, and Rehder¹⁰ states that it is shrubby and usually begins to fruit when about six years old. It has proved hardy as far north as Massachusetts. So far as we know it has not yet been introduced into England.

(H. J. E.)

¹ The shrubby chestnut of China is considered by Dode, in *Bull. Soc. Dendr. France*, 1908, pp. 151, 152, 153, to constitute three new species, *C. hupehensis*, *C. Seguinii*, and *C. Davidii*.

² *Mus. Bot. Lugd. Bat.* i. 286 (1850). Cf. Diels, *Flora von Central China*, 288 (1901).

³ *Narrative of a Journey in China*, 165 (1818).

⁴ *Plantæ Davidianæ*, i. 277 (1884).

⁵ *Residence among the Chinese*, 51, 144 (1857).

⁶ *Gard. Chron.* 1860, p. 170.

⁷ *Ibid.* 1875, p. 270.

⁸ *Forest Flora of Japan*, 69 (1894).

⁹ Cf. Bailey in *Amer. Garden*, May 1891, who gives a description and figure of the tree; and *Garden and Forest*, viii. 460 (1895).

¹⁰ Cf. W. A. Taylor, in *Cycl. Amer. Hort.* i. 294 (1900), who enumerates nineteen varieties of the Japanese chestnut, which have been introduced of late years into North America, gives the date of the first introduction as 1876.

¹¹ *Cycl. Amer. Hort.* i. 257 (1900).

CASTANEA DENTATA, AMERICAN CHESTNUT

Castanea dentata, Borkhausen, *Handb. Forstbot.* i. 741 (1800); Sargent, *Silva N. Amer.* ix. 13, tt. 440, 441 (1896), and *Man. Trees, N. Amer.* 220 (1905).

Castanea vesca americana, Michaux, *Fl. Bor. Amer.* ii. 193 (1803); Loudon, *Arb. et Frut. Brit.* iii. 1984 (1838).

Castanea americana, Rafinesque, *New Pl.* iii. 82 (1836).

Castanea vulgaris, γ . *americana*, A. De Candolle, *Prod.* xvi. 2, p. 114 (1864).

Castanea sativa, var. *americana*, Sargent, *Garden and Forest*, ii. 484 (1889).

Fagus Castanea dentata, Marshall, *Arbust. Amer.* 46 (1785).

A tree attaining in America 100 feet in height. Bark dark brown, and divided by shallow irregular fissures into broad flat ridges, separating on the surface into small thin appressed scales. Young branchlets with minute scurfy pubescence above, and with long hairs near the base; glabrous and grey in the second year.

Leaves (Plate 202, Fig. 13), pendulous, oblong-lanceolate, gradually tapering and unequal at the base, long acuminate at the apex, with about twenty pairs of parallel nerves, raised on the under surface, each ending in a triangular tooth, which is prolonged into a fine point; upper surface dull, dark green, glabrous; lower surface lighter green, glabrous, or with minute scattered hairs, thin but firm in texture. Petiole, $\frac{1}{2}$ to $\frac{3}{4}$ inch long, glabrous. Stipules, ovate-lanceolate, acute, puberulous, about $\frac{1}{2}$ inch long.

Nut,¹ usually much compressed, $\frac{1}{2}$ to 1 inch wide, gradually acuminate at the apex; two to three fruits together in each involucre.

This species is distinguished from the European one by the leaves being always cuneate and never cordate at the base, and never having any stellate tomentum, the under surface being either glabrous or covered with minute glandular hairs.

In winter it is readily distinguishable from *C. sativa* by the glabrous twigs and the more pointed ovoid buds, which have glabrous ciliate scales as in that species. The buds are smaller than in *C. sativa*, being only about $\frac{3}{16}$ inch long. In the specimens seen the twigs are much more slender, with very minute lenticels and small semicircular leaf-scars. (A. H.)

In America the chestnut is a common tree, and has a wide range from New England and southern Ontario southward along the Alleghany Mountains to central Alabama and Mississippi, and westward to Michigan, Indiana, central Kentucky, and Tennessee. So far as I have seen it does not attain so large a size as the European species, though Sargent says it occasionally reaches 100 feet in height.² The largest I saw was a fine old tree on the lawn of Mr. Nathaniel Thayer's house at Lancaster, Mass., which was 80 feet by 13 feet 6 inches, and though rather decayed at the top, where its branches were supported by iron stays, had produced suckers from the root, 40 feet high.

¹ The seedling of this species is described and figured by Rowlee and Hastings, in *Bot. Gazette*, xxvi. 351, fig. 18 (1898).

² In *U.S. Forest Service, Circ.* 71 (1907), a leaflet on the cultivation of this species, it is stated that the tree has been known in the region of its best development to reach a height of 120 feet. Throughout the greatest part of its range, it is much smaller, with an average height of 80 to 100 feet, and a diameter of from 2 to 4 feet.

Emerson mentions a tree at Bolton, Mass., which in 1840 was 15 $\frac{1}{2}$ feet in girth at 6 feet, with an unbranched trunk 24 feet long; and another, on the road to Sheffield, which was 21 feet in girth at 4 feet from the ground. He states that though near the coast it does not ripen fruit so well, yet that in the interior when growing in sunny places it yields abundance of sweet and delicious nuts; and according to Sargent these, though smaller than European chestnuts, are superior to them in sweetness and flavour, and are sold for food in the eastern cities.

In *Garden and Forest*¹ there are several pictures of the chestnut in America, one representing a large tree at Dauphin in Pennsylvania, which is about 6 feet in diameter. Another represents a young forest in West Virginia about forty years old, showing good natural reproduction. A tree on a farm belonging to D. M. Ridgely, near Dover in Delaware, is noted for its excellent fruit, and it has been propagated, the chestnuts being known as Ridgely or Dupont chestnuts.

In the *United States Bureau of Forestry Bulletin No. 53* (1904), R. Zon gives an interesting account of the chestnut tree in Maryland, where it is an important timber tree, being used for railway sleepers, telegraph poles, and fencing. It is usually coppiced, and Zon states that the sprouts usually come from the root collar, only 10 per cent. arising from the top of the stump. He has never seen any sucker shoots. The capacity of sprouting from the stool is retained to an advanced age, over 100 years. The tree in America usually becomes unsound at about 100 years old.

The American chestnut has rarely been tried in cultivation in Europe, and though not likely to succeed so well as the common species, there are thriving young trees at Kew.

Emerson states that the timber is one of the best native woods on which to lay mahogany veneers; and Mr. Weale informs me that it is now imported into England both in logs and boards; but the demand is not very great. It is used by builders as a substitute for oak, and by cabinetmakers. It carves well, and as it fumes readily, is a favourite wood with makers of antique furniture. In the log its value is from 1s. 6d. to 1s. 9d. per cube foot in Liverpool. In the board it is worth from 2s. to 2s. 6d. After conversion it cannot be distinguished from the English-grown chestnut. Hough states that the wood is rich in tannin, which is extracted and used for tanning purposes. (H. J. E.)

CASTANEA PUMILA, CHINQUAPIN

Castanea pumila, Miller, *Dict.*, ed. 8, No. 2 (1768); Loudon, *Arb. et Frut. Brit.* iii. 2002 (1838);

Sargent, *Silva N. Amer.*, ix. 17, tt. 442, 443 (1896), and *Trees N. Amer.*, 221 (1905).

Fagus pumila, Linnæus, *Sp. Pl.* 998 (1753).

A tree, rarely attaining in America 50 feet in height and 9 feet in girth, usually much smaller. Bark light-brown, slightly furrowed and broken on the surface

¹ *Garden and Forest*, ix. 114, f. 12, 234, f. 34 (1896), and vii. 484 (1894). Cf. also *Ibid.* x. 372, f. 48 (1897).

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into loose plate-like scales. Young branchlets covered with numerous long erect hairs, becoming grey and glabrous in the second year.

Leaves (Plate 202, Fig. 12) smaller than in *C. sativa*, rarely as much as 5 inches long, not pendulous, oblong-oval, base unequal and rounded or tapering, apex acute, with about 15 pairs of nerves, which end in triangular serrations, tipped by short spine-like points; upper surface dull dark green, minutely pubescent; lower surface greyish white and densely tomentose. Petioles short, $\frac{1}{4}$ inch long, pubescent. Stipules about $\frac{1}{4}$ inch long, pubescent, those of the two lowest leaves broad, ovate, acute, on the middle leaves ovate-lanceolate, towards the top of the branch linear.

Nut ovoid, rounded at the slightly narrowed base, gradually narrowed and pointed at the apex, $\frac{3}{4}$ to 1 inch long, $\frac{1}{3}$ inch broad; only one fruit in each involucre, which opens generally by two or three valves. The fruit,¹ which is ripe in America in September, is delicious in flavour, and is occasionally gathered for market.

Castanea pumila is distinguished from the other species by its smaller leaves, which remain densely whitish tomentose underneath and have fewer nerves. In winter it is distinguished from the common chestnut by the twigs being slender and having a scattered loose pubescence, especially marked towards their apex. The buds are ovoid, not acute at the apex, minute, about $\frac{1}{8}$ to $\frac{3}{16}$ inch long, with both the first and second scales appressed-pubescent and ciliate. The leaf-scars and stipule-scars are smaller than in *C. sativa*.

Castanea pumila,² according to Sargent, occurs on dry, sandy ridges, rich hill-sides, and the borders of swamps, from southern Pennsylvania to northern Florida and the valley of the Neches River, Texas. It is usually shrubby east of the Alleghany Mountains, becoming a tree west of the Mississippi River, and is most abundant and largest in size in southern Arkansas and eastern Texas.³ The wood⁴ is similar to that of *C. crenata*, with very thin sapwood, and is used for fences, posts, railway sleepers, etc.

According to Loudon it was introduced in 1699 by the Duchess of Beaufort, but it is extremely rare in cultivation, the only specimens which we have seen being small shrubs at Kew, which, however, seem perfectly hardy.

There are two specimens at Verrières,⁵ near Paris, the smaller of which has a curiously twisted stem and resembles in appearance a dwarf Japanese tree. The other has two stems, each about 28 inches in girth and about 18 feet high, and produces fruit regularly and often in great abundance.⁶ (A. H.)

¹ Hough, *Trees of N. States and Canada*, 137 (1907).

² According to Taylor, in Bailey, *Cycl. Amer. Hort.* i. 295 (1900), this species commonly throws up root-suckers.

³ *Castanea neglecta*, Dode, in *Bull. Soc. Dendr. France*, 1908, p. 155, said by Dode to occur in the eastern part of the United States, is apparently only distinguishable from *C. pumila* by its larger and less pubescent leaves. It is possibly, as this author points out, a hybrid between *C. dentata* and *C. pumila*.

⁴ Hough, *loc. cit.*

⁵ *Hortus Vilmorianus*, 55 (1906).

⁶ Since this article was corrected for the press, a leaflet has been issued by the U.S. Forest Service, on Chestnut Bark disease, which is caused by a fungus, known as *Diaporthe parasitica* or *Valsonectria parasitica*. This has recently destroyed an immense number of trees in the north-eastern states, spreading with great rapidity. As the disease, if once introduced, may be equally destructive in Europe, we think it well to warn arboriculturists against importing American chestnuts at present.

FRAXINUS

Fraxinus, Linnæus, *Gen. Pl.* 318 (1737); Bentham et Hooker, *Gen. Pl.* ii. 676 (1876); Wenzig, in Engler, *Bot. Jahrb.*, iv. 165 (1883); Lingelsheim, in Engler, *Bot. Jahrb.* xl. 185 (1907).

TREES or shrubs, belonging to the natural order Oleaceæ; leaves opposite, compound, unequally pinnate, rarely reduced to a single leaflet; stipules absent. Buds, large terminal and small axillary, the former usually with four scales visible externally, the latter with two outer scales; these scales are rudimentary leaf-stalks, often showing at their apex traces of the pinnate leaf, and increase in size after the bud opens, falling off eventually and leaving ring-like scars at the base of the shoots.

Flowers polygamous or diceious, in panicles or fascicled racemes, terminal on leafy shoots of the year, or developed from separate buds either in the axils of the leaf-scars of the previous year, or at the base of the young branchlets. Calyx absent in some species; when present, campanulate and four-lobed. Corolla absent in many species; when present, of two to four (rarely five to six) petals, free or connate in pairs at the base. Stamens two, rarely three or four, affixed to the base of the petals or hypogynous. Ovary, with a style divided above into a two-lobed stigma, two-celled, each cell containing two pendulous ovules. Fruit, a samara, indehiscent, convex or compressed below, with a dry pericarp produced into an elongated terminal and more or less decurrent wing,¹ usually one-celled and one-seeded. Seed pendulous; embryo erect in a fleshy albumen; cotyledons flat.

The genus *Fraxinus* is widely distributed over the temperate regions of the northern hemisphere, three² species, however, occurring within the tropics in Cuba and the Philippines, and south of the equator in Java. The genus consists of nearly sixty species, many of which are imperfectly known and require further study in the field. Even in the case of the Mediterranean species, authorities are at variance. The present account deals only with the species which have been seen in the living state.

The genus is divided into five sections:—

I. *Ornus*, Persoon, *Syn. Pl.* ii. 605 (1807).

Calyx and corolla both present, the calyx persisting under the samara. Panicles terminal on leafy shoots or axillary on the branchlets of the current year. About eighteen species.

¹ Abnormal fruit with three wings, has been observed in several species, as *F. americana*, *F. caroliniana*, *F. Berlandieriana*.

² *F. caroliniana*, a native of the United States, is met with in Cuba. *F. Eedenii*, Boerl et Koord, occurs in Java; and *F. philippinensis*, Merrill, in the Philippine Islands.

II. *Ornaster*, Koehne and Lingelsheim, *Mitt. Deut. Dendr. Gesell.* 1906, p. 66.
Calyx present, persistent under the samara. Corolla absent. Flowers in terminal panicles, appearing with the leaves. Seven species.

III. *Sciadhanthus*, Cosson et Durieu, *Bull. Soc. Bot. France*, ii. 367 (1855).

Calyx present, persistent under the samara. Corolla absent. Flowers in dense fascicled cymes, axillary on the preceding year's shoot. Two species.

IV. *Leptalix*, Rafinesque, *New Flora*, iii. 93 (1836).

Calyx present, persistent under the samara. Corolla absent. Flowers in panicles, axillary on the preceding year's shoot. About fifteen species.

V. *Fraxinaster*, De Candolle, *Prod.* viii. 276 (in part) (1844).

Calyx and corolla both absent. Flowers in panicles or racemes on the preceding year's shoot. About twelve species.

These sections, based on the characters of the flowers, are not available in practice in the determination of living trees, flowering specimens of which are often not obtainable; and the following key groups the species according to the characters of the branchlets and foliage:—

KEY TO THE SPECIES IN CULTIVATION

I. Leaves simple or with two to three leaflets.

* *Branchlets four-angled.*

1. *Fraxinus anomala*, Watson. Colorado, Utah, Nevada. See p. 898.

Leaves usually simple, ovate or obovate, glabrous beneath.

** *Branches terete.*

2. *Fraxinus angustifolia*, Vahl., var. *monophylla*. See p. 880.

Leaves opposite, simple or two- to three-foliolate, lanceolate, glabrous beneath.

3. *Fraxinus excelsior*, Linnæus, var. *monophylla*. See p. 866.

Leaves opposite, simple or two- to three-foliolate, ovate or oval, pubescent beneath at the base.

4. *Fraxinus syriaca*, Boissier. Western Asia. See p. 883.

Leaves in whorls. Leaflets usually three (occasionally five to seven occurring on the same branch), lanceolate, glabrous.

II. Leaves with five or more leaflets.¹

A. Branchlets, leaf-rachis, and leaflets quite glabrous.

* *Leaflets stalked.*

5. *Fraxinus potamophila*, Herder. Turkestan. See p. 885.

Leaflets seven to nine, ovate, serrate.

¹ Cf. *F. syriaca* (No. 4), which has occasionally five to seven leaflets.

** *Leaflets sessile.*

6. *Fraxinus angustifolia*, Vahl. S. France, Spain, Portugal, N. Africa. See p. 879.
Leaflets seven to thirteen, lanceolate. Leaf-rachis strongly winged, the wings meeting above; groove interrupted.

7. *Fraxinus Willdenowiana*, Koehne. Origin unknown. See p. 884.

Leaflets, seven to eleven, ovate or lanceolate, increasing markedly in size from the base to the apex of the leaf. Leaf-rachis with a continuous open groove.

B. Branchlets glabrous; leaflets pubescent on part of the lower surface.

* *Leaf-rachis strongly winged on the upper side, the wings meeting in part above, forming an interrupted open groove.*

8 to 11. *Leaf-rachis not conspicuously bearded at the nodes.*

8. *Fraxinus oxycarpa*, Willdenow. Italy, S.E. Europe, Asia Minor, Caucasus. See p. 882.

Leaflets seven to thirteen, ovate or lanceolate; serrations few, ending in long incurved points.

9. *Fraxinus excelsior*, Linnæus. Europe, Caucasus. See p. 864.

Leaflets, five to eleven, oblong-lanceolate; serrations crenate, numerous, exceeding in number the lateral nerves.

10. *Fraxinus excelsior*, Linnæus, var. *rotundifolia*. See p. 866.

Leaflets nine to thirteen, $1\frac{1}{2}$ to $2\frac{1}{2}$ inches long, ovate, oval, or orbicular, coarsely bi-serrate.

11. *Fraxinus Elonza*, Dippel.¹ Origin unknown. See p. 883.

Leaflets, eleven to thirteen, small, less than $2\frac{1}{2}$ inches long, irregularly serrate, oblong, lanceolate or oval; under surface with brown tomentum near the base.

12, 13. *Leaf-rachis with conspicuous tufts of brownish-red tomentum at the nodes.*

12. *Fraxinus nigra*, Marshall. N. America. See p. 898.

Leaflets, seven to eleven, oblong-lanceolate, rounded or broadly cuneate at the base, sessile.

13. *Fraxinus mandshurica*, Ruprecht. Eastern Asia. See p. 893.

Leaflets seven to thirteen, oblong-lanceolate, gradually tapering at the base, sub-sessile.

** *Leaf-rachis with a continuous open groove on its upper side, which is sometimes almost obsolete.*

† *Some or all of the leaflets distinctly stalked.*

14, 15. *Leaflets white beneath.*

14. *Fraxinus americana*, Linnæus. N. America. See p. 901.

Leaflets seven to nine, 4 to 6 inches long, long-acuminate, dull light green above; rachis with an extremely slight groove.

¹ The groove on the leaf-rachis is variable in this species, sometimes being open its whole length.

15. *Fraxinus texensis*, Sargent. Texas. See p. 907.
Leaflets five to nine, $2\frac{1}{2}$ to $3\frac{1}{2}$ inches long, shortly acuminate, shining bluish-green above; rachis with a very slight groove.
16. *Fraxinus caroliniana*, Miller.² S.E. United States, Cuba. See p. 904.
Leaflets, five to seven, about 3 inches long, shortly acuminate; rachis with a well-defined but shallow groove.
- 17 to 23. *Leaflets green beneath; rachis slightly pubescent at the nodes.*
17. *Fraxinus rhynchophylla*, Hance. N. China, Manchuria. See p. 892.
Leaflets five to seven, 3 to 4 inches long, coriaceous, terminating in an obtuse-tipped acumen, entire or very obscurely serrate.
18. *Fraxinus chinensis*, Roxburgh. Central and Southern China. See p. 895.
Leaflets seven to nine, 3 to 4 inches long, coriaceous, shortly cuspidate at the apex, crenately serrate.
19. *Fraxinus obovata*, Blume. Japan. See p. 895.
Leaflets five to seven, 2 to 3 inches long, membranous, variable in shape, irregularly serrate, with minute curved bristles on the lower surface and petiolules, which are also present on the rachis of the leaf.
20. *Fraxinus longicuspis*, Blume. Japan. See p. 897.
Leaflets five, 3 to 4 inches long, membranous, very pale beneath, abruptly contracted into a long cuspidate apex, crenately serrate.
21. *Fraxinus Ornus*, Linnæus. S. Europe, Asia Minor. See p. 887.
Leaflets five to nine, 2 to 3 inches long, membranous, shortly acuminate, serrate.
22. *Fraxinus floribunda*, Wallich. Himalayas, Upper Burma. See p. 890.
Leaflets seven to nine, 4 to 6 inches long, membranous, apex long-acuminate, serrate; lateral nerves prominent and numerous.
23. *Fraxinus quadrangulata*, Michaux. N. America. See p. 900.
Branchlets quadrangular and four-winged. Leaflets seven to nine, 3 to 5 inches long.
- †† *Leaflets sessile or sub-sessile.*³
24. *Fraxinus Spaethiana*, Lingelsheim. Japan. See p. 897.
Leaflets seven to nine, 4 to 6 inches long, coriaceous, lanceolate, long-acuminate, irregularly and often crenately serrate. Distinguished from all other species in cultivation by the dilated swollen base of the leaf-stalk.
25. *Fraxinus lanceolata*, Borkhausen. N. America. See p. 906.
Leaflets seven to nine, 3 to 6 inches long, lanceolate, long-acuminate. Rachis grooved.
26. *Fraxinus Berlandieriana*, De Candolle. Texas, Mexico. See p. 907, note 1.
Leaflets, five to seven, 2 to 3 inches long, oval or obovate. Rachis grooved.

¹ *Fraxinus lanceolata* (cf. No. 21), has occasionally the leaflets distinctly stalked, and might on that account be sought for here.

² Cf. No. 31A. Two forms of this species occur in cultivation, differing in the absence or presence of pubescence on the branchlets and leaf-rachis.

³ *Fraxinus Elonza* (cf. No. 11), sometimes having an open continuous groove on the rachis, might be sought for here.

27. *Fraxinus dimorpha*, Cosson et Durieu. N. Africa. See p. 884.
Leaflets, seven to nine, about $\frac{3}{4}$ inch long, ovate. Rachis with wide-spreading wings.
- C. *Branchlets minutely pubescent; leaflets glabrous.*
28. *Fraxinus Mariesii*, J. D. Hooker. Central China. See p. 892.
Leaflets five, coriaceous, about $2\frac{1}{2}$ inches long, oval, stalked, crenately serrate.
29. *Fraxinus Bungeana*, De Candolle. North China. See p. 891.
Leaflets five to seven, membranous, about $1\frac{1}{2}$ inch long, mostly stalked, oval or rhomboid, long-acuminate, irregularly serrate.
30. *Fraxinus raibocarpa*, Regel. Turkestan. See p. 886.
Leaflets five to seven, oval, entire, about $1\frac{1}{2}$ inch long; upper leaflets subsessile, lower leaflets stalked.
- D. *Branchlets, leaf-rachis, and leaflets pubescent.*
* *Leaflets distinctly stalked.*
31. *Fraxinus Biltmoreana*, Beadle. United States. See p. 905.
Leaflets seven to nine, oval, about 4 inches long, white beneath; rachis very slightly grooved.
- 31A. *Fraxinus caroliniana*, Miller.¹ S.E. United States, Cuba. See p. 912.
Leaflets five to seven, oval, about 3 inches long, green beneath, rounded or broadly cuneate at the base; rachis with a well-defined but shallow groove.
- ** *Leaflets stalked, sessile, or sub-sessile.*
32. *Fraxinus pennsylvanica*, Marshall. N. America. See p. 908.
Leaflets, seven to nine, lanceolate, 4 to 5 inches long, green beneath, pubescent on both surfaces, long-acuminate, tapering at the base; rachis densely white-pubescent, and with a narrow, shallow groove. Buds reddish pubescent.
33. *Fraxinus pubinervis*, Blume. Japan. See p. 896.
Leaflets five to seven, lanceolate, 3 to 4 inches long, glabrous above, green and pubescent beneath, acuminate, tapering at the base; rachis grooved, with pubescence densest at the nodes. Buds greyish pubescent.
- *** *Leaflets sessile or sub-sessile.*
34. *Fraxinus oregona*, Nuttall. Western United States. See p. 910.
Leaflets seven to nine, oval, 3 to 4 inches long, green beneath, shortly acuminate, entire or obscurely crenate in margin.
35. *Fraxinus velutina*, Torrey. Texas to California. See p. 912.
Leaflets three to five, about $1\frac{1}{2}$ inch long; lateral leaflets variable in shape and serration, terminal leaflet obovate.
36. *Fraxinus xanthoxyloides*, Wallich. Baluchistan, Afghanistan, N.W. Himalayas. See p. 885.
Leaflets, five to nine, about $\frac{3}{4}$ inch long, ovate. Rachis with wide-spreading wings.

¹ Cf. No. 16.

37. *Fraxinus holotricha*, Koehne. Origin unknown. See p. 887.
Leaflets nine to thirteen, lanceolate or ovate-lanceolate, about 2 inches long, sharply serrate. (A. H.)

FRAXINUS EXCELSIOR, COMMON ASH

Fraxinus excelsior, Linnæus, *Sp. Pl.* 1057 (1753); Loudon, *Arb. et Frut. Brit.* ii. 1214 (1838); Willkomm, *Forstliche Flora*, 658 (1897); Mathieu, *Flore Forestière*, 241 (1897).

A large tree, attaining 140 feet in height. Bark smooth and greyish when young, becoming rough and fissured in old trees. Branchlets glabrous. Leaflets (Plate 262, Fig. 4), 9 to 15, sessile and articulate, oval- or oblong-lanceolate, acuminate at the apex, tapering at the base, where the margin is entire, elsewhere crenately serrate, the serrations more numerous than the lateral nerves; upper surface glabrous and green; lower surface paler with pubescence on the midrib, extending over the basal part of the leaflet; venation pinnate, the lateral nerves forming loops near the margin. Rachis glabrous or pubescent, strongly winged, the wings meeting above,¹ except opposite the insertion of the leaflets where there is an open channel, and below the leaflets where the rachis is flattened or broadly grooved.

Flowers,² opening before the leaves appear, fertilised by the wind, in dense axillary panicles, polygamous or occasionally dicecious, without calyx or corolla. Male flowers with two stamens more or less connate below. Female flowers with a two-celled superior ovary, the style being dilated above into two thick stigmas. Perfect flowers with an ovary and two stamens.³

Fruit, of two carpels, joined together to form the body of the samara, which is compressed at right angles to the partition and is produced in front into a veined membranous wing. The samaræ are very variable in shape, but are usually linear-oblong or elliptic, obtuse at both ends, and notched at the tip. They hang in racemes on long stalks, and, ripening in autumn, generally remain on the tree till the following spring; and are ultimately carried by the wind a short distance away from the parent tree.

SEEDLING⁴

The young plant on appearing raises the samara out of the soil, the two cotyledons being united together at first by a cap formed of the albumen. The

¹ Rain collecting on the leaflets drains into the ducts thus formed, inside of which are hairs and peltate groups of cells that gradually absorb the water, which is retained for several days after a fall of rain. See Kerner, *Nat. Hist. Plants*, Eng. Transl. i. 231, fig. 54 (1898).

² Section *Fraxinaster*.
³ Schulz, in *Ber. Deutsch. Bot. Ges.* x. 401 (1892), has shown that trees of the common ash greatly vary in the kind of flowers which they produce. Trees bearing only male flowers are common; while those with only female flowers or with only perfect flowers are rare. In many cases two of the three kinds of flowers are borne on the same tree; and what is very remarkable, a tree is not necessarily of the same sex in successive years. Ash trees do not flower, as a rule, regularly every year; and fruit is much more abundant in some years than in others.

⁴ Figured in Lubbock, *Seedlings*, ii. 214, fig. 512 (1892).

cotyledons, when developed, are about $\frac{3}{4}$ to $1\frac{1}{2}$ inch long, oblong, obtuse, entire, glabrous, pale beneath, tapering at the base into a very short winged petiole. Caulicle terete, 1 to 3 inches long, ending in a long yellow, fleshy, flexuose tap-root. Young stem, green and glabrous, terete below, angled above. First pair of leaves, arising $\frac{1}{4}$ to 1 inch above the cotyledons, simple, ovate, acuminate or acute, irregularly serrate and ciliate, minutely pubescent, on a winged petiole about $\frac{1}{2}$ inch long. Second pair of leaves, three-foliolate, on a petiole about an inch long, the terminal leaflet the largest. Third pair with either three or five leaflets.

IDENTIFICATION

The common ash is only liable to be confused with species like *F. angustifolia* and *F. oxycarpa*; but is readily distinguished by its black buds, and the crenate serrations more numerous than the lateral nerves in the leaflets.

In winter, the twigs are stout, shining-grey or olive green, compressed towards the tip, swollen at the nodes. Leaf-scars, opposite, obliquely set on projecting pulvini, semicircular or almost orbicular, often with lateral projecting horns, and showing an almost circular row of bundle-dots. Terminal buds black, conical, quadrate, with four scales visible externally, but consisting altogether of seven to eight pairs of scales. Lateral buds smaller, given off at a wide angle, with two or three external scales.

VARIETIES

The common ash, though distributed over a wide area, varies little in the wild state; and such varieties, as have been based on the form of the fruit, cannot be considered as well established. Near Perpignan a form with small leaves has been collected, which is var. *australis*, Godron et Grenier, *Flore de France*, ii. 471. In the province of Talysch in the Caucasus, a remarkable form occurs with large leaflets, velvety pubescent underneath; and the shoots, buds, and leaf-rachis are densely pubescent. This variety, which was described by Scheele¹ as a distinct species (*F. coriariifolia*), is said by Koch² to be met with occasionally in cultivation in gardens, where it is known as *Fraxinus expansa*.

A curious variation in the common ash was observed by A. D. Richardson³ in the case of four young plants, found growing in a clump of several hundreds, on the banks of the Boyne near Navan in Co. Meath. The leader shoots had the leaves alternate in a $2/5$ spiral arrangement, instead of the normal opposite and decussate one.

Numerous varieties have been obtained as seedlings in nurseries or as isolated specimens growing wild.

¹ *Linnaea*, xvii. 350 (1843).

² *Dendrologie*, ii. 1, 243 (1872).

³ *Gard. Chron.* xxxvi. 133, fig. 55 (1904).

1. Var. *monophylla*, O. Kuntze, *Flora von Leipzig*, 82 (1867).*Fraxinus monophylla*, Desfontaines, *Tab. de l'École de Bot.* 52 (1804).*Fraxinus heterophylla*, Vahl, *Enum. Pl.* i. 53 (1804); Loudon, *Arb. et Frut. Brit.* ii. 1228 (1838).*Fraxinus simplicifolia*, Willdenow, *Sp. Pl.* iv. 1098 (1805).*Fraxinus excelsior*, var. *diversifolia*, Aiton, *Hort. Kew.* iii. 445 (1789).

This remarkable variety, which is usually known as the laurel-leaved or simple-leaved ash, is met with in the wild state in the forests near Nancy in France, and also rarely in England and Ireland. It appears¹ occasionally when a quantity of ash seeds is sown, and intermediate forms are found with three, five, and seven leaflets. The shoots and buds are identical with those of the common ash. In the ordinary form of the variety, the leaf (Plate 262, Fig. 2) is simple, not being divided into leaflets. Occasionally there is a large leaflet, with one or two small leaflets at its base; and this form is known as var. *monophylla laciniata*. The simple-leaved form or the terminal leaflet in the two- to three-leaflet form, has a stalk about half as long as the blade or a little longer, and is variable in shape, being usually oval in outline with an obtuse, acute, or acuminate apex; margin coarsely serrate; lower surface pubescent except towards the apex; petiole widely grooved on its upper side. A form of the single-leaved ash with variegated leaves, was discovered, according to Loudon, in 1830 at Eglantine, near Hillsborough, Co. Down, Ireland.

The simple-leaved ash is very distinct in appearance and thrives well in towns. It is usually propagated by grafting.

At Beauport, Sussex, there is a tree of this kind, 70 feet by 5 feet 9 inches; and self-sown seedlings reproducing the variety have been observed by us there. Other large specimens occur: at Syon, a tree² 84 feet by 7 feet 6 inches; at Sidmouth, measured by Miss Woolward in 1904, two trees 9 feet 4 inches each in girth, the taller being 86 feet high; also three good trees in the grounds at Woburn growing beside the lake. Lord Kesteven reports one at Stubton Hall, Newark, which was 67 feet high by 8 feet 1 inch in girth in 1906. Elwes has seen others from 50 to 70 feet high at Scampston Hall, Yorkshire; at Sharpham, near Totnes; and at Dodington Park, Gloucestershire. A tree at Oxford, near the east end of the broad walk in Christchurch meadow, mentioned by Walker³ in 1833, is, according to Mr. Druce, about 65 feet high and 4 feet 7 inches in girth. It is crowded by other trees and is not thriving.

On the Pitfour estate near Mintlaw in Aberdeenshire, a tree 55 feet high by 7 feet 9 inches is reported by Mr. Ainslie; and Elwes saw one at Gordon Castle, which in July 1907 was covered with fruit and measured about 60 feet by 9 feet 2 inches in girth.

There is a very good specimen in Stephen's Green, Dublin; one at Beauparc House in Co. Meath measured, in 1905, 40 feet high by 6 feet 2 inches in girth; and another at Curraghmore, Co. Waterford, was 50 feet by 5 feet in 1907.

2. Var. *rotundifolia*. A tree growing in a wood at Strete Ralegh, near Exeter,¹ Cf. Mathieu, *Flore Forestière*, 241 (1897), and *Allgem. Garten-Zeitung*, iii. 6 (cited by Loudon).² This tree in 1849 was 50 feet high by 4 feet in girth; it is now beginning to decay at the top.³ *Flora of Oxfordshire*, 3 (1833). Cf. also Dyer, in *Journ. Bot.* ix. 147 (1871).

the seat of H. Imbert Terry, Esq., who has sent specimens, is remarkably distinct in the shape of the foliage from any ash known to me; but is probably only a variety of the common ash, with which it agrees in bark and in buds. In the absence of flowers and fruit, this identification is not quite certain, and on that account a full description is now given: Leaflets (Plate 266, Fig. 32), nine to thirteen, 1½ to 2½ inches long; terminal leaflet stalked, with a long cuneate base; lateral leaflets, sessile, broadly oval or ovate, unequal at the usually cuneate, but occasionally broad and rounded base, acute or slightly acuminate at the apex, coarsely bi-serrate, slightly scabrous with scattered stiff hairs on the upper surface, pale beneath with dense woolly pubescence on the sides of the midrib and lateral nerves near the base. Leaf-rachis, strongly winged, the wings meeting above in its apical half, but forming a wide open groove towards the base; pubescent on the dorsal side with scattered stiff hairs, densest at the nodes.

This ash resembles in foliage the figure of *F. rotundifolia*, Aiton,¹ which is given by Willdenow.² The latter species, according to Aiton, Willdenow, and Loudon,³ is a small tree of Italy, with flowers and buds like *F. Ormus*; and the Strete Ralegh tree cannot be identified with it, as in all essential characters⁴ it resembles the common ash.

Nothing is known of the origin of the tree at Strete Ralegh, which Miss Woolward found in 1905 to be about 75 feet in height, the bole dividing near the ground into two stems, 3 feet 1 inch and 2 feet 7 inches in girth respectively.

3. Var. *angustifolia*, Schelle. A variety⁵ with small narrow leaves (Plate 262, Fig. 5), which differs in no essential character from the common ash, of which it has the buds and the characteristic serrations and pubescence of the leaflets; and in this way can be readily distinguished from such species as *F. angustifolia*, Vahl, and *F. oxycarpa*, Willd.

4. Var. *crispa*, Loudon (also known in gardens as var. *atrovirens* and var. *cucullata*). Leaflets dark green, curled and twisted. Plant usually rigid and stunted, of very slow growth.

5. Var. *nana*, Loudon (also known in gardens as var. *polemoniifolia* and var. *globosa*). A compact slow-growing dwarf form, with very small leaves.

6. Var. *aurea*, Loudon. With yellow branches. A pendulous form of this is known.

7. Var. *asplenifolia*, Koch. Leaflets very narrow, almost linear.

8. Var. *fungosa*, Loddiges. Bark remarkably wrinkled, with corky ridges.

9. Var. *verticillata*, Loudon. Leaves whorled, not opposite as in the common form.

10. Var. *monstrosa*, Koch. Young branches fasciated.

11. Var. *erosa*, Persoon. Leaflets incised.

¹ *Hort. Kew.* iii. 445 (1789). Cf. our remarks on this species under *F. Ormus*, p. 888.² *Berlin. Baumzucht*, 116, fig. vi. 1 (1796).³ *Arb. et Frut. Brit.* ii. 1244 (1838).⁴ Bark and buds especially. The pale under surface of the leaf, which is thin in texture, is seen in common ash seedlings and in some forms of var. *monophylla*. The strongly-winged rachis of the leaf is characteristic of *F. excelsior* and its near allies.⁵ Var. *elegantissima*, in cultivation at Aldenham, obtained from Simon-Louis, is scarcely to be distinguished from this variety.

12. Var. *verrucosa*, Desfontaines. Branchlets warty.

13. Certain variegated forms are known, as—var. *albo-marginata*, leaflets edged with white, and var. *albo-variegata*, in which the white colour appears as blotches on the leaflets.

Most of the foregoing varieties are of little or no beauty or interest, and do not, so far as we know, become large or shapely trees. (A. H.)

14. Var. *pendula*, Aiton. The weeping ash in some form or other is found in almost every garden, but rarely as a large tree. Loudon describes several forms of it, and says that the original tree was discovered near Wimpole in Cambridgeshire 150 years or more ago, and was decaying in 1835.

Another form, the Cowpen ash, which grew near Morpeth, is figured by Loudon;¹ and I have seen two trees which have naturally assumed a very similar habit. One stands by the road in the village of Ollerton, Notts. The other is in a field at Marsden, in the parish of Rendcombe, Gloucestershire.

A third form, called by Loudon the Kincairney Ash, grew in the parish of Caputh, near Dunkeld, Perthshire, and was distinguished by its alternately pendulous and upright branches. It was propagated at the Perth Nurseries, but I have not noticed any of this variety now in cultivation.

To make an effective tree, the weeping ash should be grafted on a very tall stock, and if the branches are attended to, may be trained into a shady arbour like a great umbrella. But if the stock is also allowed to grow as well as the graft, the effect will be more curious than beautiful; and the weeping ash is not so much admired or planted as it was formerly when trained and clipped trees were more in fashion. At Heanton Satchville, in North Devon, the seat of Lord Clinton, I saw it trained in combination with a trellis of living ashes which were planted all round the central weeping tree, and had their stems woven together when young so as to form the walls of the arbour; but in the course of time this had become ragged; and as the ash does not bear clipping like the beech or hornbeam, I should prefer either of those trees for such a purpose.

By far the finest grafted weeping ash that we know of is growing in the gardens of Elvaston Castle, near Derby, the seat of the Earl of Harrington. It was reported² in 1905 to be 98 feet high, with long weeping branches hanging vertically from the summit of the tree, one of them descending to about 20 feet from the ground; but when I saw it in 1906 I did not think it was more than about 90 feet high, the bole, 6 to 7 feet in girth, being straight and clean. (Plate 238.) This tree was grafted by Barron about 1848. Another larger tree also exists here, which has a bole 50 feet by 12½ feet, and was apparently grafted with weeping ash at the same time, but in this case the branches of the stock have outgrown the grafts.

In Ireland there is a very handsome and well shaped weeping ash at Castlewellan, 41 feet high, with a trunk 5 feet in girth with branches hanging to the ground all round it. (H. J. E.)

¹ *Arb. et Frut. Brit.* ii. 1216, f. 1045 (1838).

² *Garden*, 1905, lxviii. 400, with figure.

DISTRIBUTION

The common ash is spread through almost all Europe, and occurs also in the Caucasus.

The northern limit in Europe passes from the Trondhjem fjord in Norway, about lat. 63° 40', through Sweden at about lat. 61°, and in Finland extends to lat. 62°, descending from there through Russia in a S.E. direction to Riazan, whence it continues N.N.E. to Kazan, its extreme eastern point in Europe. From Kazan, the eastern limit descends in a S.W. direction through Penza, Saratof, and Voronej to Kharkof, and then passes by Ekaterinoslav to the Crimea. In the Caucasus¹ the ash does not occur north of the rivers Kuban and Terek. The southern limit extends from the Transcaucasian province of Talysch through Asia Minor and Turkey to Dalmatia, and across Italy and southern France to the Pyrenees. In the Iberian peninsula² it is met with, according to Willkomm, in the mountains of Catalonia, Aragon, Burgos, Santander, Leon, Asturias, Galicia, and northern Portugal. The western limit takes in the western coast of France and the British Isles. Outside the range mentioned above, it occurs as small scrub in rare situations, as in Norway at Tromsö (lat. 69° 40'), and in the government of St. Petersburg.

An ash occurs in the western Himalayan region which, according to most of the authorities, is *Fraxinus excelsior*. It has been distinguished as a distinct species by Wenzig,³ and, so far as I can judge from dried specimens, is very different indeed from the common ash. Sir George Watt informs me that this ash is always an insignificant tree, never attaining more than 30 feet in height and a foot in girth.

The ash is generally met with growing wild as isolated trees or in small groups in the continental forests, but pure woods of some extent occur in moist situations, as in river valleys subject to flooding, in Hungary, Slavonia, Poland, and Russia. In northern regions it is rather a tree of the plains and valleys than of the mountains; but in southern Europe it is only met with in the mountains. It ascends in south Tyrol to 4000 feet, and in Switzerland to about 4400 feet.

The ash is a true native of the British Isles, and has been found in a fossil state in the interglacial beds at Hitchin in Hertfordshire, and in neolithic deposits at Crossness in Essex.⁴

It may be said to occur wild in every part of the British Isles, except in the northern part of Scotland, where, however, it bears the climate in plantations. In Yorkshire⁵ it ascends to 1250 feet elevation. In Braemar, H. B. Watt⁶ observed it up to 1200 feet. In Ireland⁷ it is frequent in woods, hedges, and rocky places; and ascends in Donegal to 800 feet, in Down to 1000 feet, and in Wicklow to 1300 feet.

¹ It ascends in the Caucasus to 6000 feet, according to Radde, *Pflanzenverbreitung in den Kaukasusländern*, 181 (1899).

² Cf. Captain Widdrington's account of the distribution of the ashes in Spain, given under *Fraxinus angustifolia*, p. 880.

³ *Fraxinus Hookeri*, Wenzig, in Engler, *Bot. Jahrb.* iv. 179 (1883). It differs from the common ash in having fewer leaflets, usually five, rarely seven. The bud is also very distinct, being dark yellow in colour, and covered with minute warts. The leaflets are sessile, oval, broadly cuneate at the base, acuminate at the apex, pale beneath, with pubescence on each side of the midrib, minutely crenulate-serrate. The rachis appears to have a wide open groove above; and the fruit in its lower part is longitudinally and deeply grooved in the middle line.

⁴ C. Reid, *Origin Brit. Flora*, 133 (1899).

⁵ *Cairngorm Club Journal*, iv. 114 (1903).

⁶ Lees, *Flora of W. Yorkshire*, 322 (1888).

⁷ *Cybele Hibernica*, 236 (1898).

Ash woods, supposed to be wild, occur on limestone in hilly districts in Yorkshire, Derbyshire, and Somerset. In the latter county, they are very numerous in the Mendip Hills, and have been mapped by Mr. C. E. Moss,¹ who gives an interesting account of their distribution and peculiar features. The ash is often pure, with a dense undergrowth of hazel, or it is mixed with yew and whitebeam. Mr. Moss notices the prevalence of dog's mercury and wood garlic² in many of these ash woods.

The Gaelic name of the ash, according to Sir H. Maxwell,³ is *uinnse* (inshy), and becomes Inshawhill in Wigtonshire, and the plural *uinnsean* (inshan) takes the peculiar form of Inshanks, the name of two places in that county, and Inshewan, near Kirriemuir; while the common alternative form *uinnseog* (inshog) remains as Inshock in Forfarshire, Inshaig in Argyllshire, Inshog near Nairn. Analogous forms,⁴ with the initial letter *f*, appear in names of places in the south and west of Ireland, as the river Funcheon in Co. Cork.

(A. H.)

CULTIVATION

Though the oak will always be looked on as the premier tree of Great Britain, yet now that its most important use has passed away, the ash must be considered as the most economically valuable of all our native trees, and is perhaps the only hardwood from which a quick and certain return can be expected by the planter.

It is almost the only tree whose value has not fallen in consequence of foreign competition, and, though a good deal of American and some Hungarian and Japanese ash is now imported, yet the timber of these is not considered equal for toughness, strength, and elasticity to the best English ash, for which no foreign wood forms an efficient substitute. And as the tree can be grown over all parts of our islands, and attains a great size wherever suitable soil is found, it should be planted more largely in all favourable situations, where it produces timber of good quality.

In considering the requirements of the ash, one must always remember that it is a bad neighbour both to other trees and to crops, and that it is far more valuable as timber when grown in woods where it can be drawn up to a good height, than in hedgerows where it produces many branches. It likes a deep, rich soil, neither too wet nor too dry, and grows very well on limestone formations, even on a shallow soil, if the rock is sufficiently disintegrated for the roots to penetrate the crevices.

It is short-lived on wet or swampy soils, and the timber is inferior on sandy or peaty land. The finest trees are generally in sheltered situations, but though it is the latest of our native trees to come into leaf, none suffers more from late frosts; and therefore when planted in low situations it is often severely injured when young. It will grow up to a great elevation, and in the most exposed situations, though here it becomes stunted and branchy. No hardwood except that of the chestnut becomes valuable at so early an age, but the wood of old trees, even when sound, usually becomes discoloured or "black-hearted," and ash is never

¹ *Geog. Distribution of Vegetation in Somerset*, 41 (Roy. Geog. Soc., 1907).

² Mr. A. C. Forbes, in *Eng. Estate Forestry*, 72 (1904) says:—"We have always noticed that the existence of the wild garlic, *Allium ursinum*, is an almost certain indication of good ash ground."

³ *Scottish Land Names*, 109 (1894).

⁴ Cf. Joyce, *Irish Names of Places*, 488 (1870).

more valuable than when it is from 3 to 6 feet in girth, with a clean stem, a size often attained at fifty to sixty years of age.

In plantations ash is often mixed with other trees, and if allowed to take the lead will do them more harm than oak, but a few ash should be introduced in the best soil of larch or other plantations, because the seedlings, which spring up abundantly, will, when the conifers are cut, renew the plantation naturally, and the parent trees will throw up vigorous shoots from the stool after felling.

In the midland counties, ash is the commonest, and by far the most profitable underwood, being cut at intervals of twelve to twenty years; when the poles are much in demand for many purposes, especially for sheep hurdles. But in most places during the last twenty years ash poles have fallen in value, though larger timber has increased in price; and so much damage has been done to the stools by rabbits that large areas are now becoming very thin, and the crop inferior. No tree except beech suffers more from rabbits than ash, and where they are allowed to increase, and are not killed before winter, the bark of old trees as well as of underwood is sure to be peeled, and the natural reproduction from seed checked. I believe that where the soil is stiff, young ash will pay for some cultivation when young, as their shade is not dense enough to keep down grass and weeds, and if they become stunted, as they often do after planting, it is better, and, indeed, necessary, to cut them down to the ground two to five years later.

Self-sown ash seem to grow more vigorously than planted ones, if not too crowded, and their rate of growth is sometimes extraordinary. An ash self-sown in my nursery, at three years old was 7 to 8 feet high, whilst the transplanted seedlings on the same ground were only 3 feet high at the same age. I have seen shoots 6 to 7 feet long the first year from strong healthy stools, and poles worth £15 to £20 per acre at sixteen years old, on land which for agricultural purposes was not worth 8s. an acre. The stools, however, often become worn out and hollow at the base after five or six cuttings, and these should be replaced with seedling plants every time the crop is cut.

Some years ago, when ash coppice began to fall in price, I left the strongest and straightest pole on every stool at the rate of about 160 per acre, with the object of converting the coppice into timber trees. But though, where the soil is good and the stools young, these poles are likely to make useful trees at fifty to sixty years from the last cutting over, yet where the land is poor they have increased but little, and have a hidebound appearance, owing, no doubt, to the want of shelter and the exposure to the sun and wind. I should advise all intending planters of ash to examine carefully the best local ash plantations, and inquire into the probable demand for poles before adopting this course.

The ash is always raised from seed, except in the case of varieties which are grafted on stocks of the common ash. The keys are ripe in late autumn, and often hang on the tree till the following summer, especially when they are not mature. The best-ripened seed, I believe, usually falls first, and should be gathered before winter, and put in a shallow layer mixed and covered with earth or sand, and kept fairly dry until the following winter, when it should be sown. It is advised in books

that they should be turned over several times during the year before sowing, but I have not found this necessary; and with regard to the time of sowing, it should be put off as long as possible, because the natural germination of the seed takes place six to eight weeks before the tree comes into leaf, and the tender seedlings are thus often injured and killed by late frost. Therefore I advise storing them in a cold place, and not sowing until they begin to germinate. If they come up too thickly and survive the first spring, they may be transplanted in the following March or April, which will tend to check their early leafing, but if thin on the ground they may be allowed to stand two years before transplanting into rows. At three, or at most four, years old, they will be fit to go out permanently, the stronger side branches and double leads, if any, being first pruned. If intended for copsewood, they must be cut over in the month of April, two or three years after planting, and any pruning necessary to older trees should be done in summer or early autumn, so that the wounds may heal as soon as possible. The tree makes an abundance of fibrous roots, and unless these are allowed to become dry, the proportion of loss from transplanting should be very small, and transplanting may be done later than in the case of most hard woods.

For ash coppice, 4 or 5 feet apart is the right distance; for timber trees, they may be alternated with spruce or larch, which will keep them from becoming branchy. The cutting of the stools must be done with a sharp knife or axe as near the ground as possible, and with an upward cut, and the poles removed at latest by the middle of May, as much harm is caused by getting the poles away after the stools have begun to push new growth.

One of the best examples of copse-grown ash that I have seen in England is the Walk Copse near Buckhold, Berks, where a number of tall, slender, clean poles, believed by Dr. Watney to be about sixty years old, have originally sprung up from seed, in a plantation once largely composed of silver firs. Though the soil is a flinty clay, now of little agricultural value, the majority of these trees are 90 to 100 feet high, by 3 to 4 feet in girth, and quite clean to 50 or 60 feet. One of the best was quite straight and clean to 65 feet high, but only about 3 feet in girth. Such poles as these are much sought for by agricultural implement and coach makers, and are worth from 2s. 6d. to 3s. per foot.

REMARKABLE TREES

I do not know of any ash at present alive in England which equals in size a tree mentioned by Loudon as growing near Moccas Court, Herefordshire, on the edge of a dingle. This had immensely large roots, running on the surface for 50 feet or more down the steep hillside, and a clear trunk of 30 feet long, 7 feet in diameter at 15 feet from the ground. This, including three large limbs, was estimated to contain 1003 cubic feet of timber. This ash is remembered as a marvellous tree, though quite decayed, by the Rev. Sir George Cornwall, who told me that not a vestige of it now remains.

The tallest living ash trees I have seen or heard of are in a grove near the

old heronry at Cobham Hall, Kent, the seat of the Earl of Darnley, a place which contains taller and finer ash trees and hornbeams, and more of them, than any that I have seen in England. Strange to say, Strutt, who figured several trees at Cobham, overlooked these; but in Francis Thynne's continuation of Holinshed's *Chronicles*, p. 1512, I find the following, which shows that Cobham was renowned for its trees more than three centuries ago. Speaking of William, the last Lord Cobham but one, he says:—

“ Besides which, overpassing his goodlie buildings at the Blackfriars in London, in the year of Christ 1582, and since that the statelie augmenting of his house at Cobham Hall, with the rare garden there; in which no varietie of strange flowers and trees do want, which praize or price maie obtaine from the farthest part of Europe, or from other strange countries, whereby it is not inferior to the garden of Semiramis.”

The largest ash here, described by Loudon, was a tree 120 feet high, with a trunk 6 feet 8 inches in diameter, straight, and without a branch for a great height. This was perhaps the same whose trunk I saw in July 1905 lying on the ground, where it had fallen several years ago. But those which remain are not only the tallest ash trees, but the tallest trees of any sort with one exception that I have measured in England, and there are so many of them that I can well believe that I did not measure the tallest. The tallest tree, measured in April 1907, by Lord Darnley, is 146 feet high by 12 feet in girth. Another growing by the side of a drive, which he christened Queen Elizabeth's ash, I measured 143 feet high by 12 feet 7 inches in girth. In the grove near it are several, very nearly if not quite, as tall, one of which I made 141 feet by 13 feet 1 inch, with a bole 50 feet high, and a roughly estimated contents of 700 to 800 feet. (Plate 239.) Another, 140 feet by 12 feet 9 inches, with a bole of 48 feet, which, judging from the large mass of fungus growing on its root, is probably decaying. There are many other trees in this grove which are 125 to 130 feet high, and stand pretty close together, growing in a sheltered situation,¹ on what appeared to be a deep but rather sandy loam.

Other remarkable ash trees at Cobham are the Twisted Ash, whose trunk is spiral, and measures 116 feet by 17 feet 9 inches. (Plate 240.) The View Ash, a tree nearer the house, is only about 80 feet high by 17 feet 9 inches at 5 feet, but is 29 feet in girth at the base, and has its trunk and most of its branches covered with green and healthy twigs.

Next to Cobham in respect of its great ash trees is Knole Park, also in Kent, where, in a sheltered valley near the gate from the Sevenoaks Road, called “The Hole in the Wall,” are a number of very fine sound trees, from 125 to 130 feet high or more, and from 13½ to 16 feet in girth, one of which has a bole 35 feet long, and probably contains over 700 feet of timber. Here again the soil is a deep sandy loam, which grows splendid beech, oak, and chestnut, but I cannot guess the age of the ash, though they are probably over 200 years.

One of the most perfect examples, from a timber point of view, is a tree growing in a wood called Poultridge, just outside Ashridge Park (Plate 241), which

¹ This is about 330 feet above sea-level, and is situated between the Medway and the Thantes.

is about 125, perhaps 130 feet high, but difficult to measure on account of the surrounding trees. It had, in 1906, an absolutely straight, clean stem, about 75 feet in height by 11 feet 10 inches in girth, and looked as if it would square 27 to 28 inches halfway up, in which case it contains about 400 feet of faultless timber in one length. It is surrounded by other trees and underwood, and a photograph could not have been taken if Mr. Liberty, forester to Earl Brownlow, had not been obliging enough to clear away the intervening brushwood.

At Chilham Castle, in Kent, the seat of C. S. Hardy, Esq., there are some splendid ash trees. The best of these was recently cut down in the heronry, where I saw its stump in 1907, and counted about 185 rings, the diameter being about 4 feet. The soil here does not appear to be deep, and is on a chalk subsoil, as at Ashridge, but the tree grew in a very sheltered position, was drawn up to a height of 132 feet, and nourished by the beech which surrounded it. The first length contained 236 cubic feet. A tree of very similar character was growing in the park not far off, and measured about 115 feet by 13 feet 6 inches, with a straight, clean bole about 45 feet long. I estimated its contents at 280 feet in the first length.

At Godinton, Kent, there are many very fine tall ash trees in what is called the "Tole," a splendid clump mainly composed of chestnut, which contains as large a quantity of clean, fine timber as I ever saw on the same area in England. I measured an ash here about 110 feet high, and only 6 feet 5 inches in girth, which hardly fell off at all in thickness up to 50 or 60 feet.

At Woburn there was in Strutt's time an immense ash which he figures on Plate 22, and gives the height as 90 feet, the girth at 3 feet, 15 feet 3 inches, the bole 28 feet high, and the diameter of the branches 113 feet. The estimated contents were 872 feet. This tree was still healthy in Loudon's time but I can find no trace of it at present.

At Arley Castle there is a fine ash tree 120 feet by 14 feet as measured in 1904 by Mr. R. Woodward; and at Althorp there was a very fine ash which is now much damaged by wind and old age. When measured in 1890 by Mr. Mitchell, now forester at Woburn Abbey,¹ it had a bole 36 feet high with immense limbs spreading on all sides, was 17 feet 3 inches in girth at 3 feet, and had a cubic content of 800 feet. At Hatfield there is also a very fine ash tree growing near the big elm in a hollow, which I made 104 feet by 15 feet 8 inches. An immense ash butt was bought by Mr. Miles of Stamford in February 1894, and hauled into his yard by eleven horses. I am informed by Mr. C. Richardson that it measured 20 feet long by 50 inches quarter-girth, equal to 435 cubic feet of timber, and that it was the largest he had ever seen or heard of. Mr. A. B. Jackson in 1908 saw some tall trees at Kedleston Park, Derby, one measuring 120 feet by 10 feet 2 inches, and another 125 feet by 8 feet 10 inches. He measured also a tree at Elvaston Hall, 110 feet by 12 feet 7 inches.

At Studley Royal, Yorkshire, there are some tall, straight, and clean ash, the best that I measured being 119 feet by 10 feet 6 inches; and at Castle Howard and other places in the same county, and in parts of Lincolnshire, the ash is a more

¹ *Trans. Roy. Scott. Arb. Soc.* xiii. 88 (1891).

profitable timber tree than any other. The largest that I have seen in the north is one at Lowther Castle, known as Adam's Ash, which is 21 feet 10 inches in girth.

Lees in *Gardeners' Chronicle*, November 7, 1874, figures several curiously split and distorted relics of ash trees which existed in the district he knew so well round Worcester; but does not mention any of extraordinary size. He suggests that such wrecks may often have escaped being converted into firewood, owing to the superstition which formerly prevailed, that rickety children might be cured by passing them through a fissured ash tree; and relates an instance known to him of the curious superstition, that a similar passage through a cleft ash would induce fertility in barren women.

White, in his *Natural History of Selborne* (Ed. Allen, 1900, p. 266), speaks of a row of pollard ashes at Selborne which had been in former times cleft and held open by wedges while ruptured children were pushed through the aperture, in the belief that they would be cured of their infirmity. He also states that there were then several people living in his parish, who in childhood were supposed to be so cured. He describes an old pollard ash which for ages had been looked on with no small veneration as a "shrew-ash," and whose twigs were, when applied to the limbs of cattle, supposed to cure the pains caused by a shrew-mouse having run over the affected part. A "shrew-ash" was made by boring a hole in the trunk and putting a live shrew into the hole, where it was plugged up with several quaint incantations now long forgotten.

In Wales I have not seen or heard of any larger than a tree by the slaughter-house in Dynevor Park. Though not very well shaped and somewhat past its prime, I found it in 1908 to be 104 feet by 22 feet 9 inches.

In Scotland there are also many great ash trees, of which perhaps the largest recorded anywhere has long ago completely decayed. It was described in Walker's *Essays*, p. 17, as growing in a deep, rich soil, in the churchyard of Kilmalie, and was considered to be the largest and most remarkable tree in Scotland; and said to measure in 1764 no less than 58 feet in girth at the ground. Another celebrated old tree is in the hotel garden at Logierait, Perthshire, which Hunter¹ described in 1883 as measuring 47 feet 7 inches at 1 foot from the ground, and 32 feet 5 inches at 5 feet. It was then completely hollow and covered with ivy, with an opening 5 feet 9 inches wide on one side, in which a summer-house had been made. But the late Sir R. Menzies informed me in 1903 that this tree is now very much decayed.

Strutt, *Sylva Scotica*, Plate 8, figures a very fine ash tree, at Carnock, Stirlingshire, then in perfect vigour, and said to have been planted about 1596 by Sir T. Nicholson of Carnock. He gives its measurement as 90 feet high by 19 feet 3 inches at 5 feet. This tree, however, died and was broken up about 40 years ago. The tallest ash that I have myself measured in Scotland is at Gordon Castle, which is a fine healthy tree in the home park, 101 feet high with a bole of 30 feet, which in 1904 girthed 12 feet 6 inches. J. Webster records one at the same place

¹ *Woods, Forests, and Estates of Perthshire*, 545 (1883).

70 feet by 15 feet 8 inches in 1881. Sir Archibald Buchan-Hepburn reports a tree at Smeaton-Hepburn 124 feet by 11 feet in 1908.

But these are much exceeded in height by a tree west of the Beech Walk at Mountstuart in the island of Bute, which James Kay¹ states to have been in 1879 no less than 134 feet high by 9 feet 4 inches, with a bole of 35 feet 6 inches, and if this measurement was correct it must have been the tallest hardwood tree in Scotland. It was estimated to contain 273 feet of timber. I could not, however, identify this tree when I visited Mountstuart in 1906, and fear that, like some of the splendid beech trees which grew there, it has fallen.

At Ochertyre, Perthshire, Hunter² records an ash supposed to be about 400 years old, which measured in 1881 34 feet 10 inches at 1 foot and 20 feet 8 inches at 5 feet, and I am informed by the widow of the late gardener, Mr. Conacher, that the tree still remains in very good condition. At Keir, near the Bridge of Allan, there is a remarkable ash stool, from which four stems proceed, averaging 6 feet 4 inches in girth and 103 feet in height. A tape 16 feet 10 inches long, girths the four stems at 5 feet from the ground. At Dupplin Castle I measured a fine tree about 100 feet high with a stem clean to 45 feet and 10 feet 7 inches in girth. At Dalswinton, Dumfriesshire, Henry measured in 1904, a tree 110 feet by 8 feet 3 inches, with a fine clean stem; and another 93 feet by 13 feet 3 inches.

Near Cawdor Castle, Nairnshire, the property of the Earl of Cawdor, and one of the most beautifully situated of the really old inhabited castles in Scotland, there is a very large, though branchy and ill-shaped ash no less than 21 feet in girth. At Brodie Castle, Morayshire, there is a very large tree, 18 feet 8 inches in girth, of which the owner has kindly sent me a photograph; and at Darnaway, in the same county, an immense tree of great age, much damaged by storms, existed in 1881. Even as far north as Conon House, Ross-shire, the seat of Sir Kenneth MacKenzie of Gairloch, the ash grows extremely well in a low-lying flat. Here I saw a lot of beautifully grown, though not very large trees, which would have been a credit to any woodland in the south.

On the shore of Loch Fyne, a mile north of Minard Castle, a curious ash grows on the beach at high-water mark, which is known as the "Nine Sisters," because nine stems sprang from the same root, the largest of which when I saw them in 1907 were 7 to 9 feet in girth.

In Ireland the ash thrives exceedingly well; and often attains an immense size. In Co. Meath, where the soil is remarkably fertile, it has in many parts expelled all the other trees from the hedgerows; and one may drive long distances on the roads between lines of flourishing ash trees, without seeing a single oak or beech.

In the latter part of the eighteenth century several ash trees of enormous size were still living, of which Hayes gives an account.³ He relates, on the authority of an official of the Dublin Society, that a tree was then standing at Donirey near Clare Castle in Co. Galway, which measured in girth 42 feet at 4 feet and 33 feet at 6 feet. The trunk had long been hollow, having been used 25 years before as a

¹ *Trans. Scot. Arb. Soc.* ix. 75 (1879).

² *Op. cit.* 454.

³ *Practical Treatise on Planting*, 137, 142, 148 (1794).

school. In 1794, it had only a few branches remaining, which were, however, still vigorous. At Curraghmore, the seat of the Marquess of Waterford in the county of that name, there were many enormous ash trees, one of which was 22½ feet in girth at a height of 13 feet 9 inches, the girth of the butt being 33 feet 9 inches. In 1792 Hayes measured the famous ash tree at Leix in Queen's County, which was 40½ feet round at 1 foot, and 25 feet at 6 feet up, where the girth was least. Marsham in a letter to Gilbert White, dated 12th February 1792, says that a print of this tree was then being engraved in London, but we have never been able to see a copy of this, if it was ever published.

An ash at Castledurrow, which Hayes says was the finest he ever saw, in October 1793 measured 18 feet in girth and nearly as large at 14 feet high, the branches extending 45 feet from the stem in every direction. Another at Kennity Church, King's County, was 21 feet 10 inches in girth with a bole of 17 feet. The funeral parties used to stop and say prayers under this tree, after which they threw a stone at its foot.

None of these relics of antiquity now remain; and most of the fine ashes have been cut down. Probably the tallest now left in Ireland is one at Woodstock in Co. Kilkenny, in an alluvial flat beside the river Nore and close to the village of Inistioge (Plate 242). Henry, in 1904, made it 127 feet in height by 16 feet 9 inches in girth; but the forester's records give it as 136½ feet high in 1901. This tree was 11 feet in girth in 1825, 11 feet 8 inches in 1834, 13 feet 2 inches in 1846, and 16 feet 9 inches in 1901, according to the same records. Another tree beside it, which was 9 feet 5 inches in girth in 1825, was 11 feet 9 inches in 1901; and a third tree, 10 feet 5 inches in 1825, had attained 15 feet 3 inches in 1901.

At Mitchellstown, in Co. Cork, there was in 1903 a remarkably fine ash, with a tall clean stem, which was 111 feet high by 9 feet in girth. Another tree, 91 feet high, was 27 feet in girth at 2 feet above the ground, but only 15 feet 2 inches at 6 feet up. At Kilmacurragh in Co. Wicklow there is a good ash, the height of which exceeds 100 feet, but is impossible to measure on account of the situation of the tree; the girth in 1903 was 13 feet at 5 feet above the ground. There are fine trees of great girth (17 to 18 feet), but not remarkable for height, at Doneraile Court, Co. Cork. Henry measured in 1904, on Lord Oranmore's property at Castle Macgarrett, Co. Mayo, a tree 119 feet by 14 feet 2 inches, containing 216 cubic feet of timber. At Castlewellan, Co. Down, there are some very fine ash in the park, one of which near the garden gate is figured on Plate 243. It measured in 1908 about 70 feet high, and 18 feet in girth.

The finest ash that I have seen on the continent is in the Royal park of Jægersborg near Copenhagen, and measured in 1908, 125 feet by 11 feet 8 inches.

ASH DISEASES

The commonest disease in the ash in my own district is a canker which affects trees during most of their life without killing them, though the timber is worthless except for firewood. This disease is described and figured by the late Mr. Wilson

Saunders, F.R.S. ;¹ and Mr. Sidney Webb fully explained the manner in which extensive canker resulted from minute wounds, at a meeting of the Scientific Committee of the Royal Horticultural Society, February 11, 1879. A full account of the disease is given by Dr. Masters in the *Gardeners' Chronicle*, 1879, p. 208, where it is stated that the injury is originated by the larva of a minute moth called *Prays curtisellus*.² Plate 244 shows a bad case of this canker in an ash at Staple, near Colesborne; and there is a tree at least 70 feet high by the roadside, close to the sixth milestone from Cirencester to Cheltenham, which has had this disease from its base to near the summit as long as I can remember.

In *Trans. Scot. Arb.* x. 235, there is a useful paper on the Ash Bark Beetle, *Hylesinus Fraxini*, a pest which seems to be dangerous only where the ash is already unhealthy. As the eggs of this insect are laid in spring only under the bark of felled, dead, or sickly trees, wherever this pest is troublesome, all such should be removed from the neighbourhood of the healthy trees by April, and ash loppings should not be left on the ground. A curious malformation occurs in a tree growing close to Cirencester, on the east side of the Tetbury road nearly opposite the Kennels. Plate 244 shows the remarkable growths on its branches, specimens of which were sent to Kew and found to contain numerous examples of *Hylesinus Fraxini*.

TIMBER

For coach, waggon, and agricultural implement making, and for all purposes in which strength, toughness, and durability are required, ash timber has no equal, and no substitute has been found among foreign trees which can be relied on as well. In consequence, it is now the easiest to sell, if not quite the highest priced, of all English timbers; and its growing scarcity seems to point to a great future for it.

It varies much, however, in strength, toughness, and elasticity, according to the soil on which it is grown, and the age at which it is cut. I am informed by Mr. Clutterbuck of the Gloucester Waggon Works, who has had long experience with English and foreign timber, that there is no better ash in England than that grown on the Cotswold hills; but if left standing too long, it becomes discoloured at the heart, and is probably never worth more per foot than when 60 or 70 years old.

It is now perhaps the only wood worth growing as copsewood, and, when established on good land and cut every ten to fifteen years, still makes as much as a pound per acre per annum. The poles are used for making hurdles, hoops, crates, and many other purposes, and as hop-poles are only second to chestnut. I have found that for the rails of light field-gates in a hunting country, on account of their elasticity nothing is better; and when well made they last thirty years or more. Ash wood takes creosote well, which very much increases its durability; and some sheep-hurdles which I had creosoted thirteen years ago are still sound, though when not so treated, they do not last more than three to five years. Ash, however, soon decays in contact with the soil and is unfit for building purposes, though it was

¹ *Journ. Roy. Hort. Soc.* v. 135 (1879).

² Also known as *Tinea curtisella*, Don. Cf. Schlich's *Man. Forestry*, iv. 344 (1907), where the moth is figured and described.

formerly used for staircases. Loudon says that the staircase at Wroxton Abbey, near Banbury, was made of this wood, and in Hatfield House some of the inside work is made of ash. Slabs from flat-sided trees often show a very ornamental curly grain which makes very handsome panelling, and might be used for door panels with good effect.

The burrs are also cut into beautiful veneers which, when polished, are used in cabinetmaking, and which sometimes in Hungary and south Russia are of great size and perfectly sound, though in England usually small and faulty. I purchased in Manchester, under the name of Circassian ash burr, some splendid veneers of this wood, which measure about 5 feet by 3 feet, and are made up of small, closely crowded knots, which take a fine polish and are of a greyish white or pinkish grey colour.¹ English ash, however, seldom or never assumes the wavy grain which is found in Hungary and Russia, and is one of the most beautiful woods I know. This is known as fiddle-back ash, because wood of this character, usually maple, is selected for the backs of violins. It varies very much in colour, the most valuable being the whitest; and also in the size and character of the figure; but when a combination of small waves with eye-like patches is combined, it is superior to the best American maple. Such wood was formerly much used for decorating railway carriages, and for furniture, but from some reason which I cannot explain is now out of fashion. I believe that the waving rarely extends throughout the tree, the best figure being always near the outside, and the causes which produce it are, so far as I know, as yet without any scientific explanation. (H. J. E.)

FRAXINUS ANGUSTIFOLIA, NARROW-LEAVED ASH

Fraxinus angustifolia, Vahl, *Enum.* i. 52 (1804); Loudon, *Arb. et Frut. Brit.* ii. 1229 (1838).

Fraxinus australis, Gay, ex Koch, *Dendrologie*, ii. 1. 247 (1872).

A tree attaining 70 to 90 feet in height. Shoots glabrous, green, slender. Leaflets (Plate 262, Fig. 6), seven to thirteen, 1½ to 3 inches long, smooth and slightly coriaceous, shining above, usually pretty uniform in size, subsessile, lanceolate, base cuneate, apex acuminate, glabrous on both surfaces; coarsely and sharply serrate except near the base; serrations few, spreading, often with incurved points (occasionally deeply serrate with long bristle points). Rachis of leaf glabrous, strongly winged, the wings meeting above and only showing a groove opposite the insertions of the leaflets. Flowers (section *Fraxinaster*) without calyx or corolla, few in erect racemes, arising from the axils of the leaf-scars of the preceding year's shoot. Fruit lanceolate, obliquely truncate and entire at the apex; but apparently variable.

This species is distinguished from all forms of the common ash by its absolutely glabrous leaflets, which have fewer, sharper, and more spreading serrations than in that species. The terminal buds are also different, being small, dark brown, quadrate,

¹ I have seen in London a fine old cabinet, supposed to be veneered with Amboyna wood, so like the Circassian ash in pattern, though the colour was yellower, that I much doubt whether the two could be distinguished when made up.

conical, usually glabrous, with four outer scales—six external scales, however, occurring in individual trees with leaves in whorls of threes.

VARIETIES

1. Var. *monophylla*¹ (*F. Veltheimi*, Dieck). A form in which the leaves (Plate 262, Fig. 3) are simple, unequally two-foliolate, or three-foliolate; terminal leaflet or single leaf lanceolate, acuminate, coarsely serrate or dentate; lateral leaflets, when present, much smaller but similar in shape; petiole with a wide open groove on the upper side. Shoots green, glabrous, with pink lenticels.

This variety can only be confused with *Fraxinus excelsior*, var. *monophylla*, from which it is readily distinguishable by the glabrous leaflets, different in texture and usually narrower, being lanceolate and not ovate. This tree appears to do well in cultivation, but will probably not attain a large size. We know of no trees of this variety in England except in the collection at Kew.

2. Var. *lentiscifolia* (*F. lentiscifolia*, Desfontaines²?). In the typical form of *F. angustifolia*, both as it occurs wild and under cultivation, the leaflets are set close upon a short rachis and point forwards towards its apex. In this variety, the leaflets are set wide apart upon an elongated rachis, from which they spread out at right angles and are not directed forwards; they also differ slightly in colour and texture from the type.

Willdenow³ considered *F. parvifolia*, Lamarck,⁴ *F. tamariscifolia*, Vahl,⁵ and *F. lentiscifolia*, Desfontaines,⁶ to be identical. I have not been able to follow Koehne or Dippel in their treatment of these forms as distinct. It is not in the least certain what species was intended by Lamarck's *parvifolia*, a name which has been given by some writers to a small-leaved variety of *F. oxycarpa*. In the Kew Herbarium, a garden specimen, collected by Bentham in 1854 and labelled "*F. lentiscifolia*," agrees with our variety of *F. angustifolia*; and a wild specimen from Italy is indistinguishable from it.

Both pendulous and dwarf forms of var. *lentiscifolia* are known in cultivation.

DISTRIBUTION

The narrow-leaved ash, with glabrous leaves, is common in the south of France, and occurs also in Spain, Portugal, Morocco,⁷ and Algeria.

Captain Widdrington⁸ says of this tree: "The ash is extraordinarily rare in the south and central regions of Spain. It is not now cultivated, and the only specimens I saw growing wild were in the wilder parts of Estremadura and the Sierra Morena where they were generally by the side of water-courses. The only species that I have seen in these regions is the *lentiscifolia*. The first year that I was in the

¹ Stated in the *Kew Hand List of Trees*, 545 (1902), to be a cross between *F. parvifolia* and *F. excelsior monophylla*. It shows no evidence of hybrid origin, and is evidently a variety of *F. angustifolia*.

² *Table de l'École de Bot.* 52 (1804).

³ *Sp. Pl.* iv. 2, 1101 (1805).

⁴ *Encycl.* ii. 546 (1786).

⁵ *Enum.* i. 52 (1804).

⁶ *Table de l'École de Bot.* 52 (1804).

⁷ This ash, referred to *F. oxyphylla* by Ball, was seen by him in Morocco, between Tangiers and Tetuan, and also at the base of the Atlas mountains. Cf. *Journ. Linn. Soc. (Bot.)* xvi. 564 (1878).

⁸ *Spain and the Spaniards*, i. 390 (1844).

interior of Spain, I picked up the seed of an ash near the Escorial; but the leaves having fallen, I did not ascertain the species, but sending them to England they vegetated, and are now growing in Northumberland. This is the same tree, and I have never seen it farther north than New Castile; at the same time I think it probably may exist as far as Leon, where, the instant you cross the chain, the *Fraxinus excelsior*, our common species, supplies its place; at least, I could make out no difference. The timber of *F. lentiscifolia* is heavy and less elastic than that of our species, but the elegance of the tree, and its perfect hardiness in a dry soil, should make it more common than it is in our ornamental collections."

This species¹ replaces the common ash in Algeria, where it is only found wild in quantity in the forests of the plains and along the banks of streams and rivers; but it ascends as isolated trees occasionally to 6000 feet in the mountains, and is reported to be common in the Djurdjura range. I saw it growing in fields near the forest of Akfadou, inland from Bougie, where the trees have a mutilated appearance, owing to the annual lopping of their branches by the natives, who feed their cattle with the leaves.² In Algeria³ the tree attains a large size, and grows in good soil with great rapidity, reaching a height of 90 feet by 3 feet in diameter at seventy years old. The wood is similar to that of the common ash, though slightly inferior in quality. Dr. Trabut informed me that he had sent seed to Australia, where the tree is said to thrive well, succeeding better than the common ash.

A tree at Chiswick House measured, in 1903, 75 feet by 7 feet 5 inches. Another at Whitton, near Hounslow, in 1905 was 56 feet by 6 feet 2 inches. At Williamstrip Park, Gloucestershire, in 1904 Elwes measured a tree 60 feet by 6 feet 9 inches.

The variety *lentiscifolia* has been identified by us at Syon, 55 feet by 5 feet 6 inches in 1905; at Hardwick, Bury St. Edmunds, a grafted tree, 72 feet by 6 feet 3 inches below the graft and 7 feet 10 inches above it; at Bicton, another grafted tree, over 50 feet by 6 feet; and at Stowe, also a grafted tree, 68 feet by 7 feet 8 inches. From the similarity in appearance of the trees at Hardwick, Stowe, and Bicton, there is little doubt that they were all propagated and planted at the same time. Elwes has also seen at the Hendre, Monmouthshire, a tree of similar appearance, which was 71 feet high by 5 feet 4 inches below, and 6½ feet above the graft. There is also a healthy grafted tree at Ware Park, Herts, growing on sandy soil, which Mr. H. Clinton Baker measured as 78 feet by 6 feet 3 inches in 1908. Another (Plate 245) on the lawn at Rougham Hall, the seat of F. K. North, Esq., is 76 feet high by 8½ feet above the graft, and 7½ feet below it. A third at Ribston Park, Yorkshire, was 68 feet by 6 feet 7 inches.

It is hardy as far north as Denmark, where Elwes measured in the park of Count Friis, in 1908, at Boller near Horsens, a grafted tree about 60 feet by 4 feet 4 inches, which was bearing immature fruit. (A. H.)

¹ The Algerian tree has been distinguished as var. *numidica* (*F. numidica*, Dippel), with broader and larger leaflets; but specimens gathered by me at Akfadou are typical *angustifolia*.

² M. Maurice L. de Vilmorin, in *Bull. Soc. Amis des Arbres*, 1895, states that this ash is much planted around villages in Kabylia, where its leaves, which are stripped off the tree in September, are an indispensable fodder for cattle, sheep, and goats at this season when no grass is available. The foliage of a single tree is usually worth 50 francs; and he was shown a very old wide-spreading tree, the owner of which sold its leaves annually for 300 francs.

³ Cf. Lefebvre, *Forêts de l'Algérie*, 348 (1900).

FRAXINUS OXYCARPA

Fraxinus oxycarpa, Willdenow, *Sp. Pl.* iv. 2, 1100 (1805); Loudon, *Arb. et Frut. Brit.* ii. 1230 (1838).

Fraxinus oxyphylla, M. Bieberstein, *Fl. Taur. Cauc.* ii. 450 (1808); Boissier, *Flora Orientalis*, iv. 40 (1879).

Fraxinus rostrata, Gussone, *Pl. Rar.* 374, t. 63 (1826).

A tree of moderate size. Shoots green, glabrous; lenticels pink. Leaflets (Plate 263, Fig. 11), nine to thirteen, usually small, $1\frac{1}{2}$ to 3 inches long, sessile or subsessile; lanceolate, oval or ovate; base tapering, apex acuminate; serrations few, sharp, spreading and often ending in incurved points; lower surface pubescent on the midrib and veins towards the base. Rachis of the leaf glabrous, winged, the wings meeting above and only forming an open channel opposite the nodes. Flowers (section *Fraxinaster*) without calyx or corolla, in short racemes in the axils of the leaf-scars of the previous year's shoot. Fruit broad, oblanceolate, acute or acuminate at the apex.

This species closely resembles *F. angustifolia*, differing in the leaflets being always pubescent beneath. The terminal buds are conical, quadrate, long and slender, with four outer narrow scales of equal length, dark brown and pubescent.

It is doubtful if the differences in the samaræ relied upon for the separation of this species from *F. angustifolia* are really constant. The fruits in this group of *Fraxinus* are extremely variable, and do not appear to give specific characters.

While *F. angustifolia* seems to be confined to the western part of the Mediterranean region, *Fraxinus oxycarpa* is widely distributed in Italy, Asia Minor, Persia, and the Caucasus.

Var. *parvifolia*, Wenzig.¹ Leaflets small, oval-oblong. Boissier considers this to be rather a bushy or sterile juvenile form of the species than a distinct variety, and records it from various localities in Asia Minor. An ash identified by Mathieu,² with *F. parvifolia*, Lamarck, grows in the neighbourhood of Montpellier in France, as a shrub about 5 to 10 feet high, and belongs to this variety.

At Kew, the ash, cultivated as *F. parvifolia*, Lamarck, is a variety of *F. oxycarpa*, distinguished by having leaflets (Plate 263, Fig. 9) shorter than in the type, broader in proportion to their length, and more closely set upon the rachis.

Fraxinus oxycarpa is much rarer in cultivation in England than *F. angustifolia*; but small trees are growing at Kew, Woburn, Eastnor Castle, Oxford Botanic Garden, and at Grayswood, Haslemere, where it has produced seed, from which plants have been raised by Elwes, and are growing at Colesborne. It does not seem in this country to be so vigorous a tree as *F. angustifolia*. (A. H.)

¹ In Engler, *Bot. Jahrb.* iv. 175 (1883).

² *Flore Forestière*, 245 (1897).

FRAXINUS SYRIACA

Fraxinus syriaca,¹ Boissier, *Diag. Ser. I.* ii. p. 77 (1849).

Fraxinus oxyphylla, M. Bieberstein, var. *oligophylla*, Boissier, *Fl. Orient.* iv. 40 (1879).

A tree attaining 60 feet in height. Shoots glabrous, green, stout, conspicuously marked by very prominent leaf-bases; lenticels white. Leaves (Plate 263, Fig. 10), small, always in whorls of threes or fours. Leaflets usually three, occasionally five to seven on some of the branchlets, sessile, lanceolate to ovate, base cuneate, apex acuminate, sharply and coarsely serrate, the serrations with incurved points, glabrous on both surfaces. Rachis of the leaf narrowly winged, the wings not meeting above, but forming an open groove.

Flowers (section *Fraxinaster*) in short racemes in the axils of the leaf-scars of the preceding year's shoot; without calyx or corolla. Fruit ovate-oblong; apex rounded, truncate or acuminate, ending in a mucro.

This species occurs in Syria, Kurdistan, Persia, Baluchistan, and Afghanistan.

The occurrence always of the leaves in whorls, a phenomenon met with in individual instances in other species, appears to be constant in this species. On strong shoots leaves with five to seven leaflets exceptionally appear; those with three leaflets, however, being by far the most common. Small specimens of this tree are growing at Kew, but it does not seem likely to be worth growing in England. (A. H.)

FRAXINUS ELONZA

Fraxinus Elonza, Dippel, *Laubholzkunde*, i. 87, fig. 46 (1889); Koehne, *Deutsche Dendrologie*, 513 (1893).

A small tree. Branchlets green, glabrous; lenticels few, oval, white. Buds laterally compressed and not quadrangular, narrowed and rounded at the apex; external scales four, densely brown pubescent, inner pair longer than the outer pair. Leaflets (Plate 266, Fig. 27), eleven to thirteen, 1 to $2\frac{1}{2}$ inches long, sessile, oval or lanceolate, with unequal base and acuminate apex, sharply and irregularly serrate, some of the serrations being often triangular and spreading; under surface pubescent near the base with brown tomentum, often occurring only on the inner side of the midrib. Leaf-rachis, with scattered pubescence, densest at the nodes; strongly winged, the wings meeting above in part of their length. Fruit described as broadly linear, with almost parallel sides, truncate and emarginate at the apex.

The native country of this species is unknown; and it is possibly a hybrid, as

¹ *Fraxinus sogdiana*, Bunge, *Mém. Sav. Etrang. Acad. Pétersbourg*, vii. 390 (1851), occurring in Turkestan, formerly supposed to be identical with this species, is considered distinct by Koehne in *Gartenflora*, 1899, p. 288, and by Lingelsheim, in Engler, *Bot. Jahrb.* xl. 222 (1907).

Koehne suggests. It occurs in England in cultivation under the erroneous name of *F. chinensis*,¹ the plants at Kew having been obtained from Sir C. W. Strickland, who tells us that it was sent out by the Royal Horticultural Society some years ago. Plants cultivated as *F. Elonza* are usually *F. oxycarpa*. (A. H.)

FRAXINUS WILLDENOWIANA

Fraxinus Willdenowiana, Koehne, *Deutsche Dendrologie*, 515 (1893).

Fraxinus parvifolia, Willdenow, *Berlinische Baumzucht*, 124, t. 6, f. 2 (1796) (*non* Lamarck); and *Sp. Pl.* iv. 1101 (1805).

A small tree. Shoots glabrous, lenticels white. Leaflets (Plate 265, Fig. 24), seven to eleven, 2 to 3½ inches long, subsessile (except the terminal one, which is much the largest and stalked), ovate, base broad and unequally cuneate, apex acuminate; serrations coarse and sharp with minute incurved points; both surfaces glabrous. The leaflets increase in size from the base to the apex of the leaf, the rachis of which is winged, the wings usually not meeting on the upper side, but forming an open groove. Fruit unknown.

This species was considered by Willdenow to be different from *F. parvifolia*, with which he had first identified it, yet he left it with this name. Koehne has accordingly given it a new name. It is sometimes met with in cultivation under the name of *F. rotundifolia*. It is readily distinguished by the large terminal leaflet and the open-grooved rachis from the other glabrous species. Its native home is uncertain. It is perfectly hardy at Kew and has very distinct foliage. (A. H.)

FRAXINUS DIMORPHA

Fraxinus dimorpha, Cosson et Durieu, *Bull. Soc. Bot. France*, ii. 367 (1855); Mathieu, *Flore Forestière*, 245 (1897).

Fraxinus xanthoxyloides, Wallich, *var. dimorpha*, Wenzig, in Engler, *Bot. Jahrb.* iv. 188 (1883).

A small tree attaining 40 feet in height. Young shoots purple, slender, glabrous, obscurely quadrangular. Leaves (Plate 262, Fig. 1) on barren branchlets with seven to nine small leaflets, which are ½ to ¾ inch long, sessile or subsessile, ovate or oval, crenulate-serrate, and glabrous except for pubescence on the midrib towards the base on the under surface; leaf-rachis usually glabrous, strongly winged, the wings spreading and forming a very open channel. The leaves on flowering shoots are larger, with seven to eleven leaflets, oblong-lanceolate, acute and serrate. Flowers (section *Sciadanthus*) perfect, without a corolla, but with a calyx which persists under the fruit, grouped in fascicled cymes on the previous year's shoot

¹ *F. chinensis*, Roxburgh, a native of China, is entirely distinct from *F. Elonza*, which is closely allied to *F. oxycarpa*, a Mediterranean species. Koch, in *Dendrologie*, ii. pt. 1, 247 (1872), mentions *F. Elonza* as having been in cultivation some years, and considered it to be probably a variety of *F. angustifolia*.

in the axils of the leaf-scars. Fruit oblong; body compressed with a longitudinal furrow on each surface, and many-rayed; wing long and obliquely truncate at the apex. Buds very small, with two outer scales pinnately lobed.

This remarkable ash was observed by Sir Joseph Hooker in South Morocco.¹ It also occurs in the mountainous regions of Algeria in the valleys at 4000 to 6000 feet altitude. In dry situations it remains a bush with very rigid and almost spiny branches, and rarely flowers even when very old. On the banks of streams it grows to be a small tree and produces flowers and fruit. The wood is very hard and heavy, with a satin-like lustre.

This species is rarely seen² except in botanical gardens, where, as at Kew, it grows to be a small tree, remarkable for its diminutive foliage. It has smooth grey bark. (A. H.)

FRAXINUS XANTHOXYLOIDES

Fraxinus xanthoxyloides, Wallich, *List*, 2833; C. B. Clarke, in Hooker, *Fl. Brit. India*, iii. 606 (1882); Brandis, *Indian Trees*, 444 (1906).

This species is probably only a pubescent geographical form of *Fraxinus dimorpha*, which it resembles exactly in habit. The young shoots are covered with a minute dense pubescence. The leaflets only differ from those of *F. dimorpha* in having a scattered pubescence all over the lower surface; the rachis of the leaf is also pubescent.

This species occurs in Baluchistan, Afghanistan, and the north-west Himalayan region, at altitudes of 3000 to 9000 feet, growing mainly in dry valleys, where it is often gregarious. It is reported to attain a height of 25 feet.

It is rare in cultivation, and forms a small tree, scarcely distinguishable in appearance from *F. dimorpha*. (A. H.)

FRAXINUS POTAMOPHILA

Fraxinus potamophila, Herder, in *Bull. Soc. Imp. Mosc.*, xli. 65 (1868); Dippel, *Laubholzkunde*, i. 98, fig. 54 (1889).

A small tree; branchlets glabrous. Leaflets (Plate 262, Fig. 8) small, seven to nine, about 1½ to 3 inches long, stalked (petiolules glabrous, ½ inch or more in length), ovate, tapering unequally at the base, acute at the apex, coarsely serrate, the serrations often ending in long points; glabrous on both surfaces. Rachis of the leaf with angled edges on its upper side, enclosing a shallow groove. Flowers

¹ Hooker and Ball, *Tour in Morocco*, 176 (1878); Ball, in *Journ. Linn. Soc. (Bot.)*, xvi. 564 (1878).

² A tree at Coombe Wood, which had attained almost 25 feet in height, was destroyed in 1907. Mr. A. B. Jackson has seen small specimens at Barron's nursery, Elvaston, where they were erroneously named *E. lentiscifolia*.

unknown. Fruit described as linear-oblong, nearly two inches long, acute, blunt or obliquely truncate.

This ash grows along the banks of rivers in Turkestan and Songaria, occurring in the Ili region at 1000 to 2500 feet elevation. It was introduced into cultivation by the Botanic Garden at St. Petersburg; and small trees are doing fairly well at Kew.

Fraxinus Regelii, Dippel,¹ of which I have seen no authenticated specimen, is said to be also a native of Turkestan, and was considered by Koehne² to be probably identical with *F. potamophila*, Herder. There are young plants in the Kew collection, raised from seed sent in 1900 by M. Scharrer, Director of the Botanic Garden at Tiflis, and named *F. Regelii* on his authority, which are remarkably distinct from any ash known to me, and differ from Dippel's description of *F. Regelii* in the larger size of the leaflets, which are crenate and not dentate in serration. The Tiflis plants have the young branchlets glabrous, purplish; leaflets (Plate 265, Fig. 25), five or seven, about 3 inches long, stalked, the base of the leaflet often decurrent on one side of the petiolule to its insertion; terminal leaflet obovate or rhomboid; lateral leaflets ovate or oval; all shortly acuminate or cuspidate at the apex, unequal at the base, crenately serrate; bluish green and glabrous on the upper surface; pale green and slightly pubescent on the sides of the base of the midrib on the lower surface; rachis elongated, terete, glabrous, with a shallow groove on its upper side. The identification of these plants with *F. Regelii* must be left uncertain.

(A. H.)

FRAXINUS RAIBOCARPA

Fraxinus raibocarpa, Regel, in *Act. Hort. Petrop.* viii. 685 (1884).

A small tree. Branchlets brown, minutely pubescent, glandular. Leaflets (Plate 266, Fig. 29), five, upper subsessile, lower stalked, about $1\frac{1}{2}$ inch long, oval, unequal and rounded at the base, acute or obtuse at the apex, usually entire in margin without cilia; under surface glabrous, with a few minute brown glands. Leaf-rachis slightly glandular, with a wide open groove on its upper side. Fruit in leafy panicles, arising on the current year's shoot; samara surrounded at the base by the persistent calyx, curved, falcate; body terete and rayed; wing terminal, very broad, spathulate-obovate, obtuse.

This species, of which the flowers are unknown, belongs apparently to the section *Ornus*. It was discovered in 1882 by Regel at elevations of 6000 to 7000 feet in the mountain valleys of eastern Bokhara and Turkestan; and was introduced into cultivation shortly afterwards by the St. Petersburg Botanic Garden. Small plants at Kew have grown very slowly, and this species does not seem likely to be worth cultivating in this country.

(A. H.)

¹ *Laubholzkunde*, i. 97, fig. 53 (1889), described from plants sent out by the St. Petersburg Botanic Garden as *F. sogdiana*, an entirely different species, referred to on p. 883, note 1.

² *Deutsche Dendrologie*, 515 (1893).

FRAXINUS HOLOTRICHA

Fraxinus holotricha, Koehne, in *Mitt. Deut. Dendrol. Ges.* 1906, p. 67.

A small tree. Branchlets grey, densely covered with short stiff erect pubescence. Leaflets, nine to thirteen, subsessile, lanceolate or ovate-lanceolate, about 2 inches long, $\frac{1}{2}$ to $\frac{5}{8}$ inch wide; apex prolonged into a sharp-pointed and often curved acumen; base unequal and tapering; margin ciliate, unequally and sharply serrate; both surfaces covered with a scattered grey pubescence. Rachis of the leaf, with pubescence like that of the branchlets, densest at the nodes; narrowly grooved on the upper side.

Flowers (section *Fraxinaster*), without calyx or corolla, in short racemes, perfect in the single specimen seen; ovary pubescent. Fruit unknown.

This species resembles *F. angustifolia* in the shape and size of the leaflets; but differs in the copious pubescence on the branchlets and leaves. The buds are quadrate, with four dark brown scales, very pubescent at the tips.

F. holotricha was discovered by Koehne in Späth's nursery near Berlin, and in the botanic gardens at Berlin and Dresden, where it had received the erroneous name of *F. potamophila*. Its native country is unknown. The specimen, from which I have drawn up the above description, was sent me from Metz by Messrs. Simon-Louis. Three young plants were sent by Späth to Kew in 1908. (A. H.)

FRAXINUS ORNUS, FLOWERING ASH, MANNA ASH

Fraxinus Ornus, Linnæus, *Sp. Pl.* 1057 (1753); Bentley and Trimen, *Medicinal Plants*, iii. 170, fig. 170 (1880); Hanbury, *Science Papers*, 362-368 (1876).

Fraxinus paniculata, Miller, *Dict.* No. 4 (1759).

Fraxinus florifera, Scopoli, *Fl. Carn.* ii. 282 (1772).

Ornus europæa, Persoon, *Syn. Pl.* ii. 605 (1807); Loudon, *Arb. et Frut. Brit.* ii. 1241 (1838).

A tree attaining about 60 feet in height and 6 feet in girth, with smooth ashy-grey bark. Young branchlets slender with white lenticels, usually glabrous, occasionally glandular pubescent, marked with a ring of brown hairs at the base of the shoot. Leaflets (Plate 265, Fig. 26), five to nine, 2 to 3 inches long, the terminal one obovate and stalked, the lateral ones with distinct stalklets, which are about $\frac{1}{4}$ inch long and brownish pubescent; ovate to oblong, base rounded or broadly cuneate, apex shortly acuminate, finely and irregularly serrate, under surface glabrous except for brown woolly pubescence on the midrib. Rachis of the leaf grooved, the groove deepest in the upper part of its length, usually glandular pubescent, with tufts of brown hairs opposite the insertions of the leaflets.

Flowering branches developed from terminal buds, which contain leaves as well as flowers, the inflorescences being usually accompanied by two pairs of leaves and consisting of five panicles, the largest one terminating the branch, four smaller ones arising in the axils of the leaves, the whole forming a drooping compound panicle. Pedicels long and slender. Calyx divided into four triangular acute persistent sepals.

Corolla deeply divided into four strap-shaped wavy wide-spreading petals. Stamens two, hypogynous, the filaments twice as long as the petals. Flowers apparently perfect, but functionally behaving as if distinctly staminate and pistillate. Fruit compressed, with a terminal flat obovate-linear wing, blunt or emarginate at the apex.

IDENTIFICATION

In summer the tree is readily distinguished by its smooth bark and stalked leaflets showing the characters just enumerated. In winter the twigs show a slight pubescence towards the apex and a ring of hairs at the base of the shoot. Leaf-scars parallel to the twig on projecting leaf-cushions, semi-orbicular to crescentic, the ends of the horns truncate, marked on the surface with a curved row of separate bundle scars. Terminal bud large, greyish to greyish brown, ovoid, four-sided, rounded (rarely acute) at the apex, the two outer scales gaping above and densely pubescent. Lateral buds smaller, densely pubescent, arising from the twigs at a wide angle.

VARIETIES

Fraxinus Ornus, occurring over a wide area, both as a wild tree in forests, and cultivated in sunny arid regions, as in Sicily, shows considerable variation in the size, shape, and texture of the leaflets; and several varieties have been established.¹ The only one of those which is truly distinct is var. *argentea*, Grenier et Godron,² a remarkable form, growing wild in the forests of Corsica and Sardinia, distinguished by the leaflets being silvery white beneath, firm in texture, crenulate-serrate, usually smaller than the type, often subsessile, though stalked leaflets also occur on the same branch, ovate or oval in outline, occasionally approximating to an orbicular shape. This singular variety has been made a distinct species;³ but modern French and Italian botanists regard it as only a peculiar geographical variety, which seems to be sporadic in forests where the type is also met with.

Aiton⁴ and Willdenow⁵ described, as the true manna ash, *F. rotundifolia*, with broad ovate or almost orbicular, deeply serrate leaflets. Willdenow's figure of the foliage corresponds with the ash which I have described (p. 866) as *F. excelsior*, var. *rotundifolia*, and it is possible that both he and Aiton were in error in considering their plant to have flowers like those of *F. Ornus*.

Lamarck's⁶ *Fraxinus rotundifolia*, differs, according to the description, from Aiton and Willdenow's species of the same name, and is considered by Wenzig⁷ and Lingelsheim⁸ to be *F. Ornus*, var. *rotundifolia*; but is kept up by Koehne⁹ as a distinct species. Hanbury¹⁰ states that the manna ash cultivated in Sicily shows

¹ Fiori et Paoletti, *Flora Analitica d'Italia*, ii. 341, mention, besides the typical form, var. *rotundifolia* with broad elliptical leaflets, and var. *lanceolata* with lanceolate leaflets.

² *Flore de France*, ii. 473 (1850).

³ *Fraxinus argentea*, Loiseleur, *Flora Gallica*, ii. 697 (1806).

⁴ *Hort. Kew*, iii. 445 (1789).

⁵ *Berlin. Baumzucht*, 116, fig. vi. 1 (1796). The figure was copied by Loudon, *Arb. et Frut. Brit.* ii. 1244 (1838), who merely repeats Willdenow's description, and was probably unacquainted with the tree.

⁶ *Encycl.* ii. 546 (1786).

⁷ In Engler, *Bot. Jahrb.* iv. 169 (1883).

⁸ *Ibid.* xl. 212 (1907).

⁹ *Deutsche Dendrologie*, 508 (1893).

¹⁰ *Science Papers*, 368 (1876).

great variation, but that no special form can be singled out as deserving the name *rotundifolia*; and I have seen no specimens of *F. Ornus*, which could be separated as a var. *rotundifolia*, much less any which could be separated as a distinct species.¹

A variegated form of *F. Ornus*, of which I have seen no specimens, is said to occur in cultivation. A simple-leaved form, var. *diversifolia*, Roch., is of rare occurrence in the wild state, and has been noticed in the canton of Tessin in Switzerland.²

DISTRIBUTION

The manna ash is widely distributed in southern Europe and Asia Minor. In France it only occurs wild in the department of the Maritime Alps; and in Switzerland it is met with in a few places in mountain woods about Lake Lugano in the canton of Tessin.² It grows in the southern Tyrol, where it ascends to 2000 feet elevation, in Carniola, Istria, Dalmatia, Croatia, Slavonia, and Banat, reaching its northern limit in Hungary on the south side of the Carpathian chain. It is common in eastern Spain, Corsica, Sardinia, Italy, Servia, Bosnia, Greece, and Asia Minor.

The wood of the flowering ash is excellent, and the foliage is used as fodder in the southern countries of Europe; but its chief economic importance is due to its being the source of manna. The manna of commerce, according to Hanbury, is exclusively collected in Sicily, where the plantations are known as Frassinetti. However, of late years, attempts have been made to cultivate it on a large scale for manna in the southern parts of the Austrian empire. In Sicily trees begin to produce manna when they are about eight years old; and they are tapped in subsequent years annually until they are about twenty years old, when they are cut down and their place taken by coppice shoots from the stools. During July and August transverse incisions are made in the bark, so as just to reach the wood; and the manna exudes as a clear liquid, which solidifies on the stem of the tree or on pieces of straw or wood that are inserted in the incisions. Manna consists mainly of a peculiar sugar called mannite, which is a mild laxative and is employed as an officinal drug in many countries. (A. H.)

REMARKABLE TREES

The manna ash is said to have been introduced into England by Dr. Uvedale of Enfield about 1710. It is commonly cultivated as an ornamental tree, on account of its beautiful appearance when in flower; and it thrives and attains a large size, especially in the southern parts of England. The largest I have measured is an old

¹ Tenore, in *Syll. Pl. Fl. Neap.* 10 (1831) considers Lamarck's plant to be a variety of *F. Ornus*. Both Tenore and Bertolini, *Fl. Italica*, i. 54 (1833), were of opinion that *F. rotundifolia*, Willdenow, was a distinct species. Lingelsheim, in Engler, *Bot. Jahrb.* xl. 212, 213 (1907), retains *F. rotundifolia*, Tenore, *loc. cit.*, as a distinct species, confined to a small area in south Tyrol, Bosnia, and Dalmatia; and creates a new species, *F. cilicica*, occurring in Cilicia in Asia Minor. These supposed species appear to be glabrous forms of *F. Ornus*.

² Cf. Bettelini, *Flora Legnosa del Sottoceneri*, 145 (1904).

tree in the park at Godinton, Kent, which is about 60 feet high, 10 feet 4 inches in girth below the graft, and 8 feet 8 inches above it.

There is a fine tree growing at Escot, Ottery St. Mary, Devonshire, the residence of Sir John Kennaway, which was in 1905, according to Miss F. H. Woolward, 61 feet in height, with a girth of stem at 5 feet up of 6 feet 9 inches, the circumference at the base being 11 feet 9 inches. This tree flowers abundantly every year. Another at Carclew is 50 feet by $9\frac{1}{2}$ feet.

A tree, about 60 feet high, grows near the stables at Tottenham House, Savernake, the seat of the Marquess of Ailesbury; a photograph of this tree, which was taken in June 1908, from the roof of the stables, shows it in full flower.

There is a good tree at Kew, close to the North Gallery, which measured, in 1907, 42 feet by 5 feet; and another, on the mound, near the Cumberland gate, is 60 feet high and 7 feet 6 inches in girth at three feet from the ground, dividing above into three main stems.

At Syon there is a tree 62 feet by 6 feet 6 inches, and good trees occur at Beauport, Sussex, and Whiteaway, Devon. A very fine one is reported by the Hon. Vicary Gibbs to be growing at Rook's Nest, near Oxted, Surrey. At Brocklesby Park, Lincolnshire, a tree was 50 feet by 7 feet 1 inch in 1904.

In Scotland there is a tree at Gordon Castle about 50 feet high.

In Ireland, a tree at Fota measures 65 feet by 5 feet 6 inches; and trees about 40 feet high are growing at Narrow Water, near Warrenpoint, in Down, and at Glenstal, Limerick.

Henry saw specimens in the botanic gardens at Copenhagen and Christiania, about 40 feet high and 3 feet in girth, in 1908. (H. J. E.)

FRAXINUS FLORIBUNDA

Fraxinus floribunda, Wallich, *List*, 2836, and in Roxburgh, *Fl. Ind.* i. 150 (1820); Hooker, *Fl. Br. India*, iii. 605 (1882); Gamble, *Man. Indian Timbers*, 471 (1902); Brandis, *Indian Trees*, 443 (1906).

Ornus floribunda, A. Dietrich, *Sp. Pl.* i. 1, 249 (1831).

A large tree, attaining in the Himalayas over 100 feet in height. Shoots compressed, purple, glabrous, with scurfy glands; lenticels white and prominent. Leaflets (Plate 264, Fig. 17), seven to nine (rarely five), the upper pair subsessile, the others on glabrous petiolules, 4 to 6 inches long, oblong, except the terminal one which is obovate, base unequal and rounded, apex long-acuminate, midrib and principal veins prominent and pubescent beneath, regularly and sharply serrate. Rachis of the leaf winged, the wings enclosing a broad open groove on the upper side, pubescent in the groove and at the insertions of the leaflets.

Flowers (section *Ornus*) in large panicles; corolla lobes, $\frac{1}{8}$ to $\frac{1}{6}$ inch, linear-oblong. Samaras very narrow, obtuse or emarginate.

This is the largest and finest of the flowering ashes, and attains a great size in its native home, Sir D. Brandis mentioning trees in the Chenab Valley planted near villages and temples, which reach 120 feet in height and 15 feet in girth. It is the only valuable species of ash in the Himalayas, where it grows on rich moist soils, generally on limestone. It is distributed throughout the Himalayas from the Indus to Sikkim, between 5000 and 9000 feet, but is only common locally. It is also met with in Baluchistan, Afghanistan, and in the Shan Hills of Upper Burma.

We have seen no large trees of this species in England; but it appears to do well at Kew, and probably would succeed as an ornamental tree in at any rate the warmer parts of the British Isles. (A. H.)

FRAXINUS BUNGEANA

Fraxinus Bungeana, De Candolle,¹ *Prod.* viii. 275 (1844); Franchet, *Pl. David.* i. 203 (1884); Hemsley, *Journ. Linn. Soc. (Bot.)*, xxvi. 84 (1889); Sargent, *Garden and Forest*, vii. 4, fig. 1 (1894).

Fraxinus parvifolia, Lingelsheim, in Engler, *Bot. Jahrb.* xl. 214 (1907) (not Lamarck).

A shrub about 5 feet high. Branchlets grey, minutely pubescent, with a dense ring of hairs at the base of the shoot. Buds ovoid, with dark puberulous scales. Leaflets (Plate 266, Fig. 31), five to seven, 1 to $1\frac{1}{2}$ inch long, thin, membranous; usually on pubescent stalklets, $\frac{1}{4}$ -inch long, upper pair sometimes subsessile; oval or rhomboid, broadly cuneate or rounded at the base, abruptly contracted into a long acuminate apex, crenately serrate, pale beneath; both surfaces quite glabrous. Leaf-rachis, grooved on the upper side, minutely pubescent, pubescence densest opposite the nodes.

Flowers, in terminal panicles, polygamous; petals 4, linear-obovate; calyx minute, 4-lobed. Fruit with a short slightly flattened many-nerved body, margined to about the middle by the decurrent base of the wing, which is oblong with a rounded, often emarginate apex.

This species is common on the hills near Peking and in the adjacent parts of Mongolia, and is the representative there of the European *F. Ornus*. Dr. Bretschneider sent seeds in 1881 to the Arnold Arboretum, Massachusetts, where plants were raised which are perfectly hardy in New England. They are pretty shrubs with abundant clusters of white flowers. This species does not seem to be in cultivation² in England. (A. H.)

¹ This species was founded by De Candolle on specimens (one of which is at Kew) of a shrub, collected by Lunge in 1831, near Peking, and named by the latter *F. floribunda* in *En. Pl. Chin. Bor.*, 61 (1832). Maximowicz, followed by Koehne and Lingelsheim, have erroneously applied De Candolle's name to *F. rhynchophylla*.

² Plants, sent to Kew by Sargent in 1903, cannot be found, and are supposed to have died. Since this article was corrected for the press, four plants from the Arnold Arboretum have arrived at Kew.

FRAXINUS MARIESII

Fraxinus Mariesii, J. D. Hooker, *Bot. Mag.*, 6678 (1883); Hemsley, *Journ. Linn. Soc. (Bot.)*, xxvi. 86 (1889).

A small tree. Branchlets slender, terete, purple, minutely pubescent, especially towards the tip; lenticels white. Leaflets (Plate 264, Fig. 18) five, $1\frac{1}{2}$ to 3 inches long, coriaceous, oval, acute or acuminate at the apex, base rounded or slightly tapering; regularly and crenately serrate, occasionally entire in margin; glabrous beneath. Petiolules $\frac{3}{4}$ to $\frac{5}{8}$ inch, scurfy pubescent. Rachis of the leaf purple, finely pubescent, grooved on its upper side.

Flowers very showy in erect panicles from the uppermost axils, about as long as the leaves. Calyx minute, four-cleft. Petals five or six, $\frac{1}{4}$ inch long, linear-oblong. Stamens two to four, as long as the petals.

This was discovered by Maries in the Lushan Mountains near Kiukiang in central China; and it has not been found elsewhere by subsequent collectors. Maries sent home seeds in 1879 from which the plant was raised by Messrs. Veitch. It flowered¹ for the first time, at Coombe Wood, as early as 1882.

It appears to be perfectly hardy in England, and is an ornamental small tree or shrub of considerable value, on account of the creamy-white large panicles of flowers, which appear about the end of June, and the bronze tint of the foliage.

(A. H.)

FRAXINUS RHYNCHOPHYLLA

Fraxinus rhyrachophylla, Hance, *Journ. Bot.*, vii. 164 (1869); Franchet, *Pl. Davidiana*, i. 203, t. 17 (1884); Sargent, *Garden and Forest*, vi. 484, fig. 70 (1893); Komarov, *Fl. Manshurica*, iii. 248 (1907).

Fraxinus Bungeana, Maximowicz, *Mél. Biol.* ix. 396 (1874) (not De Candolle).

Fraxinus chinensis, Roxburgh, var. *rhyrachophylla*, Hemsley, *Journ. Linn. Soc. (Bot.)*, xxvi. 86 (1889).

A large tree. Shoots glabrous, lenticels few and scattered. Terminal buds remarkable, obtuse, conical, somewhat four-sided, with four or six outer scales, which are ovate, strongly keeled, with acute points directed outwards, pubescent and grey on the dorsal surface, and densely ferruginous woolly pubescent on their inner surface and edges; lateral buds, ovoid to rounded, small, with two to four outer scales, directed outwards at an open angle.

Leaflets (Plate 265, Fig. 23) five to seven, coriaceous, stalked or sessile, ovate to ovate-lanceolate; base cuneate; apex with a long acumen, which is blunt or rounded and tipped with a short mucro; margin remotely and crenately serrate

¹ *Hortus Veitchii*, 367 (1906).

in its upper half, sometimes almost entire; upper surface glabrous; lower surface glandular and glabrous except for some pubescence along the midrib towards the base. Terminal leaflet largest, basal leaflets smallest. Rachis of the leaf with a wide and open shallow groove on its upper side, pubescent in its whole length and bearded at the insertions of the leaflets, the pubescence being continued on the upper side of the petiolules.

Flowers (section *Ornaster*) in compact terminal panicles, polygamous, without a corolla; calyx persistent at the base of the samaræ, which are long, narrow, and erect on filiform pedicels.

This is the large ash tree¹ which is common in the mountains about Peking; and it also occurs in the adjacent parts of Mongolia, and in Manchuria and in northern Korea. It was discovered¹ by Père D'Incarville in the eighteenth century. Dr. Bretschneider sent seeds to the Arnold Arboretum in 1881, and plants were raised there, which are growing vigorously and promise to become large trees. They had already in 1893 produced flowers and fertile seed.

The species is remarkably distinct, and is very different from *F. chinensis*, Roxburgh, of which it has been supposed to be a variety. It appears to be scarcely known in Europe, the only specimens which I have seen being from Tortworth, where small plants are reported to be growing badly; and from Aldenham, where the foliage of a young tree, growing freely, is remarkable for its large size and glossy appearance. (A. H.)

FRAXINUS MANDSHURICA

Fraxinus mandshurica, Ruprecht, *Bull. Phys. Math. Acad. Sc. Pétersb.*, xv. 371 (1857); Maximowicz, *Prim. Fl. Amurensis*, 194, 390 (1859), and *Mél. Biol.* ix. 395 (1874); Hemsley, *Journ. Linn. Soc. (Bot.)*, xxvi. 86 (1889); Komarov, *Fl. Manshurica*, iii. 248 (1907).

A large tree, attaining 100 feet in height and 12 feet in girth, with bark like that of the European ash. Branchlets glabrous. Leaflets (Plate 266, Fig. 28), seven to thirteen, 3 to 5 inches long, oblong-lanceolate, sessile, or with very short pubescent stalklets, tapering and unequal at the base, long-acuminate at the apex, sharply and irregularly serrate; glabrescent above; under surface with scattered coarse hairs on the sides of the midrib and lateral nerves. Leaf-rachis, with dense tufts of rusty-brown tomentum at the nodes, winged, the wings meeting above in part of its length, elsewhere deeply grooved.²

Flowers (section *Fraxinaster*) dioecious, in panicles in the axils of the leaf-scars of the preceding year, without calyx or corolla. Fruit, in loose clusters, oblong-lanceolate, apiculate or emarginate.

¹ See Bretschneider, *European Bot. Discoveries in China*, 53, 336, 1058 (1898). There are two ashes in the Peking mountains, one a large tree, *F. rhyrachophylla*; the other a small shrub, *F. Bungeana*.

² The rachis of the uppermost two leaves is usually fringed at its insertion, close to the terminal bud of the branchlet, with rusty-brown pubescence.

The Manchurian ash is the representative of the common ash in eastern Asia, and is very similar in appearance to *F. nigra*,¹ being mainly distinguishable by the longer points to the leaflets, which are more tapering at the base, often shortly stalked, and usually more sharply serrate. (A. H.)

F. mandshurica is widely spread throughout Manchuria, Amurland, Korea, Saghalien, and Japan, and is a large tree, Ruprecht having measured specimens at the mouth of the Ussuri 12 feet in girth.

In Japan this fine ash is known as *yachidamo*, and is one of the commonest trees in Hokkaido, but is only known to occur in the north of the main island. I did not see it in Aomori or Akita. It seems to grow best in Hokkaido in the deep rich flats of black alluvial soil which are now being rapidly brought under cultivation by the Japanese settlers, but even here seldom attains the dimensions of the European ash; the average size of the trees in the virgin forests being from 80 to 100 feet high by 6 to 8 feet in girth, though no doubt, if they had room to spread they would grow much thicker than this. The general habit of the tree and of its leaves and seed is very similar to that of *F. excelsior*, and the wood also seems similar, but it is not apparently used for the same purposes as in Europe. A great quantity of it is made into railway sleepers, which are now being exported largely to Korea and China, and which, if I can judge from what I saw on the Hokkaido railroads, will not last very long unless creosoted. There is, however, a particularly handsome variety of this wood, which seems to be found only near the butt and on the outside of old trees growing in damp places, which goes by the name of Tamu, and which, if known in Europe would certainly command a high price for veneers. A large wardrobe, which has been made for me from Japanese woods, is fronted with veneer cut from a billet of this wood, which I brought home in 1904, and is extremely handsome; showing a figure like that of the best Hungarian ash but of a pale pinkish-brown colour. This wood is much used in Japan for veneering railway carriages, for doors, and for the posts used for supporting and for fitting the sliding screens of Japanese houses. It is liable to warp, however, and requires very careful seasoning to prevent cracking.

F. mandshurica was introduced² at Kew in 1891 from the St. Petersburg Botanic Garden; but only one plant now survives, which has a stunted and unhealthy appearance. Like many plants from Manchuria and Amurland, the foliage appears early in the spring, and is badly injured by late frosts every year. I have raised seedlings from seed sent me from Japan by Professor Shirasawa, but they are too young to judge of the probable success of the tree in England.

Sargent, however, says³ that this tree has proved perfectly hardy in the Arnold Arboretum, where it has been introduced for some years. He considers it one of the noblest of all the ashes, and one of the most valuable timber trees of Eastern Asia. None of the other ashes of Japan, so far as I saw, attain any great size, or are likely to have any economic value in Europe. (H. J. E.)

¹ Lingelsheim, in Engler, *Bot. Jahrb.* xl. 223 (1907), unites this species with *F. nigra*, of which he considers the Manchurian tree to be only a geographical variety.

² The St. Petersburg plants were probably raised from seed from Amurland. Cf. *Gartenflora*, xxvii. 13 (1879).

³ *Forest Flora of Japan*, 52 (1894).

FRAXINUS CHINENSIS

Fraxinus chinensis, Roxburgh, *Fl. Ind.* i. 150, Carey's edition (1820); Hanbury, *Science Papers*, 271, fig. 17 (1876); Hance, *Journ. Bot.* xxi. 323 (1883); Hemsley, *Journ. Linn. Soc. (Bot.)* xxvi. 85 (1889); Lingelsheim, in Engler, *Bot. Jahrb.* xl. 216 (1907).

A small tree. Branchlets glabrous. Leaflets seven to nine, 2 to 4 inches long, coriaceous, shortly cuspidate at the apex, crenately serrate; terminal leaflet the largest, obovate-oval, and long-stalked; lateral leaflets oval or elliptic, subsessile or with short pubescent winged stalklets, unequal and broadly rounded or tapering at the base; dark green and glabrous above; under surface pale green and pubescent on the sides of the midrib and lateral nerves. Leaf-rachis deeply channelled throughout, with brownish tufts of tomentum on the upper side of the nodes; base of the rachis of the uppermost two leaves fringed with brown hairs.

Flowers (section *Ornaster*) in terminal and lateral glabrous panicles; calyx 4-toothed; corolla absent. Fruit, about $1\frac{1}{2}$ inch long, $\frac{1}{4}$ inch wide, oblanceolate, acute or rounded at the apex.

This species in the wild state is very variable as regards the shape of the leaves, five varieties being distinguished by Lingelsheim. The above description is drawn up from small specimens cultivated at Kew, which were received in 1891 from St. Petersburg under the name *F. Bungeana*. A distinct variety has been in cultivation at Kew for some years under the erroneous name *F. longicuspis*, which has five or seven leaflets, obovate-lanceolate or narrow-oblong, 2 to $3\frac{1}{2}$ inches long, about 1 inch wide, cuspidate at the apex, cuneate at the base, indistinctly serrate. It agrees exactly with a dried specimen at Kew, gathered in the Ningpo mountains, where the broad leaflet form also occurs.

This species is widely spread throughout the central and southern provinces of China, and is noteworthy as being one of the trees on which the wax insect lives. It is very rare in cultivation, the only specimens we have seen being those at Kew and a small shrub at the Edinburgh Botanic Garden. (A. H.)

FRAXINUS OBOVATA

Fraxinus obovata, Blume, *Mus. Bot. Lugd. Bat.* 311 (1850); Franchet et Savatier, *Enum. Pl. Jap.* i. 310 (1875).

Fraxinus Bungeana, Maximowicz, *Mél. Biol.* ix. 396 (1873) (not De Candolle); Franchet et Savatier, *Enum. Pl. Jap.* ii. 434 (1879); Lingelsheim, in Engler, *Bot. Jahrb.* xl. 214 (1907) (in part).

A small tree. Branchlets glabrous. Leaflets five or seven, 2 to 3 inches long, membranous, terminal one largest and long-stalked; lower pairs shortly-stalked,

obovate or oval; cuneate and unequal at the base; acute, acuminate or rounded at the apex; remotely and irregularly serrate; upper surface shining, smooth, glabrous; lower surface light green, glabrous, but roughened on the midrib and nerves by minute, curved, stiff bristles, which are also present on the petiolules and on the margin of the blade. Rachis of the leaf, grooved throughout, pubescent on the upper side of the nodes, and armed near the nodes and at the base with minute curved bristles, which are also occasionally present towards the apex of the branchlet. Flowers (section *Ornus*), in terminal glabrous panicles, on filiform pedicels; calyx with five long acuminate teeth. Fruit linear, $1\frac{1}{2}$ inch long, $\frac{1}{8}$ inch wide.

This species, of which we have seen the type specimen, preserved at Leyden, and a specimen at Kew, lately received from Tokyo, differs from all the ashes known to me, in the occurrence of characteristic minute curved prickles on the under surface, margin, and petiolules of the leaflets and on the rachis of the leaf. Blume considered it to be only cultivated in Japan, and possibly an introduction from China. It appears to be unknown to Japanese botanists. However the only living specimen which we have seen is a small plant at Aldenham, which was raised from seed obtained from the Imperial Garden at Tokyo. (A. H.)

FRAXINUS PUBINERVIS

Fraxinus pubinervis, Blume, *Mus. Bot. Lugd. Bat.* i. 311 (1850); Franchet et Savatier, *Enum. Pl. Jap.* i. 311 (1875), and ii. 435 (1879); Lingelsheim, in Engler, *Bot. Jahrb.* xl. 214 (1907).
Fraxinus Bungeana, De Candolle, var. *pubinervis*, Wenzig, in Engler, *Bot. Jahrb.* iv. 170 (1883).

A small tree, with smooth bark. Young branchlets densely covered with greyish pubescence, disappearing in the second year. Buds conical, densely covered with a brownish-grey pubescence. Leaflets, five or seven, coriaceous, 3 to 4 inches long, 1 to $1\frac{1}{2}$ inch wide; terminal largest, long-stalked and often broadest in its upper half; lateral, upper pair sessile, lower pairs shortly stalked; lanceolate, cuneate at the base, acuminate at the apex, crenately serrate; upper surface glabrous; lower surface pale green, with dense whitish pubescence on the side of the midrib, spreading to the lateral nerves, and continued on the petiolules. Rachis of the leaf, with a continuous open groove, pubescent throughout, the pubescence densest at the nodes. Flowers (section *Ornus*), in large, terminal glabrous panicles, with early deciduous petals and long pedicels; calyx with long acuminate teeth. Fruit linear-spatulate, acute, $1\frac{1}{2}$ inch long, $\frac{1}{8}$ inch wide.

This species is known to the Japanese as *toneriko*; and in a native book on forest trees, is said to attain 30 feet in height and 3 feet in girth, but no accurate account of its distribution or habitat is given. There is a dried specimen at Kew, lately received from Tokyo. The only tree in cultivation known to me, is one at Aldenham, about 15 feet high, which was received six years ago from the Yokohama Nursery Company, and is growing vigorously.

FRAXINUS SPAETHIANA

Fraxinus Spaethiana, Lingelsheim, in Engler, *Bot. Jahrb.* xl. 215 (1907).
Fraxinus Sieboldiana, Dippel, *Laubholzkunde*, i. 63, t. 27 (1889); Koehne, *Deutsche Dendrologie*, (1893) (not Blume).

A small tree. Branchlets glabrous, grey. Leaflets seven to nine, coriaceous, 4 to 6 inches long, $1\frac{1}{2}$ to $1\frac{3}{4}$ inch wide, sessile or subsessile (terminal leaflet sessile or with a stalk up to $\frac{1}{2}$ inch long); lanceolate-oblong; unequal and tapering at the base; abruptly contracted at the apex into a long, often curved acumen; margin non-ciliate, irregularly and often crenately serrate; lateral nerves fifteen to twenty pairs; glabrous except for slight pubescence along the midrib on the lower surface at the base. Rachis of the leaf, glabrous, with a continuous open groove on its upper side, dilated at its base into a swollen, dark-brown, shining sheath, which partly embraces the branchlet and conceals the glabrous dark-brown buds. Flowers, section *Ornus*. Fruit in large terminal glabrous leafless panicles. Samaræ linear-spatulate, $1\frac{1}{2}$ inch long, $\frac{1}{3}$ inch wide in the broadest part, rounded and entire at the apex; calyx with five short teeth.

This species, which has been a considerable time in cultivation, under the garden name of *F. serratifolia*, is readily distinguishable from all the other species¹ of ash which have been introduced, by the swollen base of the petiole, which somewhat resembles that of the plane tree. It is a native of Japan, where it appears to have been confused with *F. Sieboldiana*, which we consider to be a form of *F. longicuspis*. Specimens lately received at Kew, through the Hon. Vicary Gibbs, from Dr. Fukuba, Director of the Imperial Gardens at Tokyo, enable us to describe the fruit, which has hitherto been unknown.

It is a handsome and striking species, represented at Kew by a tree about 15 feet high, and at Aldenham by small plants. (A. H.)

FRAXINUS LONGICUSPIS

Fraxinus longicuspis, Siebold et Zuccarini, in *Abhand. Baier. Acad. Wissen.* iv. 3, p. 169 (1846); Franchet et Savatier, *Enum. Pl. Jap.* i. 310 (1875); Shirasawa, *Icon. Ess. Forest. Japon*, text 126, t. 81 (1900); Lingelsheim, in Engler, *Bot. Jahrb.* xl. 214 (1907).
Fraxinus Sieboldiana, Blume, in *Mus. Lugd. Bat.* i. 311 (1850).

A tree, attaining, according to Shirasawa, 50 feet in height and 7 feet in girth. Young branchlets grey, glabrous. Leaflets five, occasionally seven; terminal largest, stalked; lateral, upper pair sessile, lower pair stalked; oblong, oblong-lanceolate, or

¹ *F. platypoda*, Oliver, a species, discovered by me in Central China, has a similar swollen base to the petiole; but it has never been introduced.

ovate, cuneate at the base, abruptly contracted above into a long cuspidate apex, crenately serrate; upper surface glabrous; lower surface pale green, slightly pubescent on the side of the midrib, elsewhere glabrous. Rachis of the leaf, grooved on its upper side, pubescent at the nodes, glabrous elsewhere. Buds purplish brown, minutely pubescent. Flowers (section *Ornus*) in terminal and lateral panicles; petals four, narrowly-linear. Fruit about an inch in length, subtended by a 4-toothed calyx, oblanceolate, with a long cuneate base and an obtuse emarginate apex.

This species is variable as regards the shape of the leaflets; and two varieties have been noticed, regarded as distinct species by Blume; one characterised by broad ovate leaflets (terminal leaflet 3 to 3½ inches long and 1½ inch broad), with slight pubescence along the midrib beneath; the other with narrow oblong leaflets (terminal leaflet 3½ to 4 inches long and 1 to 1½ inch wide), glabrous on the under surface; but, as Franchet points out, there are numerous specimens with intermediate characters.

*Fraxinus longicuspis*¹ is a native of the mountainous districts of Japan, attaining, according to Shirasawa, an elevation of 5000 feet in the central chain of Hondo. It is abundant in Nikko, Chichibu, and Kiso; and has been collected near Hakodate by Maximowicz, in Akita by Elwes, in the mountains of Yamagata by Faurie, and in the island of Tsu-sima by Wilford. On account of its small size, it is of no economic importance in Japan. It appears to be extremely rare in cultivation in this country, the only specimen which we have seen being a small plant at Kew, about 2 feet high, which was raised from seed sent by Sargent in 1894. (A. H.)

FRAXINUS NIGRA, BLACK ASH

Fraxinus nigra, Marshall, *Arb. Am.* 51 (1785); Sargent, *Silva N. Amer.* vi. 37, tt. 264, 265 (1894), and *Trees N. Amer.* 764 (1905).

Fraxinus sambucifolia, Lamarck, *Dict.* ii. 549 (1786); Loudon, *Arb. et Frut. Brit.* ii. 1234 (1838).

A tree, attaining in America 90 feet in height and 5 feet in girth of stem, with bark divided into large irregular scaly plates. Shoots glabrous. Leaflets (Plate 264, Fig. 19), seven to eleven, 3 to 5 inches long, terminal one petiolulate, lateral leaflets sessile; oblong to oblong-lanceolate, rounded and unequal at the base, long acuminate at the apex, remotely and finely crenulate-serrate; under surface glabrous, except for long reddish hairs along the nerves and midrib, densest towards the base, where they spread over the surface of the leaflet. Leaf-rachis winged on the upper side, the wings meeting above and not forming a continuous open groove; glabrous except opposite the insertions of the leaflets, where it is bearded all round with dense rufous hairs.

The terminal buds are blackish, broadly ovate and acute, with six scales visible externally, of which the outer pair, slightly puberulous, almost enclose the others.

¹ The Japanese botanists recognise two species:—*F. longicuspis*, called in Japanese *oshida* or *aotago*; and *F. Sieboldiana*, known as *shioji*. The latter name may possibly refer to *F. Spaethiana*. Cf. p. 897.

Flowers (section *Fraxinaster*) polygamous, without calyx or corolla, arising in the axils of the leaf-scars of the preceding year's shoot. Fruit, linear-oblong, with a short flattened faintly nerved body, surrounded by a thin wing very emarginate at the apex.

This is the American representative¹ of the common European ash, and it is easily distinguished from nearly all the other species by the dense ring of rufous pubescence on the leaf-rachis at the nodes. *Fraxinus mandshurica*, which has the rachis similarly bearded, but more deeply grooved, differs in having leaflets with a sharp serrate margin and a tapering base. (A. H.)

Fraxinus nigra is found, according to Sargent, in deep, cold swamps and on the low banks of streams and lakes, from southern Newfoundland and the north shores of the Gulf of St. Lawrence to Lake Winnipeg, and southward to the mountains of Virginia, southern Illinois, and north-west Arkansas. Macoun says that in Canada it is more widely distributed than the white ash, and more abundant than the latter throughout its range, from Anticosti to eastern Manitoba, in swamps and river bottoms. It grows on peat mosses, but remains small in such situations. I saw it in the woods about Ottawa, but of no great size, and Sargent gives 80 to 90 feet as its extreme height. Ridgway found it abundant in Knox County, Indiana, where a tree 83 feet high, of which the bole was 57 feet, only measured 1½ foot in diameter at 5 feet from the ground. He says that it presents so very close a resemblance to the young Pecan tree (*Carya olivæformis*) as not to be readily distinguished except by experts.² In *Carya*, however, the leaves are alternate. Its wood, according to Emerson, is remarkable for toughness, and on this account was preferred to every other by the Indians for making baskets, and is still used for that purpose in preference to every kind of wood except that of a young white oak.

We have seen no specimens of this tree except small plants³ at Kew and Colesborne, although it was probably planted in many places early in the nineteenth century; having been introduced, according to Loudon, in 1800. Like many other trees of the Atlantic side of North America, it is short-lived and does not thrive in our climate. Prof. Sargent informs me in a letter that at the Arnold Arboretum, near Boston, it is one of the most difficult of all trees to grow. At Angers in France, it does badly on its own roots, but succeeds when well grafted; a specimen there having attained 15 feet high in eight years. (H. J. E.)

¹ According to Cobbett, *Woodlands*, Art. 136 (1825), the seeds of this species, like the English ash, do not come up until the second year.

² Mr. G. B. Sudworth, however, tells me that the bark of the two is so distinct that they can readily be distinguished. He adds that other species of ash, hickory, oak, Liquidambar, and Nyssa, are now used for basket-making.

³ These plants were raised from seed sent from Michigan in 1895, and are not thriving, having been repeatedly injured by frost. They are now only 2 feet high.

FRAXINUS ANOMALA, UTAH ASH

Fraxinus anomala, Watson, King's Rep. v. 283 (1871); Sargent, *Silva N. Amer.* vi. 39, t. 266 (1894), and *Trees N. America*, 765 (1905).

A small tree, attaining about 20 feet in height, with bark shallowly fissured by narrow ridges. Branchlets quadrangular, slightly four-winged, glabrous, with inconspicuous reddish lenticels. Leaves (Plate 262, Fig. 7) simple (occasionally two- to three-foliolate), ovate or obovate, acute or rounded at the apex, base cuneate or cordate, slightly crenulate or entire in margin, glabrous beneath. Petiole flattened and grooved above, about half the length of the blade of the leaf.

Flowers (section *Leptalix*) in panicles from the axils of the leaf-scars of the preceding year's shoot, with a calyx, but corolla absent. Fruit oblong, with a rounded wing surrounding the long, flattened, striately nerved body.

This curious tree, so remarkable amongst the ashes, in its usually simple leaves and quadrangular stems, occurs in Colorado, Utah, and Nevada.

It is in cultivation at Kew, where it is perfectly hardy, and is worthy of a place in collections on account of its peculiarities. (A. H.)

FRAXINUS QUADRANGULATA, BLUE ASH

Fraxinus quadrangulata, Michaux, *Fl. Bor. Am.* ii. 255 (1803); Loudon, *Arb. et Frut. Brit.* ii. 1235 (1838); Sargent, *Silva N. Amer.* vi. 35, t. 263 (1894), and *Trees N. Amer.* 761 (1905).

A large tree, attaining 120 feet in height and 9 feet in girth. Bark separating irregularly into large thin plates. Branchlets glabrous, stout, quadrangular; with four wings between the nodes, persisting and becoming corky in the second year; lenticels white. Leaflets (Plate 265, Fig. 22), five to nine, 3 to 5 inches long; on pubescent stalklets, $\frac{1}{8}$ to $\frac{1}{4}$ inch long; ovate or oval, rounded or broadly cuneate at the base, acuminate at the apex, regularly serrate, glabrous above; under surface covered with scattered whitish tomentum, densest towards the base. Leaf-rachis pubescent, with a shallow open channel on its upper side.

Flowers (section *Leptalix*) in panicles from the axils of the leaf-scars of the previous year's shoot, perfect, calyx obsolete, corolla absent. Fruit oblong; body long, flat, with numerous faint rays, surrounded by the base of the broad wing, which is emarginate at the apex.

This species is readily distinguished from all the other species with numerous leaflets by the conspicuous wings on the branchlets. (A. H.)

The blue ash though little known outside of botanic gardens in Europe is, next to the white ash, the largest of its genus found in the United States. It is unknown in New England or Canada, though hardy at Ottawa, where I saw it in the

arboretum of the Experimental Farm. Sargent says that it grows usually on rich limestone hills from southern Michigan to Iowa, central Missouri, and north-eastern Arkansas, and southward to northern Alabama and east Tennessee on the Big Smoky mountains, where it attains a great size. Usually it is from 60 to 70 feet high, with a trunk 2 to 3 feet in diameter; but Ridgway says that four freshly cut trees, in the Wabash valley in Illinois, were 116 to 124 feet high, with clear trunks 51 to 76 feet long, and 2 to 2½ feet diameter on the stump. Here it was common in rich hilly woods, but I saw none standing of anything like these dimensions.

The tree was discovered by the elder Michaux in 1795 and introduced¹ by him into France, and his son speaks of the beautiful stocks that were growing in Europe; but I have seen none of considerable size, the best perhaps in England being a tree at Tortworth, which was 34 feet by 1 foot 10 inches in November 1905, and reported by Lord Ducie to be growing freely. Michaux says that the wood of this species in the western states is extensively used for waggon-building and wheels, and also for flooring houses; but it does not now seem to be known to English importers. Mr. G. B. Sudworth informs me, however, that this timber is still found in considerable quantity in the Ohio valley, and can be obtained in logs as large as 24 to 30 inches in diameter. He adds that for farm tool handles it is preferred to any other ash on account of its superior strength and elasticity. (H. J. E.)

FRAXINUS AMERICANA, WHITE ASH

Fraxinus americana, Linnæus, *Sp. Pl.* 1057 (1753); Loudon, *Arb. et Frut. Brit.* 1232 (1838); Sargent, *Silva N. America*, vi. 43, tt. 268, 269 (1894), and *Trees N. America*, 767 (1905).
Fraxinus alba, Marshall, *Arbust. Am.* 51 (1785).
Fraxinus acuminata, Lamarck, *Dict.* ii. 547 (1786).
Fraxinus juglandifolia, Lamarck, *Dict.* ii. 548 (1786).
Fraxinus epiptera, Michaux, *Fl. Bor. Am.* ii. 256 (1803).

A large tree, attaining in America 120 feet in height and 15 to 20 feet in girth. Bark deeply divided by narrow fissures into broad flattened scaly ridges. Shoots stout, green, glabrous, with white lenticels. Leaflets (Plate 265, Fig. 21), seven to nine, 4 to 6 inches long, distinctly stalked (the petiolules glabrous and $\frac{1}{4}$ to $\frac{1}{2}$ inch long), lanceolate or oval, rounded or broadly cuneate at the base, acuminate at the apex; entire, crenulate, or coarsely serrate; under surface whitish and pubescent along the midrib and nerves, or in some cases throughout. Rachis of the leaf terete and apparently not grooved on the upper side; but usually a slight groove can be made out on close examination.

Flowers (section *Leptalix*) dioecious, in glabrous panicles in the axils of the leaf-scars of the preceding year's shoot; corolla absent. Fruit in crowded clusters, surrounded by the persistent calyx at the base, lanceolate or oblong, with a terete rayed oblong body, much shorter than the terminal wing, which is pointed or emarginate at the apex.

¹ It was introduced, according to Loudon, into England in 1823.

VARIETIES

A form is known with very small fruit, var. *microcarpa*, Gray.¹ In regard to the leaf, two varieties have been described,² viz. :—

Var. *acuminata*, Wesmael. Leaflets dark green above, very white and almost glabrous beneath, nearly entire in margin. This form is more common in the southern states.

Var. *juglandifolia*, Rehder. Leaflets usually broader than in the preceding variety, more or less pubescent beneath, coarsely serrate at least above the middle. This is the northern form of the species.

These two varieties occur in cultivation in England, the leaves of both remaining unchanged in colour until they fall in autumn. A form of var. *acuminata* occurs, in which the leaflets are narrow at the base, and turn reddish brown before they fall.

There is also said to exist a horticultural variety, var. *albo-marginata*, in which the leaflets are edged with white.

IDENTIFICATION

As *Fraxinus americana* may be a valuable tree for economic planting in England, its correct identification is important. Reputed trees of *F. americana* growing slowly usually turn out on examination to be *F. viridis* or some other species. In summer, the leaflets white beneath and distinctly stalked, the rachis terete and practically not grooved, and the glabrous branchlets, will readily distinguish *F. americana*. The only species which closely agrees with it, *F. texensis*, has, when adult, fewer, usually five (rarely seven) leaflets, which are smaller and quite different in shape, being broadly oval with a rounded or acute apex. (A. H.)

DISTRIBUTION

The white ash is one of the best known and most highly valued trees in New England and Canada; where it occurs according to Sargent, from Nova Scotia and New Brunswick through Ontario to northern Minnesota, southward to northern Florida, and westward to Kansas, Indian Territory, and eastern Nebraska, and the valley of the Trinity River, Texas; being less common and smaller west of the Mississippi. It attains in the forest a height of 120 feet with a diameter of 4 feet and upwards, and thrives best in a deep loamy soil near the banks of streams, just as the common ash does in England. When standing alone it assumes a spreading habit with large branches.

Ridgway measured a sound tree in Wabash County, Illinois, which was 144 feet high with a clean stem 83 feet long and 9 feet in girth at the top, and 13 feet at the base, which, according to English measure, would have contained over 500 cubic feet; and Dr. C. Schneck measured a tree in the same county 144 feet high with a stem 90 feet long and 17½ in girth above the swell at the base; and this tree, if it carried its girth up, might have contained 1000 feet of timber.

¹ This variety is common in the Gulf States, the fruit being less than ½ inch long; whereas it usually attains 1½ to 2 inches. Sargent, however, states that both large and small fruit may occur on the same individual, and even on the same branch.

² Cf. Rehder in *Cycl. Amer. Horticulture*, 607 (1900).

I saw no large specimens of this species in New England or Canada where most of the best have been felled. I noticed at Ottawa that in the autumn its leaves assume a rich purplish colour, which the black and red ashes did not show.

Michaux says¹ that on large trees the bark is deeply furrowed, and divided into small squares from 1 to 3 inches in diameter; and that it grows in Maine in company with the white elm, yellow birch, white maple, hemlock, and black spruce, and in New Jersey with red maple, shellbark hickory, and button-wood (*Platanus occidentalis*), in places that are constantly wet or occasionally flooded. Pinchot and Ashe² figure a splendid tall straight forest tree with small head and rough bark resembling that of the common ash, and say that its average height in North Carolina is 50 to 80 feet with a diameter of 2 feet to 3 feet.

Professor Sargent says³ that the white ash when planted with the common ash in the high regions of central Europe comes into leaf still later than that species, and thus escapes the spring frosts; it is less able to resist drought than the green ash, and is usually found on moist soil, though it does not like wet swamps, like the black ash. In the forest it sends up a perfectly straight and slender stem to a great height, ash poles 100 feet high and not over a foot in diameter being often seen. A photograph taken in Chester County, Pennsylvania, shows a tree in the open with a rather spreading head and a trunk 15 feet 10 inches in girth.

CULTIVATION

Fraxinus americana is stated by Aiton⁴ to have been introduced into England in 1724 by Catesby. Sargent, however, points out that the ash described by Catesby is another species.

Though very seldom seen, I believe that the American ash will grow in this country, in some places at least, almost as fast as the native ash. My attention was first called to this fact by the very straight, clean, and rapid growth of a young tree at Kew which stands by the walk not far from the Old Conservatory, now the Museum of Timbers. The date of planting is unknown. It measured in 1907 63 feet by 2 feet 5 inches, while *F. lanceolata*, growing near it is 43 feet by 2 feet 1 inch, and *F. oregona*, 44 feet by 2 feet 8 inches.

Knowing that the wood is considered better for oars than that of the native ash, and used exclusively for the heavy oars of our navy, I thought it worth trying as a timber tree, and raised a large number of plants from seed sent me by Messrs. Meehan of Philadelphia as *F. americana*, but which I found out three years later to be *F. lanceolata*.⁵ Later on I raised seedlings of the true white ash and found that at first they do not grow nearly so fast as *F. lanceolata*. They do not ripen the young

¹ *N. Amer. Sylva*, iii. 49.

² *Garden and Forest*, vii. 402.

³ Mr. G. B. Sudworth informs me that ten or fifteen years ago Messrs. Meehan became aware that they had been selling two or three species of ash seed as *F. americana*, and submitted samples to him for identification. To his great surprise he found that none of it was pure, but contained a mixture of *F. americana*, *F. lanceolata*, and *F. pennsylvanica*. Since then they have been more careful. He adds that continental tree planters have, to his knowledge, been planting green and red ash in mistake for white ash; and it is probable that most of the young trees grown under that name on the continent are incorrectly named.

⁴ *Trees of North Carolina*, p. 71, plate 6.

⁵ *Hort. Kew*, iii. 445 (1789).

wood well until they attain a certain age, but are perfectly hardy and will probably grow best in the east and south-east of England.

The only large trees I know of in England are two at Kew which grow on the mound near the Cumberland gate and which measure 85 feet by 8 feet 6 inches and 85 feet by 8 feet respectively (Plate 246). There is a tall slender white ash at Croome Court, Worcestershire, crowded by other trees, which measures about 80 feet by 4 feet 6 inches, and another¹ at Arley Castle 60 feet by 5 feet 4 inches. There is also a smaller one at Syon. Another at Tortworth was 46 feet by 3 feet in 1907. Loudon says that at St. Anne's Hill in Surrey there was one 33 feet high which had been planted thirty-six years, and that near London young plants are generally injured by spring frost, which I have not found to be the case at Colesborne.

Sir Charles Strickland tells me that he has planted the tree at Hildenley at Yorkshire, but does not find it succeed so well as the Oregon ash.

A tree at Fota, in the south of Ireland, is 50 feet high and 6 feet in girth.

Cobbett says:² "This tree grows much faster than ours. I have abundant proof, for the American white ash plants which I have at Kensington, which were not sown till last April, are now (1825) full as tall again as any of the English ash of the same age that I ever saw. This, therefore, is above all others the ash which I recommend to be put into plantations in England, whether for ornament, for timber, or for under-wood." But Cobbett in this case, as in many others, was rather apt to jump to conclusions after too short experience; for if the tree had continued to grow as it did at first, there must by this time have been many good-sized ones in England.

TIMBER

The timber of the white ash is as highly valued in America as ours is in England for the same purposes, and is largely imported to England where it is used as a substitute for English ash. Laslett in writing of American white ash says: "It is tough, elastic, clean, and straight in the grain, and stands well after seasoning, hence we get from this tree the best material for oars for boats that can be produced. They are much and eagerly sought after by foreign governments as well as our own, and also by the great private steamship companies and mercantile marine. The best quality wood has a clean, bright uniform whitish colour; the second is slightly stained with red and yellow shades alternating; the third and least valuable quality is that in which the red and yellow colours predominate. It is much slower in growth than the English, and is probably not so durable." On visiting the principal importers of this wood in Liverpool, I found large quantities of American oars imported ready-made; and was told that the timber had now become so scarce in the east, that it came from the west side of the Mississippi.³ I have not been able to procure a sample grown in this country for comparison; but I am indebted to

¹ *Catalogue of Hardy Trees, Arley Castle*, No. 43 (1907).

² *Woodlands*, art. 135.

³ A lot of oars which I saw in the Portsmouth Dockyard were stamped on the blade "De Valls Bluff. Ark. U.S.A." I am informed by experienced naval carpenters, and officers, that they believe that English ash, if it can be procured of sufficient straightness and length, would be at least as good, if not better.

Mr. A. Howard for a plank believed to be of this species, which was imported from Canada, and was cut from a log measuring 56 feet long by 24 inches quarter-girth at the top. It cost £66 and was cut into twenty-four boards containing 2763 feet board measure. (H. J. E.)

FRAXINUS TEXENSIS, TEXAN ASH

Fraxinus texensis, Sargent, *Silva N. Amer.* vi. 47, t. 270 (1894), and *Trees N. Amer.* 768 (1905).

Fraxinus albicans, Buckley, *Proc. Philad. Acad.* 1862, p. 4 (in part).

Fraxinus americana, Linnæus, var. *texensis*, Gray, *Syn. Fl. N. Amer.* ii. part i. 75 (1878).

Fraxinus americana, Linnæus, var. *albicans*, Lingelsheim, in Engler, *Bot. Jahrb.* xl. 219 (1907).

A small tree, with a short stem, rarely attaining 50 feet in height and 9 feet in girth. Bark dark grey, deeply divided by narrow fissures into broad scaly ridges. Branchlets glabrous. Leaflets, five to seven, often nine in young plants, 2 to 2½ inches long, distinctly stalked, with glabrous petiolules about ⅛ to ¼ inch long, ovate or oval (the terminal leaflet often obovate), base rounded and unequal, apex acute or rounded (acuminate in young plants), crenate-serrate and non-ciliate in margin; upper surface shining bluish green, glabrous; lower surface whitish, usually pubescent on the sides of the midrib and lateral nerves, the latter being forked near the margin; rachis slender, glabrous, terete, slightly grooved on the upper side.

Flowers (section *Leptalix*) dioecious in glabrous panicles in the axils of the leaf-scars of the preceding year; corolla absent. Fruit, spatulate, with persistent calyx at the base; body short, terete; wing terminal, rounded or emarginate at the apex.

This species, while very close to *F. americana* in technical characters, is distinct in appearance, and differs in the smaller leaflets, which are shining bluish green, and not dull on the upper surface.

It was discovered in 1852 by Dr. J. M. Bigelow, and grows on high dry limestone bluffs and ridges in northern, central, and western Texas, from near Dallas City to the valley of the Devil's River.

Young plants are growing in the nursery at Kew, which are thriving, and about 6 to 8 feet in height, after six years' growth. They were raised from seed sent by Mr. Bush in 1901. These plants have usually 7 to 9 leaflets, while specimens in the Kew Herbarium from Texas have only five leaflets; but this is probably a juvenile character. It is also growing well at Aldenham.

(A. H.)

FRAXINUS BILTMOREANA, BILTMORE ASH

Fraxinus Biltmoreana, Beadle, *Bot. Gazette*, xxv. 358 (1898); Sargent, *Trees N. Amer.* 773, fig. 618 (1905).

Fraxinus catawbiensis, Ashe, *Bot. Gazette*, xxxiii. 230 (1902).

A tree attaining in America, according to Ashe, over 100 feet in height, with a girth of about 7 feet. Young shoots covered with a dense white pubescence, retained in the second year; lenticels few, conspicuous, narrow, long, white. Leaflets (Plate 266, Fig. 30), seven to nine, about 4 inches long, oval or oblong (the terminal one on a long stalk, broadly oval or obovate), abruptly tapering and unequal at the base, acuminate at the apex, remotely serrate (the serrations often obsolete, so that the margin is nearly entire), with occasional scattered cilia; distinctly stalked with pubescent petiolules, $\frac{3}{8}$ to $\frac{1}{2}$ inch long; upper surface dark green, glabrous except for a little pubescence towards the base of the leaflet; lower surface white in colour, with a thin fine short pubescence, densest on the sides of the midrib and nerves. Rachis of the leaf slender, terete, finely pubescent, not grooved or only slightly grooved towards the apex.

Flowers (section *Leptalix*) dioecious in pubescent panicles in the axils of the leaf-scars of the previous year; corolla absent. Fruit girt at the base by the persistent calyx; body, short, elliptical, many-nerved; wing not decurrent, only slightly narrowed at the ends, emarginate at the apex.

Buds shortly ovoid, with four outer visible scales, equal in length, the external pair overlapping the inner pair; scales carinate, obtuse at the apex, orange-coloured, and covered with a scaly pubescence.

This species, as regards leaf-characters, looks like a pubescent *Fraxinus americana*;¹ and is readily distinguished from *F. pennsylvanica* by the leaflet being white in colour beneath, with a finer pubescence, and being more abruptly tapering and unequal at the base, with shallower and remoter serrations, which often become obsolete. The rachis of the leaf is like that of *F. americana*.

According to Sargent, it occurs on the banks of streams from northern West Virginia through the foothills of the Appalachian Mountains to northern Georgia and Alabama, and to middle Tennessee.

This species in the United States has apparently been considered to be a form of *F. pennsylvanica*, and has been in cultivation probably as long. At Fawley Court, Oxfordshire, the residence of W. D. Mackenzie, Esq., there are two fine trees. The largest, in a shrubbery, rather crowded by other trees, is about 80 feet in height by 7 feet 3 inches in girth. The other, standing in the open, is a very well-shaped vigorous tree (Plate 247), measuring 68 feet by 6 feet 6 inches. Both are bearing mistletoe and grow in good alluvial soil. The bark is grey in colour, and fissured like that of the white ash.

(A. H.)

¹ Beadle says that this species bears the same relation to *F. americana* as *F. pennsylvanica* bears to *F. lanceolata*. Lingelsheim, *op. cit.* 191, 222, considers this species to be a hybrid, between *F. americana* and *F. pennsylvanica*; but its wide distribution and abundance in the forest are not favourable to his view.

FRAXINUS LANCEOLATA, GREEN ASH

Fraxinus lanceolata, Borkhausen, *Handb. Forst. Bot.* i. 826 (1800); Sudworth, *Check List Forest Trees U.S.* 107 (1898).

Fraxinus viridis, Michaux, *Hist. Arb. Amer.* iii. 115, t. 10 (excl. fruit), (1813).

Fraxinus juglandifolia, Willdenow, *Sp. Pl.* iv. 1104 (1805) (not Lamarck); Loudon, *Arb. et Frut. Brit.* ii. 1236 (1838).

Fraxinus pennsylvanica, Marshall, var. *lanceolata*, Sargent, *Silva N. America*, vi. 51, t. 272 (1894), and *Trees N. America*, 771 (1905).

A tree rarely attaining more than 60 feet in height, with a girth of stem of 6 feet. Shoots dark green, glabrous, with conspicuous white lenticels. Leaflets (Plate 264, Fig. 16), seven to nine, usually sessile, 3 to 6 inches long, pale green beneath, ovate-lanceolate, tapering and unequal at the base, long-acuminate at the apex, under surface glabrous except for slight pubescence along the midrib, variable in serration. Rachis of the leaf glabrous, distinctly grooved on its upper side.

Flowers and fruit similar to those of *F. pennsylvanica*.

This species¹ is considered by Sargent to be a variety of *F. pennsylvanica* because west of the Mississippi trees occur, which are intermediate in character and can be as readily referred to one species as to the other. As seen in cultivation in England, it is very distinct, and on account of its glabrous shoots, it is very often mistaken for *F. americana*. The green ash is, however, readily distinguished from that species by the usually sessile leaflets, which are pale green and not white beneath.² The rachis is, moreover, more deeply grooved than is ever the case in *F. americana*, and the buds in the two species are different. (A. H.)

This tree was described and figured by the younger Michaux, who says, "The green ash is easily recognised by the brilliant colour of its young shoots and leaves, of which the two surfaces are nearly alike." He found it more common in the western districts of Pennsylvania, Maryland, and Virginia, than anywhere else, and speaks of it as a tree of moderate dimensions, laden with seed when only 25 to 30 feet high.

Sargent, who treats it as a variety of *F. pennsylvanica*, and distinguishes it by the leaves being rather narrower, shorter, and usually with more sharply serrate leaflets, bright green on both surfaces, says that it rarely exceeds 60 feet high, and occurs from the shores of Lake Champlain through the Alleghany mountains to western Florida and west to the valley of the Saskatchewan, the valley of the Colorado river, Texas, the eastern ranges of the Rocky Mountains, the Wasatch range, Utah, and Arizona. It is comparatively rare east of the Alleghany mountains, and most abundant in the Mississippi basin. East of the Mississippi it seems distinct, but westward is connected with the red ash by intermediate forms.

¹ A small tree growing in Kew Gardens and labelled *F. coriacea*, resembles in many respects the green ash. It is apparently the Texan form of the Mexican *F. Berlandieriana*, DC., which was formerly considered to be a variety of *F. lanceolata*. The Kew tree has glabrous shoots like those of the green ash; but the leaflets (Plate 263, Fig. 14) are smaller, more coriaceous and very reticulate, usually three to five in number, the terminal one largest and obovate, the lateral ones oval and acuminate at the apex, all sparingly and irregularly serrate in the upper two-thirds, with the under surface pale green and glabrous except for some pubescence along the midrib. Rachis of the leaf glabrous and slightly grooved. *F. coriacea*, Watson, a tree occurring in desert regions from Utah to California is probably a variety of *F. Berlandieriana*, differing in the pubescent branchlets and leaf-rachis. It is in cultivation at Aldenham, where a young tree, about 10 feet high, obtained from Barbier's nursery at Orleans, is thriving.

² Mr. G. B. Sudworth, adds, that the leaflets are usually sharply serrate, while those of *F. americana* are commonly undulate, entire, or with only a few teeth.

Ridgway, in his *Additional Notes on the Trees of the Wabash*,¹ says that Dr. J. Schneck of Mount Carmel measured a tree 92 feet high and 5 feet in girth; but when I visited the remains of this wonderful forest, in September 1904, I saw no ash trees of considerable size.

Pinchot and Ashe² say that the wood is inferior in quality to that of the white ash, but in North Carolina is not distinguished from it commercially.

Having raised a large quantity of plants from seed sent me as that of *Fraxinus americana*, which I did not identify as the green ash until Mr. F. V. Coville of Washington saw them growing in my nursery in 1904, I have distributed them to many friends as *F. americana*, and it is probable that the tree will thus become common in England under a wrong name, as has happened in so many cases before. For this mistake, which was unavoidable, I now apologise; but as the tree grows faster than any other American ash in a young state, and is likely to make useful poles, if not large trees, I have planted out some thousands of them at Colesborne.

Like all the American ashes which I have raised, the seed germinates quickly after sowing, and though liable to be injured by late frosts is at least as hardy as the common ash. When young the shoots continue to grow late in autumn and do not ripen their young wood, which for three to four years at least is liable to be killed back by winter frosts. Some of these seedlings are now, at four years old, 6 to 7 feet high and growing very vigorously. Michaux says that this species was introduced by his father to France in 1785, but I cannot hear of any surviving under this name.

Loudon says that at Stackpole Court, Pembrokeshire, it had in forty years attained a height of 60 feet, and had ripened seeds from which many plants had been raised and distributed in the plantations, but the Earl of Cawdor tells me that his gardener can find no trees in the woods which resemble the American ash, and that none of the men on the place can remember any peculiar ash trees there. In 1906 I also searched the woods at Stackpole without finding any trace of these trees. Loudon also mentions a tree in the garden of Pope's villa at Twickenham, which no longer exists. There are several young trees in Kew Gardens; and the tallest, about 40 feet high, is widely branching in habit, differing remarkably from a white ash of the same height beside it, which has narrow branches and a straighter stem. Their foliage is also very different in colour. (H. J. E.)

FRAXINUS PENNSYLVANICA, RED ASH

Fraxinus pennsylvanica, Marshall, *Arb. Amer.* 51 (1785); Sargent, *Silva N. Amer.* vi. 49, t. 271 (1894), and *Trees N. Amer.* 770 (1905).

Fraxinus pubescens, Lamarck, *Dict.* ii. 548 (1786); Loudon, *Arb. et Frut. Brit.* ii. 1233 (1838).

A tree, attaining 60 feet in height and 5 feet in girth of stem. Bark brownish red and slightly furrowed, with scaly ridges. Young shoots stout, covered with

¹ *Proc. U.S. Nat. Mus.* xvii. 411 (1894).

² *Timber Trees of North Carolina*, 73.

dense white pubescence, which is retained in the second year; lenticels white, inconspicuous. Leaflets (Plate 263, Fig. 13), seven to nine, occasionally five, 3 to 5 inches long, three times as long as broad, ovate-lanceolate to oblong-lanceolate, tapering at the base, acuminate at the apex, finely serrate and ciliate in margin; upper surface with scattered fine pubescence; lower surface densely pubescent and green in colour. The leaflets are usually distinctly stalked, with pubescent petiolules; but forms occur in which they are sessile, the substance of the leaflet being prolonged to its insertion. Rachis of the leaf densely white pubescent, with a distinct shallow groove on its upper side.

Flowers (section *Leptelix*) dioecious, in tomentose panicles in the axils of the leaf-scars of the preceding year's shoot; corolla absent. Fruit linear-spatulate, surrounded at the base by the persistent calyx; body slender, terete, many-rayed; wing slightly decurrent, narrow, and rounded or acute at the apex.

For the distinctions between this species and the Oregon ash, see under the latter. *Fraxinus Biltmoreana* differs conspicuously in having the leaflets white beneath. *Fraxinus profunda*, Bush,¹ which is remarkably distinct in its fruit, differs also in having the leaflets entire or undulate in margin, their base being usually very asymmetrical.

There are several forms of *F. pennsylvanica* in cultivation, some having the leaflets very firm in texture and set close on the rachis, others having thin leaflets wider apart on the rachis. The leaflets also vary in the length of their stalklets, in the size of the serrations, and in the shape of the base, which may be gradually tapering or abruptly tapering and almost rounded. *F. Richardi*, *F. Boscii*, and *F. glabra*, names given to certain horticultural varieties, are all probably referable to this species.

Var. *aucubæfolia* (*F. aucubæfolia*, Kirchner, *Arb. Musc.* 507 (1864)), in which the leaves are variegated with yellow, is considered by Lingelsheim² to be a hybrid between *F. pennsylvanica* and *F. lanceolata*. At Aldenham³ this forms a handsome tree about 30 feet high. (A. H.)

It is neither so large nor so common a tree as the white ash in the United States where, according to Sargent, it has nearly the same distribution as the latter; being most common and largest in the north Atlantic States, smaller and less abundant west of the Alleghanies. Macoun says⁴ that in Canada it ranges farther west than the white and black ashes, growing along the Assiniboine river and the tributaries of Lake Manitoba. It is usually 40 to 60 feet high, with a diameter rarely exceeding 18 inches to 20 inches; and is here of no value for timber, but makes good firewood, even when green. Emerson measured a tree at Springfield in September 1840 which was 9 feet in girth at 3 feet from the ground; and Ridgway says⁵ that Dr. Schneck measured a tree in the Wabash forests 138 feet high by 16 feet in girth.

¹ See Sargent, *Trees N. America*, 772. This ash, which is probably not yet introduced, grows to a great size in river swamps in Missouri, Arkansas, and Florida. It is considered by Lingelsheim, in Engler, *Bot. Jahrb.* xl. 220 (1907), to be a variety of *F. pennsylvanica*. ² *Op. cit.* 222.

³ It is cultivated here under the erroneous name, *F. americana*, var. *aucubæfolia*, which is given in *Kew Handlist of Trees*, 533 (1902). ⁴ *Forest Wealth of Canada*, p. 23. ⁵ *Proc. U.S. Nat. Mus.* xvii. 411 (1894).

Fraxinus pennsylvanica was introduced into England in 1783¹; and it is often met with in cultivation in public parks and botanic gardens, where it grows well as a small tree. One in the Botanic Garden at Oxford measures about 50 feet by 3 feet, and I have seen smaller trees at Stowe and elsewhere. I have raised it from American seed, and it seems to grow as fast as the white ash, but not so fast as the green ash. It ripens its wood better, and when young loses its leaves earlier than either of these.

Macoun says² that the red ash and the green ash are not separated commercially from the other species, the wood of the latter resembling that of the white ash, while that of the former is more like the black ash. Therefore there is some doubt whether Laslett, who writes of the Canadian ash, whose timber is often confounded with that of the white ash, is speaking of this tree or of the black ash which he does not mention. He says that it was, until recently, imported in considerable quantity in the form of oars, and that it is reddish brown in colour, considerably darker than the wood of the English ash. (H. J. E.)

FRAXINUS OREGONA, OREGON ASH

Fraxinus oregona, Nuttall, *Sylva*, iii. 59, t. 99 (1849); Sargent, *Silva N. Amer.* vi. 57, t. 276 (1894), and *Trees N. Amer.* 776 (1905).

A tree attaining 80 feet in height and a girth of stem of 12 feet. Bark deeply divided by interrupted fissures into broad flat scaly ridges. Young shoots stout, covered with dense white tomentum, which persists in the second year; lenticels white, inconspicuous. Leaflets (Plate 263, Fig. 15), 3 to 4 inches long, subsessile, usually seven, sometimes five or nine, oval, about twice as long as broad, base rounded or abruptly tapering, apex acute or shortly acuminate; margin entire or minutely and remotely crenate, ciliate; upper surface with scattered fine pubescence; lower surface covered with dense white tomentum. Rachis white tomentose, with a distinct shallow groove on its upper side, basal part wide and flattened.

Flowers (section *Leptaliæ*) dioecious in glabrous panicles rising out of the axils of the preceding year's shoot; calyx present, persisting under the fruit, corolla absent. Fruit obovate-oblong; body slightly compressed; wing long, decurrent, many-nerved, and rounded, apiculate or emarginate at the apex.

Fraxinus oregona can only be confused with sessile forms of *F. pennsylvanica*, which has longer serrate leaflets, with more nerves, tapering gradually to the base. In *F. oregona* the leaflets are shorter in proportion to their breadth, and are usually entire in margin; but this last character is not absolutely distinctive, as the leaflets of the two species vary in regard to the presence or absence and size of the serrations.

¹ Aiton, *Hort. Kew.* v. 476 (1813).

² *Forest Wealth of Canada*, p. 23.

This species was discovered by David Douglas in 1825 on the banks of the Lower Columbia river. It is mentioned by Koch¹ as having been in cultivation in the Botanic Garden of Berlin prior to 1872. (A. H.)

This tree is the common ash of north-west America, extending from Puget Sound through western Washington and Oregon and the coast region of California to San Francisco, and along the western foothills of the Sierra Nevada to San Bernardino and San Diego counties. It is an important timber tree in Oregon and Washington, but if it occurs in British Columbia,² is too scarce to be noticed by Macoun. I saw no trees of great size during either of my visits to the Pacific coast, but Sheldon³ says that it attains as much as 100 feet in height and 1 to 4 feet in diameter, and describes the wood as hard, tough, firm, straight-grained, and taking a high polish.

In California, according to Jepson,⁴ *F. oregona* only attains a length of 15 to 30 feet, growing along the Sacramento river, and on the banks of the streams of the coast ranges. The leaflets become glabrous with age; and on this account Lingelsheim⁵ has distinguished the Californian form as var. *glabra*.

In England the tree grows well in a young state; but I know of none of any size, except one at Nuneham Court, Oxfordshire, which in 1907 was 63 feet high and 3 feet 8 inches in girth. A tree of *F. americana* growing near it, and believed to have been planted at the same time, was only 38 feet by 1 foot 8 inches. Sir Charles Strickland has a plantation at Hildenley, Yorkshire, of this species mixed with larch; and as these trees, when I saw them in 1901, were 20 to 30 feet high, and had ripened seed from which I have raised plants, I think their hardiness in this country is abundantly proved; and that the tree is more likely to succeed in the west and north of England than the eastern American ashes. At Tortworth Court Lord Ducie has made a mixed plantation of *F. americana* and this species, which are now 20 to 30 feet high at about fifteen years old; but the soil and situation are not very favourable. In 1908 the Oregon ash were bearing seed freely. (H. J. E.)

¹ *Dendrologie*, ii. 1, p. 260 (1872).

² Piper, *Flora of the State of Washington*, 449 (1906), says its range is "British Columbia to California, in the coast region"; but gives no localities for British Columbia. It is not mentioned as occurring in Vancouver Island by the authors of *Postelsia*, the year-book of the Minnesota Seaside Station for 1906.

³ *Forest Wealth of Oregon*, 32 (1904).

⁴ *Flora W. Mid. California*, 385 (1901).

⁵ In Engler, *Bot. Jahrb.* xl. 220 (1907).

FRAXINUS CAROLINIANA, SWAMP ASH

Fraxinus caroliniana, Miller, *Dict.* No. 6 (1768); Loudon, *Arb. et Frut. Brit.* ii. 1237 (1838); Sargent, *Silva N. Amer.* vi. 55, t. 274, 275 (1894), and *Trees N. Amer.* 762 (1905).
Fraxinus platycarpa, Michaux, *Fl. Bor. Amer.* ii. 256 (1803).
Fraxinus triptera, Nuttall, *Gen.* ii. 232 (1818).
Fraxinus cubensis, Grisebach, *Cat. Pl. Cub.* 170 (1866).

A tree attaining 40 feet in height, with a stem 3 feet in girth; bark marked by irregularly-shaped brown patches, separating on the surface into thin scales. Branchlets glabrous or pubescent, with white minute scattered lenticels. Leaflets (Plate 263, Fig. 12) seven, occasionally five, stalked (petiolule $\frac{1}{4}$ to $\frac{3}{8}$ inch), about 3 inches long, oval; unequal, rounded, or broadly cuneate at the base; apex shortly acuminate; finely and irregularly serrate; green and glabrous on the under surface except for some white pubescence along the sides of the midrib and nerves, or in some forms pubescent throughout. Leaf rachis, glabrous or pubescent, with two slight wings on the upper side, forming a groove.

Flowers (section *Leptaliæ*) diœcious in panicles arising in the axils of leaf-scars of the preceding year's shoot; calyx present, persisting under the fruit; corolla absent. Fruit broad, elliptic or spatulate; body short and compressed, surrounded by a pinnately-veined broad thin wing.

This species grows in river swamps in the coast regions of the Atlantic and Gulf States from southern Virginia to the valley of the Sabine river in Texas, extending through western Louisiana northwards to south-western Arkansas. It also occurs in Cuba.

This species was introduced into England in 1783, according to Loudon, who, however, mentions no trees of any size as growing in England in 1838. We have seen no specimens, except small trees at Kew, which are thriving. (A. H.)

FRAXINUS VELUTINA

Fraxinus velutina, Torrey, *Emory's Report* 149 (1848); Sargent, *Silva N. Amer.* vi. 41, t. 267 (1894), and *Trees N. Amer.* 774 (1905).
Fraxinus pistaciaefolia, Torrey, *Pacific R. Report*, iv. 128 (1856).

A tree, 40 feet high, with a girth of stem of 2 feet. Bark deeply divided into broad flat broken scaly ridges. Shoots purple, covered with dense white pubescence; lenticels white. Leaflets (Plate 265, Fig. 20), small, about $1\frac{1}{2}$ inch long, three or five, occasionally seven or nine, or rarely only one, and variable in shape, margin, and insertion; usually sessile, occasionally stalked, the terminal leaflet often obovate, the lateral leaflets commonly lanceolate with cuneate base and acuminate

apex; coarsely serrate in the upper half or two-thirds, but sometimes entire, ciliate; upper surface pubescent; lower surface densely white pubescent. Rachis of the leaf white pubescent and deeply grooved on its upper side.

Flowers (section *Leptaliæ*) diœcious in short panicles in the axils of the leaf-scars of the preceding year's shoot; calyx present and persisting under the fruit; corolla absent. Fruit spatulate, with terete body and terminal wing.

This species is readily distinguished by the dense white pubescence over the shoot, leaf-rachis, and leaflets, the latter being variable in number and smaller than those of the other pubescent ashes, except *F. xanthoxyloides*, which has still smaller leaflets with a broadly winged rachis and is much less strongly pubescent.

Fraxinus velutina occurs usually in elevated cañons beside streams in Texas, New Mexico, Arizona, southern Nevada, and south-east California.

Young trees are doing well at Kew, where they are of considerable interest from their peculiar foliage, which gives them a neat and elegant appearance. The oldest, planted in 1891, are now about 15 feet high. (A. H.)

ZELKOVA

Zelkova,¹ Spach, in *Ann. Sc. Nat. sér. 2*, xv. 356 (1841); Bentham et Hooker, *Gen. Pl.* iii. 353 (1880); Nicholson, in *Woods and Forests*, 1884, p. 176.

Abelicea, Reichenbach, *Consp. Veg.* 84 (1828); Schneider, *Laubholzkunde*, i. 224 (1904).

Planera, Gmelin, subgenus *Abelicea*, Planchon, in *Ann. Sc. Nat. sér. 3*, x. 261 (1848).

DECIDUOUS trees or shrubs, belonging to the order Ulmaceæ. Branchlets slender, distichous. Leaves alternate, distichous, simple, shortly stalked, penni-nerved, crenately serrate. Stipules in pairs, membranous, lanceolate, caducous.

Flowers monœcious; corolla absent; calyx, four- or five-lobed. Staminate flowers, clustered, two to five together, on the branchlets below the leaves or in the axils of the lowermost leaves; disc absent; stamens, four or five, with short, erect filaments and exserted anthers; ovary rudimentary or absent. Pistillate flowers, solitary in the axils of the uppermost leaves; disc cupular, fleshy; staminodes present or absent; ovary sessile; styles, two, stigmatiferous on the inner side; ovule solitary, pendulous. Fruit, a small drupe, sessile, subtended by the persistent calyx, subglobose, oblique, veined or rugose on the surface, crowned by the remains of the styles, persisting as two minute beaks; with a membranous or slightly fleshy outer covering, and a thin, hard endocarp or stone, containing a compressed, concave, horizontal seed, without albumen. The fruit ripens late in autumn, and persists on the branchlets till the following spring.

In *Zelkova* no true terminal bud is formed, and the tip of the branchlet falls off in early summer, leaving a small circular scar at the apex of the twig. The base of the shoot is ringed with the scars of the inner scales of the previous season's bud, and shows, as a rule, a few of the outer scales persisting dry and membranous. The buds, all axillary, and composed of numerous imbricated scales, are often multiple, two being then developed, side by side, in a single axil. The leaf-scars are narrow, crescentic, and three-dotted; with a linear stipule-scar on each side. In *Ulmus* the buds are single in the axils, and none of the scales persist at the base of the shoot.

Three species of *Zelkova*² are known to exist in the wild state, two of which are large trees well known in cultivation, *Z. acuminata*, Planchon, a native of China and

¹ The name *Zelkova* is sanctioned, and *Abelicea* rejected in *Actes Congrès Internat. Bot. Vienne*, 77 (1906).

² *Hemiptelea Davidii*, Planchon, *Compt. Rend. Acad. Paris*, lxxiv. 1496 (1872), a thorny tree, occurring in northern and central China and Korea, is united with *Zelkova* by Bentham and Hooker, in *Gen. Pl.* iii. p. 353. It differs from that genus in having winged fruit. Cf. Schneider, *Laubholzkunde*, i. 224. This species does not appear to be in cultivation in Europe.

Zelkova

Japan, and *Z. crenata*, Spach, inhabiting the Caucasus and North Persia. The third species, *Z. cretica*, Spach, is a shrub growing in Crete and Cyprus, which has not yet been introduced, and does not come within the scope of our work. The following species, also a shrub, is only known in cultivation:—

Zelkova Verschaffeltii, Nicholson, *Kew Handlist of Trees*, 145 (1896).

Zelkova japonica, Dippel, var. *Verschaffeltii*, Dippel, *Laubholzkunde*, ii. 39, fig. 14 (1892).

A shrub or small tree. Branchlets slender, pubescent, with white hairs. Leaves (Plate 267, Fig. 8), coriaceous, variable in size, from $1\frac{1}{4}$ inch long by $\frac{3}{4}$ inch wide to $2\frac{1}{2}$ inches long by $1\frac{1}{4}$ inch wide, oval, acuminate at the apex, cuneate and unequal at the base, divided by the midrib into unequal halves, the larger half with six to eight nerves, the smaller half with four to seven nerves, each nerve ending in a long triangular tooth, tipped with a short cartilaginous point; margin ciliate; upper surface dark green, with scattered white pubescence; lower surface light green, with downy white pubescence, densest on the midrib and nerves; petiole, $\frac{1}{8}$ inch to $\frac{1}{4}$ inch, pubescent. Buds, often two together in an axil, small, globose, pubescent. Fruit similar to that of *Z. crenata*, but slightly smaller in size.

This species, which resembles an elm in having asymmetrical oblique leaves, was considered by Schneider¹ to be a peculiar variety of *Ulmus glabra*, and is occasionally met with in cultivation, as *Ulmus Verschaffeltii*, and *Ulmus pendula laciniata Pittcursii*.

A tree, 15 feet high, in the nursery of the Paris Municipality, specimens of which have been sent us by M. Vacherot, produced flowers and fruit this year; and the fruit, hitherto unknown, proves to be that of a *Zelkova*. *Z. Verschaffeltii* is not known in the wild state, though Koehne² states that O. Kuntze collected specimens of *Z. crenata* in the Caucasus, which strongly resembled it. It is possibly a hybrid between *Z. crenata* and *Z. cretica*, and was first noticed by Dippel in 1892.

(A. H.)

ZELKOVA CRENATA

Zelkova crenata, Spach, *Ann. Sc. Nat.* xv. 358 (1841); Boissier, *Fl. Orientalis*, iv. 1159 (1879).

Zelkova carpinifolia, Dippel, *Laubholzkunde*, ii. 38 (1892).

Zelkova ulmoides, Schneider, *Laubholzkunde*, i. 806 (1906).

Rhamnus ulmoides, Gleditsch, *Itin.* i. 313 (1787).

Rhamnus carpinifolius, Pallas, *Fl. Rossica*, i. 2, 24 (1788).

Planera Richardi, Michaux, *Fl. Bor. Am.* ii. 248 (1803); Loudon, *Arb. et Frut. Brit.* iii. 1409 (1838).

Planera carpinifolia, Watson, *Dendrol. Brit.* 106, t. 106 (1825); Koch, *Dendrol.* ii. 1. 425 (1872).

Planera crenata, Desfontaines, *Cat. Hort. Paris* (1829).

Abelicea ulmoides, Kuntze, *Rev. Gen.* ii. 621 (1892); Schneider, *Laubholzkunde*, i. 224 (1904).

A tree attaining about 100 feet in height, and 15 feet in girth. Bark thin, smooth, greyish-brown, marked with persistent lenticels; on older trees, scaling off in small

¹ *Laubholzkunde*, i. 226 (1904).

² *Deutsche Dendrologie*, 137 (1893).

irregular plates. Branchlets covered with dense, white pubescence. Leaves (Plate 267, Fig. 6), slightly coriaceous, about 3 inches long and $1\frac{1}{2}$ inch wide, oval-lanceolate, acute at the apex, cordate and unequal at the base, with nine to eleven pairs of nerves, each ending in a crenate serration, the apex of which is minutely pointed; margin ciliate; upper surface dark green, with scattered minute pubescence; lower surface more or less covered with white pubescence, densest on the midrib and nerves; petiole, $\frac{1}{8}$ to $\frac{3}{16}$ inch, pubescent.

Fruit, about $\frac{1}{5}$ inch long, pubescent, with a very slight depression on either side of the prominent ridge on the upper surface.

In winter the twigs are pubescent, and bear elongated conical buds, which are brownish, tinged with white in colour, owing to the scales, which are glabrous on the surface, being fringed with long, white cilia.

This species is readily distinguished by the pubescent oval leaves, acute and not acuminate at the apex, the serrations only showing minute points. *Z. acuminata* has glabrous ovate leaves, with a long acuminate apex, the serrations ending in long, sharp, often recurved points.

DISTRIBUTION

This species occurs in the Russian provinces, lying south of the main range of the Caucasus, and in northern Persia, in the territory bordering on the Caspian Sea, extending as far eastward as Asterabad.

The best account of its distribution in Transcaucasia is given by Scharrer,¹ who states that it grows wild in two distinct areas, one in the government of Kutais and the other in Talysch, while there are a few scattered trees at Araxes, in the Karabagh district. In Kutais it grows in the Mingrelian plain, east of Sennakh, and ascends in the lower mountains of Imeritia to about 1000 feet, occurring at low levels in small groups in the oak forests, and at higher elevations mixed with ash, maple, and beech, and never forming pure woods. In Talysch it is not found on the marshy plains, but is common in river valleys, ascending on the mountains to 5000 feet, and often forming pure and dense woods. Scharrer measured a tree, 100 feet in height, with a stem 8 feet in diameter and free of branches to sixty feet. The climate in which it thrives is humid, with a rainfall of 50 or 60 inches; and it requires a moist, permeable, rich soil to come to perfection. At Tiflis, however, where the rainfall is only $19\frac{1}{2}$ inches, the tree is met with growing on good loamy soil and on rocky mountain slopes, but is slower in growth than in Mingrelia. It has borne without injury a temperature of -24° C.

The elder Michaux,² who travelled in Persia in 1782, and saw the tree growing in the forests of Ghilan, states that it commonly attains a height of 80 feet, with a girth of 9 to 12 feet, with a straight trunk, branching at about thirty feet up, and resembling the hornbeam in its bark, fluted trunk, and mode of branching. Scharrer, however, states that in the forest it produces clean stems, very uniform in thickness

¹ *Gartenflora*, xxxvi. 187 (1887).

² Cf. André Michaux, *Mémoire sur le Zelkova* (Paris, 1831).

and free from branches, except at the summit, excelling in this respect most broad-leaved trees. It grows fast in youth, continuing its growth in height to sixty or eighty years old, afterwards mainly increasing in girth. It is moderate in its demands for light, and gives good coppice shoots.

CULTIVATION

This species was introduced into cultivation in 1760, the oldest known tree in Europe being one¹ in the garden of M. Lemmonier at Petit Montreuil, near Paris, which was cut down in 1820, when it was 72 feet in height and 6 feet 8 inches in girth. It is probable that the elder Michaux, who saw this tree growing in northern Persia in 1782, also introduced seed.¹ Further consignments¹ were sent to France in 1831, by Chevalier Gamba, French Consul at Tiflis. Seeds from this source germinated after lying eighteen months in the ground; but Gay, in a note in the Kew Herbarium, states that this tardy germination was probably accidental, as seeds from Karabagh, which he sowed in the last days of March, produced seedlings, which were peeping out of the ground at the end of May. (A. H.)

This tree is now rarely seen in nurseries, though it is easily propagated by suckers, and seed could be procured without difficulty from its native country. In consequence it is hardly known to modern gardeners, though both from its ornamental habit and valuable timber it would be much better worth planting than many trees of more recent introduction.

The principal point to be attended to is to protect it from frost, and prune it carefully until the main stem has attained the desired height; and to plant it in a deep, rich alluvial soil, and warm, sheltered situation. So far as I have been able to learn, no tree has produced fertile seed in this country.

REMARKABLE TREES

A remarkable tree at Wardour Castle, Tisbury, Wiltshire, is reputed by tradition to have been sent, when quite young, from North America by the second Lord Baltimore, about 1632, and has been supposed² to be *Planera aquatica*, Gmelin,³ a native of swamps in the south-eastern United States. There must be some error in the tradition, as the tree is undoubtedly *Zelkova crenata*. It is known as the Iron tree, and the late Lord Arundell of Wardour assured me that this name, used in America for the Hornbeam and Hop Hornbeam, was a proof of its American origin. He also believed that the tree had been cut down during the siege of Wardour Castle in Cromwell's time, and had afterwards produced from the stool the seventeen

¹ André Michaux, *Mémoire sur le Zelkova* (Paris, 1831).

² See a lengthened correspondence concerning this tree in *Garden*, xxiv. 370 (1883), xxvi. 38 (1884), and xxxii. 92 (1887).

³ This species was introduced into England in 1816, according to Loudon, *Arb. et Frut. Brit.* iii. 1413 (1838); but it appears to be unsuitable for our climate, and no specimens are known to us to exist, except two plants in the Elm collection at Kew, about 8 feet high, which were introduced in 1897, and are thriving so far.

tall stems which it now shows (Plate 248). These measure from 5 to 8 feet in girth, the whole forming a group about 12 feet wide, and some of them reaching nearly 100 feet in height. There are many small suckers, as usual, and some of these have been transplanted to the front of the present mansion, where they were, when I saw them in 1903, about 25 feet high. Lord Arundell was good enough to give me two rooted suckers from the old tree, one of which is now planted at Tortworth Court, and the other at Colesborne.

At Holme Lacy, Hertfordshire, the seat of the Earl of Chesterfield, there is a very fine tree standing on a walled depression near the house. Its bole was until recently surrounded by laurels, which have now been cleared away, so that I was able in October 1908 to measure it carefully. I found it to be about 95 feet high by 19 feet in girth at the smallest point, about 3 feet from the ground. A photograph of this tree is at Kew, and it was reported in 1884 to be 70 feet high.

There are several trees in Kew Gardens, the largest growing in front of the Herbarium, and measuring 60 feet in height and 9 feet 3 inches in girth. A larger specimen was cut down a good many years ago, and a section of the trunk is exhibited in the Timbers Museum.

There are several fine trees at Syon,¹ the largest near the lake being, in 1905, 98 feet in height and 12 feet 7 inches in girth, while another is 89 feet by 13 feet. Both these trees are remarkable for their buttressed stems. Near the bridge there is a slender specimen, crowded by other trees, which is 92 feet high, with a stem 7 feet 2 inches in girth, and free of branches to about 50 feet.

At Albury there is a remarkable specimen, with a bole of only 4 feet in height, but 16 feet in girth, dividing into numerous stems.

In the Wilderness, at Croome Court, Lady Coventry showed me a tree of this species, which was supposed to be a species of hornbeam. It measured, in 1906, 65 feet by 14½ feet, and grew in an angle between two hedges, into which its suckers had spread profusely, and being clipped with the hedge, may eventually form part of it when the original tree dies. Another tree grows in the Temple Shrubberies at the same place, about 70 feet by 7 feet, with a clean trunk about 15 feet long, and was of a better shape, but is now partially decayed.

At Pitt House, near Chudleigh, Devonshire, the seat of Captain Morrison Bell, there are several Zelkovas which seem to thrive well in this climate. The largest is a very well-shaped and healthy tree measuring 80 to 85 feet by 13 feet. Its leaves were beginning to unfold on 15th April 1908. Some trees have thrown up suckers in the hedge by the high road here, but the gardener has not observed any flowers.

At Oxford, in the University Park, on the banks of the Cherwell, there are two, the larger of which, not a well-shaped tree, is about 80 feet by 12½ feet.

At Kyre Park there are two trees on the banks of a pond near the house, both of which have begun to decay, and large pieces of the smooth bark were dropping off them when I visited Kyre in 1904. The largest measured about 75 feet by 16 feet

¹ According to Loudon the largest tree at Syon was in 1834, 54 feet high and 2 feet 3 inches in diameter.

7 inches. Mrs. Childe tells me that in the hot summer of 1905 flowers were produced by this tree.

At Belshill, near Belford, Northumberland, the property of Sir W. Church, Bart., there is a fine tree in a sheltered situation which measures 70 feet by 9 feet 10 inches, and looks healthy, though it is believed to be over 100 years old.

In Scotland we have not seen or heard of any trees, though there is no doubt it would grow well in the south and west, where the climate is much better than at Belshill.

There are two trees at Glasnevin, one 50 feet and the other, a remarkably fine one, 61 feet in girth (Plate 249). Both are 9 feet in girth, and divide at 10 feet up into numerous branches.

A tree¹ at Verrières, near Paris, is 70 feet in height and 8 feet in girth.

There is a large tree in the grounds of the Petit Trianon at Versailles, about 90 feet by 10 to 12 feet, which appears to be grafted on the roots of an elm, and Mr. Hickel informed me that most of the older trees in France were so grown.

This species² is represented in the United States at Woodlands, Philadelphia, where there are growing in a cemetery a few low bushy trees, with short trunks, 4 feet in diameter, and numerous erect branches.

TIMBER

According to Scharrer the wood is homogeneous, prettily veined, very tough and flexible, does not crack and warp, takes a fine polish, and is very durable even when placed in wet situations. It is very suitable for cabinet-work and carriage-building. The native name of the tree, *dzelkwa*, signifies "stone-wood," so-called on account of the hardness of the timber, into which nails are driven with difficulty.

The younger Michaux, who examined a tree cut down at Paris in 1820, states that the sapwood is white, and the heartwood reddish in colour, the latter being heavier and stronger than that of elm, while even the sapwood equalled the ash in strength and elasticity.

A plank of this wood cut from a tree which grew at Boynton, in Yorkshire, was given me by Sir Charles Strickland, and resembles the wood of the Japanese species in texture and colour. Mrs. Baldwyn Childe has also sent me a specimen of it from a branch of her tree. Though unknown in the trade, and, as far as I can learn, never cut for export, I believe that this wood would prove valuable for making furniture if it could be obtained at a reasonable price. (H. J. E.)

¹ *Hortus Vilmorinianus*, 52 (1906).

² *Garden and Forest*, x. 488 (1897).

ZELKOVA ACUMINATA

- Zelkova acuminata*, Planchon, in *Compt. Rend. Acad. Paris*, lxxiv. 1496 (1872), and DC. *Prod.* xvii. 166 (1873).
Zelkova Keaki, Maximowicz, *Mél. Biol.* ix. 21 (1872); Sargent, *Garden and Forest*, vi. 323, fig. 49 (1893); Shirasawa, *Icon. Ess. Forest. Japon*, text 65, t. 36, figs. 1-17 (1900); Mayr, *Fremdländ. Wald- u. Parkbäume*, 525, figs. 247-249 (1906).
Zelkova serrata, Makino, in *Tokyo Bot. Mag.* xvii. 13 (1903).
Zelkova hirta, Schneider, *Laubholzkunde*, i. 806 (1906).
Corchorus hirtus, Thunberg, *Fl. Jap.* 228 (1784).
Ulmus Keaki, Siebold, *Verh. Bot. Gen.* xii. 28 (1830).
Planera acuminata, Lindley, *Gard. Chron.* 1862, p. 428.
Planera japonica, Miquel, *Ann. Mus. Bot. Lugd.* iii. 66 (1867).
Planera Keaki, Koch, *Dendrol.* ii. 1. 427 (1872).
Abelicea Keaki, Schneider, *Dendrol. Winterstudien*, 238 (1903).
Abelicea hirta, Schneider, *Laubholzkunde*, i. 226 (1904).

A tree attaining in Japan 120 feet in height and 15 feet or more in girth. Bark smooth, greyish, resembling that of a beech, but on old trees dividing on the surface into irregular rounded scaly plates. Branchlets slender, at first with a scattered slight pubescence, but becoming glabrous in summer. Leaves (Plate 267, Fig. 7), membranous, thinner than those of the Caucasian species, about 3 inches long and $1\frac{1}{4}$ inch broad, ovate, with a long acuminate apex, slightly cordate and unequal at the base; nerves, nine to twelve pairs, each ending in the long, sharp, often recurved tip of a serration; margin ciliate at first, the cilia falling off in summer; upper surface dark green, with scattered, short, stiff hairs; lower surface light green, at first slightly pubescent, becoming glabrous in summer; petiole $\frac{3}{8}$ to $\frac{1}{4}$ inch, glabrescent.

Fruit about $\frac{1}{8}$ inch broad, sub-globose, oblique, with a concave depression on either side of a transverse ridge on the upper surface, which bears the remains of the styles; prominently veined, glabrescent.

In winter the twigs are glabrous, and the buds are minute, ovoid, uniformly brown in colour, with glabrous slightly ciliate scales.

DISTRIBUTION

Zelkova acuminata occurs in China and Korea, as well as in Japan, but appears to be only common in China in the Tsin-Ling mountain in Shensi, where it was collected by Père Giraldi.¹ It has also been found² in the province of Chekiang, on the hills near the Taihoo Lake, and on the mountains inland from Ningpo. Carles² collected it near Seoul in Korea.

It is much more widely distributed in Japan, occurring throughout Kiushiu, Shikoku, and Honshu, forming forests in mixture with maple, beech, *Quercus grosseserrata*, and other broad-leaved trees. According to Shirasawa, it is usually of branching habit in the forest, the tallest and stoutest trees being those cultivated

¹ Diels, in Engler, *Jahrb.* xxxvi. No. 5, p. 33 (1905).

² Hemsley, *Journ. Linn. Soc. (Bot.)*, xxvi. 449 (1894).

near houses and temples, which often have clean stems due to pruning. Mayr, however, records a forest tree, 123 feet in height, with a stem 33 inches in diameter, and clean of branches to 57 feet. Dupont,¹ who gives many interesting particulars concerning this species, states that it ascends in Kiushiu to 3000 feet on northern slopes, and in Honshu to 4000 feet on southern slopes; and that it requires for its best development a deep, permeable, and rich soil, such as is found on alluvial tracts. It thrives well also on volcanic soils and sandy loams, but does not succeed on poor sands or on stiff clays. Dupont states that on suitable soils and situations it grows remarkably straight, whether isolated or crowded in the forest, attaining on soil of middling quality at 1600 feet elevation in the latitude of Fuji-yama, 5 feet in girth at 60 years old, 9 feet at 120 years, and $12\frac{1}{2}$ feet at 180 years. The growth of isolated trees on alluvial soil is still more rapid, the annual rings averaging $\frac{1}{8}$ inch in width. He advocates the planting of this tree on account of its rapid growth and the value of its timber, which he considers to be superior to that of oak. (A. H.)

It seems strange that this tree, whose wood is more highly valued by the Japanese than any other hard wood, should be planted on so small a scale in Japan. Probably it requires too many years to come to maturity to induce private persons to plant it when bamboo, Cryptomeria, and pine offer so quick and certain a return. But though I saw no plantations of Keaki,² I believe the Government are making efforts to preserve and increase the area under this species. It is said to be found wild in the south up to about 5000 feet, and in the north up to about 2000 feet. It also grows wild in Hokkaido, but not to so great a size as in the north-eastern districts of the main island which are famous for their large trees. I heard of, but was not able to see, one said to be the largest in Japan at Sendai. Rein³ speaks of one which was felled at Meguro, near Tokio, in 1874, and measured 11.7 metres in girth at one metre high.

The largest I measured myself was growing by the side of the Nakasendo road, at a place called Hideshiwa, near the village of Sooga in Shinano, in a grove of trees just below the road, and may have been wild or planted. It was about 115 feet high and 20 feet in girth, dividing at about 20 feet, into two tall upright limbs, each 10 feet or more in girth, and seemed to contain about 800 to 1000 cubic feet of timber. Close to it was a very large *Æsculus*, and on the other side of the road another Keaki, 113 feet high, by 13 feet 6 inches in girth, clean and straight to about 70 feet high.

Such trees as these are found only where they have been crowded when young, the tendency of the species being to assume a branching and spreading habit, so that most of these which are seen planted singly are thick and spreading rather than tall.

In the forest the Keaki grows scattered among other trees, and is said by the author of the handbook on Japanese forestry to love calcareous soils. I never saw any such soil in Japan, but it seemed to grow equally well on all kinds of soil provided it is deep and moist. As to the age to which the tree attains I cannot speak positively, but it looks like a very long-lived tree. Its bark is smooth and greyish in colour, somewhat like that of the beech. It seeds freely and reproduces itself

¹ *Essences Forest. du Japon*, 45 (1879).

² The Japanese name of this species is *Keyaki*, occasionally spelled *Keaki*.

³ *Industries of Japan*, 225 (1889).

easily, the seedlings being hardy and fast growing and bearing shade well. In appearance the Zelkova is not an ungraceful tree, resembling a beech perhaps more than an elm, but its small leaves make it a poor shade tree, and its habit of growth varies very much according to the situation in which it grows.

CULTIVATION

This species was introduced into cultivation in England by J. Gould Veitch,¹ who sent seeds from Japan in 1862. It was apparently introduced on the Continent a few years earlier by Siebold; and Koch, writing in 1872, mentions that it had been cultivated previously for several years in the Botanic Garden at Berlin, where it had sustained severe frost without injury.

I raised a quantity of seedlings in 1901 from Japanese seed, which grew rapidly at first, and seemed quite hardy; but those which I have planted out grow slowly, and, where not protected from spring frost, have been killed back every winter, so that they produce bushy shrubs. I should, therefore, suppose that it requires more summer heat and moisture than most parts of England afford, and that it should be planted only in rich, deep soil, where it can be shaded and drawn up by other trees. Careful pruning is also evidently necessary to check its tendency to produce lateral branches when young, and I do not anticipate that it will ever attain large dimensions in Great Britain or be worth planting for its timber.

So far as we have ascertained there are no large trees existing in England, the best specimens we have seen at Kew Gardens, at Tortworth, and in Lord Kesteven's woods at Casewick, Lincolnshire, not exceeding 20 to 30 feet in height.

Mr. C. Palmer tells me that in November 1864, he planted a specimen received from Veitch, then 3 feet high, in an exposed situation, at about 500 feet above the sea, near Stukeley Grange, Leighton Buzzard. This tree in 1874 was 18½ feet high by 6 inches only in girth. In 1892 it had increased to 2 feet in girth.

A good-sized and healthy-looking tree, of whose age no record can be found, grows near the pond below the entrance from Woburn village to Woburn Park on the right-hand side of the drive.

At Kilmacurragh, Co. Wicklow, a healthy tree measured, in 1904, 41 feet in height and 3 feet 1 inch in girth.

The oldest and largest tree of this species that we know of in Europe is growing in the Botanic Gardens at Karlsruhe. I am indebted to Herr Max Leichtlin, of Baden-Baden, for a photograph of this tree (Plate 250), and Herr Gräbener has also sent us one. He informs us that it is one of three seedlings which was raised at St. Petersburg (or brought from Leyden). It was planted sometime between 1859 and 1861, and has never suffered from frost, having sustained the severe winter of 1879-1880 without injury.² In 1904 it measured at 1½ metre from the ground 3.10 metres in girth.

¹ *Hortus Veitchii*, 386 (1906). Mr. H. J. Veitch informs me that the plants raised at Coombe Wood only attained 3 to 4 feet in height, and gradually died out, the whole being finally lost during a severe winter.

² Mayr says that at Grafrath it has endured -25° Cent. without injury.

This species¹ has been planted pure in small experimental plots at five different forestry stations in Germany; but the results have not been encouraging. Both Schwappach and Mayr consider that it probably would succeed if planted in mixture with other hardwood trees.

In the Botanic Garden at Copenhagen, Henry saw, in 1908, a fine tree, about 40 feet high, but dividing into three stems at 2 feet from the ground. This tree was planted about 1870, and exceeds considerably in size a *Z. crenata* planted beside it the same year. At Christiania, *Z. acuminata* remains a bush about a foot high, being repeatedly cut by frost.

The largest specimens in the United States are two trees, growing in Dr. Hall's gardens at Warren, Rhode Island, which were raised from seed sent home in 1862. According to Sargent,² who says that this species is probably the only Japanese tree worth introducing into North America, on a large scale for timber, these have received no special care, the soil is not particularly good, and their growth has been checked by overcrowding. They were about 50 feet high in 1893, with trunks about a foot in diameter, and had produced flowers and fruit. There appear³ to be several other trees of this species in the same garden, and hundreds of self-sown seedlings were observed near them in 1893. The only drawback⁴ to the cultivation of this species in America is that it is subject to the attack of the elm-leaf beetle.

TIMBER

The wood⁵ resembles in structure that of the elm, the vessels being disposed in similar broken lines. The sapwood, according to Mayr, about 1½ inch in thickness, and white in colour, is separated from the brown heartwood by a narrow pink zone. According to Dupont,⁶ the wood, while like that of the elm in appearance, is more like the ash in working, as it bends readily, and is of great strength, surpassing even the oak in this quality. It resists exposure to moisture, and is very durable for building purposes. It is much used in Japan for making furniture, an especial kind, cut from burrs, and called *jo-rin-moku*, being especially esteemed. The most beautiful trays and cabinets⁷ which come from Japan are made of dark, irregularly grained, and wavy-lined wood of the Zelkova. Many of these trays are ornamented with the bark of *Pterocarya*. Dupont says that the wood contains an oil, with a disagreeable odour, which prevents it from being made into articles used for containing liquids.

The wood is the most valuable in Japan for building, for furniture, and for all purposes where a strong, tough, durable wood, not liable to warp, crack, or decay, is required; and it is also valuable for carving and lacquering. It is the highest priced wood in Japan, worth in ordinary sizes up to 4s. per cubic foot, and for finely grained or very wide planks much more. I was told that a single large plank of

¹ Schwappach, *Anbauversuche mit Fremdländischen Holzarten*, 79 (1901).

² *Garden and Forest*, vi. 324 (1893).

³ *Ibid.* 468.

⁴ *Ibid.* 369.

⁵ Figured in Mayr, *op. cit.* t. xx. fig. 44.

⁶ *Ess. Forest. du Japon*, 45 (1879).

⁷ Sargent, *Garden and Forest*, x. 40 (1879).

finely grained wood of this tree shown at the Osaka Exhibition in 1903 was priced at 800 yen (over £80); and I saw beautifully figured pieces myself of a peculiar reddish tint which were held for fancy prices, such pieces being much valued for the construction of the dais which is a marked feature in Japanese rooms, and on which is the seat of honour. Most of the pillars, beams, gateways, gates, and carved roofs, which are so striking a feature in Japanese temples, old and new, are made of Keaki wood, which seems indestructible by time or damp when covered in, and I was told that some of these which looked sound, though much weather worn, were 1000 years old. It seemed to me, however, that 1000 years is simply a convenient expression in Japan for anything very old, though no doubt historical evidence could be found if wanted as to the durability of this fine wood. The fancy grained varieties are known as Jorin, Uzura (partridge), Tama (gem), or Botan (peony), and these are used for cabinetmaking and fancy work. The colour, according to Rein, is deepened by long submersion in water. Rein gives the specific gravity of the wood at 0.682. I bought some of the wood in Japan, and have used it in making a large wardrobe; it takes polish well, makes good joints, and seems equal to mahogany for furniture making, but so far as I can learn has not as yet been imported, and is unknown in the trade.

(H. J. E.)

CELTIS

Celtis, Linnæus, *Gen. Pl.* 337 (1837); Bentham et Hooker, *Gen. Pl.* iii. 354 (1880).
Mertensia, Humboldt, Bonpland et Kunth, *Nov. Gen. et Spec.* ii. 30 (1817).
Momisia, F. G. Dietrich, *Lexic. Garten.* v. 128 (1819).
Solenostigma, Endlicher, *Prod. Fl. Norf.* 41 (1833).

THE genus *Celtis*, belonging to the order Ulmaceæ, comprises about sixty species, spread over the temperate and tropical regions of the northern hemisphere; and was divided into four sub-genera by Planchon.¹ In the following account, the characters of one of the sub-genera, *Euceltis*, are given, as all the species in cultivation belong to it.

Deciduous trees, without spines. Leaves stipulate, alternate, distichous, simple, stalked, serrate or entire, usually oblique and three-nerved (rarely four- or five-nerved) at the base, the midrib and basal nerves giving off pinnately secondary nerves.

Flowers minute, pedicellate on the branchlets of the year, polygamo-monoecious. Staminate flowers in few-flowered fascicles from the axils of caducous bud-scales. Perfect flowers solitary or in two- to three-flowered fascicles in the axils of the lower leaves. Calyx four- or five-lobed, imbricate in æstivation, deciduous. Corolla absent. Stamens, four or five, inserted under the margin of a pubescent disc; filaments, subulate, erect and exerted in the staminate flowers, shorter and included, occasionally absent, in the perfect flowers; anthers two-celled, extrorse, opening longitudinally. Ovary sessile, one-celled, crowned with a short style, divided into two divergent, elongated, reflexed lobes, papillo-stigmatic on the inner surface; ovule solitary, suspended. Fruit, a fleshy drupe, with a firm epicarp, a succulent thin mesocarp, and a thick-walled bony stone, containing one seed. Cotyledons emarginate at the apex, raised above ground in germination.

Seven species of *Celtis* are in cultivation in this country, which may be distinguished as follows:—

I. *Leaves ovate.*

* *Leaves quite glabrous.*

1. *Celtis Davidiana*, Carrière. China. See p. 929.

Leaves shining on both surfaces, toothed in the upper third, shortly acuminate, minutely punctate when viewed with a lens.

¹ De Candolle, *Prod.* xvii. 169 (1873).

2. *Celtis glabrata*, Steven. Asia Minor, Caucasus. See p. 929.
Leaves bluish green, serrate except near the base, acute or very shortly acuminate, conspicuously punctate when viewed with a lens.

** *Leaves pubescent.*

3. *Celtis occidentalis*, Linnæus. North America. See p. 930.
Leaves caudate-acuminate, serrate in the upper half or two-thirds, smooth to the touch above, pubescent on the nerves beneath.
4. *Celtis crassifolia*, Lamarck. North America. See p. 932.
Leaves shortly acuminate, serrate in the upper half or two-thirds, scabrous to the touch above, pubescent on the nerves beneath.

II. *Leaves lanceolate.*

* *Leaves usually entire.*

5. *Celtis mississippiensis*, Bosc. North America. See p. 933.
Leaves, entire in margin, rarely dentate at the apex, glabrous except for axil tufts at the base beneath.

** *Leaves serrate.*

6. *Celtis australis*, Linnæus. Southern Europe, North Africa, Caucasus. See below.
Leaves caudate-acuminate, covered beneath throughout with a soft pubescence.
7. *Celtis caucasica*, Willdenow. Caucasus, Persia, Afghanistan, Baluchistan, N. India. See p. 928.
Leaves shortly acuminate, pubescent beneath only on the midrib and nerves.

(A. H.)

CELTIS AUSTRALIS, NETTLE TREE

Celtis australis, Linnæus, *Sp. Pl.* 1043 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1414 (1838); Planchon in DC. *Prodr.* xvii. 169 (1873); Boissier, *Fl. Orientalis*, iv. 1156 (1879); Willkomm, *Forstliche Flora*, 545 (1887); Mathieu, *Flore Forestière*, 293 (1897).

A tree, usually attaining 50 to 70 feet in height, and 10 feet in girth, but in rare cases becoming as much as 20 feet in girth. Bark thin, greyish, smooth, somewhat resembling that of the beech, but on old trunks sometimes covered with warty excrescences. Young branchlets pubescent. Leaves (Plate 267, Fig. 5), about 4 inches long by $1\frac{1}{4}$ inch broad, oval-lanceolate, unequal and cuneate at the base, contracted above into a very long caudate-acuminate apex, serrate except near the base; upper surface dark green, scabrous, shortly-pubescent; lower surface greyish, covered with a soft tomentum; petiole greyish-tomentose, about $\frac{1}{2}$ inch long. Fruit globose, up to $\frac{1}{2}$ inch in diameter, at first whitish, then red, and finally dark-brown; with a scanty sweetish flesh. Fruit pedicel, very slender, an inch or more in length. The seedling¹ is similar to that of *C. occidentalis*; but the cotyledons are wider, rhomboidal in shape, and with a shallower emargination; and the primary leaves are longer, narrower, and more acuminate. The seedling attains about 8 inches in height in the first year.

¹ Lubbock, *Seedlings*, ii. 495 (1892).

In winter, the twigs are slender, tomentose. Leaf-scars crescentic, 3-dotted, on prominent pulvini. Stipule-scars linear, one on each side of each leaf-scar. Terminal bud not formed and scar present at the apex of the twig, as in *C. occidentalis*. Lateral buds, appressed to the twig, compressed, ovoid, acute, with 2 to 3 pairs of loose, tomentose, ciliate, imbricated scales.

No varieties of *C. australis* have been described; but in the eastern part of its area there are forms connecting it with *C. caucasica*, which is a very closely allied species.

Celtis australis is widely distributed throughout the Mediterranean region, and extends into Asia Minor and probably farther eastward, in the Caucasus and north Persia. In France, it is common in Provence and Languedoc, where it is often cultivated as coppice, and is met with as a rare tree as far north as Poitiers and Lyons. It is usually an inhabitant of the plains and low hills, but occasionally ascends to 3000 feet in the mountains. In the north of France, it is scarcely hardy, at least when young. It occurs in Switzerland in the canton of Tessin. Farther east, its northern limit is the southern parts of Tyrol, Styria, and Hungary, whence it extends southward through the Balkan States to Greece and Crete. In Banat, Istria, and Dalmatia it often forms small woods, and ascends to 1600 feet. It is in all these regions extensively planted, and has become naturalised in many districts. It also occurs in Spain and Portugal, Sardinia, Italy, Sicily, Morocco, Algeria, and Tunis; and is said to grow in the Madeira Islands.

Celtis australis attains a great age, and trees of extraordinary size are recorded, there being one¹ in the public square at Aix in Provence, estimated to be 500 years old, which is 19 feet in girth, and higher than any of the adjoining houses. There are fine specimens also in the Botanic Gardens at Montpellier, which are 10 to 12 feet in girth. Willkomm saw very large trees in the Balearic Islands, and says that enormous trees are to be seen in Istria and Dalmatia, one at Pisino being supposed to be 1000 years old.

Celtis australis produces suckers from the roots, and when cut gives good coppice shoots. In the south of France, coppice woods of this species are very valuable, as the shoots² attain about 4 inches in diameter in ten or twelve years, and are worth one to two francs each. The wood resembles much that of the ash, of which it has all the good qualities, and is used in carriage-building, and for making numerous kinds of small articles, as tool-handles, hay-forks, trenails, tent-pegs, etc. Whip handles in France are almost universally made of this wood, and are called "perpignans," because the chief place of manufacture is at Perpignan. The foliage is given to cattle as fodder, the seed contains a sweet oil, and the bark and root yield a yellow colouring matter.

Celtis australis was introduced³ in 1796, according to Loudon, who mentions a

¹ Mouillefert, *Traité des Arbres*, ii. 1207 (1898).

² Jolyet, *Les Forêts*, 226 (1901).

³ In the *London Catalogue of Trees*, 18 (1730), three species of *Celtis* are mentioned as being in cultivation in England:—

"I. Virginian Nettle Tree. Red fruit. In several gardens near London there are large trees.

II. Nettle Tree, with black fruit. European sort, is most rare in England.

III. *Celtis* with large yellow fruit. Has been grown in Devonshire many years, where there are some large trees, which produce ripe fruit, from which many plants have been raised; but we know not where it came from originally."

tree at Mitcham, which was 6 feet 8 inches in girth, and had a spread of 60 feet; and a tree at Kew, 40 feet in height, which no longer exists, there not being at present a single specimen there of this species. It appears to be very rare in cultivation at the present time, the only trees which we have seen being one at Liphook, and another at Hursley Park. The latter is a small unhealthy-looking tree about 20 feet high, though of considerable age. There is also a small tree at Tortworth.

According to Bureau,¹ this species supports at Paris the severest winters without injury; but according to Pardé,² it bears with difficulty severe frosts in the north of France. The seedlings which Elwes raised at Colesborne were killed by 20° of frost, and though the tree may succeed in the warmest and driest parts of the south-east of England, it seems hardly worth planting elsewhere. (A. H.)

CELTIS CAUCASICA

Celtis caucasica, Willdenow, *Sp. Pl.* iv. 994 (1805); Loudon, *Arb. et Frut. Brit.* iii. 1415 (1838); Boissier, *Flora Orientalis*, iv. 1156 (1879).

Celtis australis, Brandis, *Forest Flora of N.W. India*, 428 (1874), and *Indian Trees*, 595 (1906) (not Linnæus); Hooker, *Flora Brit. India*, v. 482 (1888); Gamble, *Indian Timbers*, 629 (1902).

A tree of moderate size, very similar to *C. australis*, of which it is possibly only a geographical form. It differs in the following characters:—Leaves ovate-lanceolate, broader in proportion to their length, and more rhomboidal, with a shorter and non-caudate acuminate apex; upper surface glabrescent, scarcely scabrous; lower surface with slight pubescence, confined to the nerves and midrib. Drupes yellow.³

This species, which is connected with the European species by var. *cuspidata*,⁴ with long-acuminate leaves, is widely spread through the Caucasus, Persia, Afghanistan, Baluchistan, and northern India. In the Caucasus, it is associated with *C. australis*; but farther east the latter species is scarcely met with. In Afghanistan, according to Aitchison,⁵ it is usually a planted tree near shrines and in graveyards; but it is quite wild along the Darban and Shendtoi rivers; and in Baluchistan, its leaves, according to Lace,⁶ are often used, as they are in India, for feeding sheep and goats, the trees being pollarded for this purpose. It occurs in India in the north-west Himalaya, as far east as Nepal ascending to 8000 feet, where it is a common tree, wild in the forests, and around villages. According to Webber,⁷ in Gorakhpur, it reverses the season of casting its leaves, which wither and fall off in the hot weather, and it flowers in the early months of the cold season. The wood is tough and strong, and is used for oars, tool-handles, sticks, and other purposes requiring toughness and elasticity.

This species, though mentioned by Loudon, was not in cultivation in England in his day; and Schneider⁸ doubts if it has yet been introduced on the Continent.

¹ *Nowv. Arch. Mus. Hist. Nat.* vi. 181 (1894).

² Brandis mentions a variety with purplish-black fruit.

³ *Journ. Linn. Soc. (Bot.)* xviii. 93 (1880).

⁴ *Forests of Upper India*, 232 (1902).

⁵ *Arb. Nat. Des Barres*, 242 (1906).

⁶ Planchon, in DC. *Prod.* xvii. 170 (1873).

⁷ *Ibid.* xxviii. 305 (1891).

⁸ *Laubholzkunde*, 231 (1904).

There is, however, a tree of this species in the Kew Collection, which is marked "Aitchison" on the label, and was probably raised from seeds sent by Aitchison from Afghanistan, about the year 1881. (A. H.)

CELTIS GLABRATA

Celtis glabrata, Steven, ex Planchon, in *Ann. Sc. Nat. sér. 3, x.* 285 (1848).

Celtis Tournefortii, Lamarck, var. *glabrata*, Boissier, *Fl. Orient.* iv. 1157 (1879).

A shrub or small tree. Young branchlets with a minute scattered pubescence. Leaves (Plate 267, Fig. 10), about 2 inches long, 1¼ inch broad, quite glabrous, ovate, unequal and rounded or broadly cuneate at the base, acute or very shortly acuminate at the apex, coarsely serrate except near the base; upper surface bluish green, roughened with minute papillæ; lower surface lighter green in colour; punctate with numerous translucent minute dots, when viewed with a lens; petiole glabrous, ⅓ inch. Fruit pedicels about an inch. Drupes globose, reddish brown.

This species occurs in Asia Minor, in Lycia and Cilicia, and in the Caucasus. Schneider doubts if it has been introduced into cultivation; but there is at Kew a small tree, undoubtedly of this species. *C. Tournefortii*, Lamarck, a closely allied species, occurring in Sicily, Greece, and Asia Minor, is mentioned by Loudon, as having been introduced into England in 1739, and cultivated in 1838 in the London Horticultural Society's Garden; but I have seen no specimens in this country. (A. H.)

CELTIS DAVIDIANA

Celtis Davidiana, Carrière, *Rev. Hort.* 1868, p. 300.

Celtis Bungeana, Blume (in part); Hemsley, *Journ. Linn. Soc. (Bot.)* xxvi. 449 (1894).

Celtis sinensis, Persoon (in part); Maximowicz, *Mél. Biol.* ix. 27 (1872); Bretschneider, *Botanicon Sinicum*, i. 117 (1882).

A small tree. Young branchlets slightly pubescent. Leaves (Plate 267, Fig. 11), about 2½ inches long, 1¼ inch broad, ovate or ovate-lanceolate, base rounded, contracted above into a short acuminate apex, rarely entire, usually slightly toothed in the upper third; glabrous and shining on both surfaces, dark green above, light green beneath, punctate when viewed with a lens; petiole ⅓ inch, pubescent. Fruit-pedicels, slender, ¾ inch long. Drupes small, ovoid, black in colour.

This species occurs in north China, in the hills around Peking, and in the mountains of the province of Shingking; and was found by me growing as a small tree, about 20 feet in height, in the mountains of Hupeh. It has been confused with two other Chinese species, *C. Bungeana*¹ and *C. sinensis*,² which do not appear to be in cultivation in Europe. It is readily distinguishable from all the other cultivated species by the very shining glabrous leaves; and is a very distinct and handsome tree.

¹ Blume, *Mus. Bot. Ludg. Bat.* ii. 71 (1852).

² Persoon, *Syn. Pl.* i. 292 (1805).

It was introduced into Kew Gardens, where there is a small tree about 15 feet high, by seeds sent from Peking by Bretschneider in 1882. It had, however, been previously introduced into France by Père David, who sent seeds to Carrière in 1868, from which a tree was raised in the Jardin des Plantes. This tree, according to Franchet¹ had become with age identical in character with *C. Bungeana*; but this is incorrect. It fruited for the first time² at Paris in 1894. Schneider³ mentions trees of this species in the Botanic Gardens at Strassburg and Darmstadt.

(A. H.)

CELTIS OCCIDENTALIS, HACKBERRY

Celtis occidentalis, Linnæus, *Sf. Pl.* 1044 (1753); Michaux, *Hist. Arb. Am.* iii. 225, t. 8 (1813); Loudon, *Arb. et Frut. Brit.* iii. 1417 (1838); Sargent, *Silva N. Amer.* vii. 67 (in part), t. 317 (1895), and *Trees N. Amer.* 299 (1905) (in part).

A tree, attaining in America, 100 feet in height and 9 feet in girth. Bark grey, broken on the surface into appressed scales, and often roughened on old trees with thick discontinuous corky ridges. Young branchlets glabrous or pubescent. Leaves (Plate 267, Fig. 4), uniform in size, about $2\frac{1}{2}$ inches long and $1\frac{1}{4}$ inch wide, ovate, unequal and rounded or shortly cuneate at the base, with a long caudate-acuminate usually non-serrated apex; serrate in the upper half or two-thirds; upper surface smooth to the touch; lower surface pubescent on the nerves; petiole $\frac{1}{4}$ inch or more, glabrous or pubescent. Fruiting pedicels short, about $\frac{3}{8}$ inch. Drupe, purplish-black or orange when ripe, globose or ovoid, about $\frac{2}{5}$ inch in diameter.

In winter the twigs show the following characters:—Branchlets slender, zigzag, reddish-brown, shining, glabrous. Leaf-scars oblique on prominent pulvini, three-dotted. Stipule scars minute, linear, one on each side of each leaf-scar. Terminal bud not formed, the end of the branchlet falling off in summer, and leaving a minute orbicular scar at the apex of the twig. Buds⁴ all axillary, uniform in size, about $\frac{3}{16}$ inch long, alternate, distichous, appressed to the twig, ovoid, acute, compressed, covered by three pairs of pubescent, ciliate, imbricated scales.

Seedling.⁵—Primary root long, tapering, flexuose, with numerous lateral fibres. Caulicle erect, pubescent, about $1\frac{1}{2}$ inch long. Cotyledons oblong, cuneate and three-nerved at the base, emarginate at the apex, green above, pale beneath, about $\frac{3}{4}$ inch long. Stem hispid. First pair of leaves opposite, ovate, acuminate, serrate, three-nerved, covered in the young stage with clear dot-like glands. Succeeding leaves similar, but alternate.

Scarcely any varieties are known, unless *C. crassifolia* be considered a geographical form of this species. *C. pumila*, Pursh,⁶ a low shrub, of xerophytic

¹ *Planta Davidiana*, i. 269 (1884).² *Rev. Hort.* 1894, p. 97.³ *Laubholzkunde*, 228 (1904).⁴ Sometimes in this species, the axil of the leaf produces three buds side by side. The middle bud sends out a shoot in the following year, whilst the lateral ones are left as a reserve. If the shoot happens to die in the year after, one of the two accessory buds develops. Cf. Kerner, *Nat. Hist. Plants*, Eng. transl. ii. 32 (1898).⁵ Cf. Lubbock, *Seedlings*, ii. 493, fig. 646 (1892).⁶ *Fl. Amer. Sept.* i. 200 (1814); Hill, *Bull. Torr. Bot. Club*, xxvii. 496 (1900).

habit, usually growing on sand dunes, rocky places, and dry hills and mountains, and widely distributed in the United States from Delaware and Pennsylvania to Utah and Colorado, is considered by some to be a variety of this species, but is probably distinct.

This species is widely distributed, occurring in the north from Quebec to Manitoba, and extending southward to Louisiana, Missouri, Kansas, and North Carolina. Its exact distribution is not clearly known, as it has been confused with other species; but it appears to be commoner in the north and east, while *C. crassifolia* is most prevalent in the Mississippi valley and west of the Alleghanies. It is replaced by *C. mississippiensis* in the extreme south, and by *C. reticulata* in the dry regions of the far west.

In New England it is a low round-headed tree, and is well depicted by Sargent in *Garden and Forest*, iii. 39, fig. 43 (1890), which represents a tree growing close to the seashore in Massachusetts. It is not common east of the Hudson,¹ but on the banks of this river grows with a slender trunk and long graceful pendulous branches. Amongst North American species none, perhaps, retains its foliage green and fresh so late in the season.

(A. H.)

The American Nettle Tree or Hackberry was introduced into England in 1656 by Tradescant, and the first description of the species, made from a tree cultivated in England, was published in Ray's *Historia Plantarum*, ii. 1917. It seems to be the only species of *Celtis* which bears our climate well enough to be worth planting, but is so rare in cultivation that very few people know it, and it is rarely found in nurseries.

I have found it easy to raise from seed, and though the seedlings grow slowly and are somewhat susceptible to frost when young, it will, as it grows older, endure a greater degree of cold in winter than *C. australis*. The largest tree mentioned by Loudon was one at Syon, which, in 1838, was 54 feet high and 7 feet in girth. This cannot be the same as one which now grows there, which, according to the garden catalogue, was 50 feet by 3 feet 3 inches in 1849, and when I measured it in 1903, was 60 feet by 4 feet 4 inches. There is a fine tree in Kew Gardens, which, owing to its being crowded on one side by an evergreen oak, leans considerably, and is about 45 to 50 feet by 6 feet 4 inches. This is probably one of the original trees of the Kew Arboretum, though not mentioned by Loudon, unless, as is possible, he mistook it for *C. australis*.

The finest and best-shaped tree, however, that we know of, is one at West Dean Park (Plate 251), which is probably the one mentioned by Loudon as then fourteen years planted and 19 feet high. Now it is 50 feet by $5\frac{1}{2}$ feet, and when I saw it in July 1906 was bearing fruit abundantly. This tree evidently lives to a considerable age, as I saw one in the Botanic Gardens at Padua which was planted in 1760, and measures no less than 32 metres high by 2 metres in girth, with a fine clean bole.

Henry saw a good specimen in the Botanic Garden at Copenhagen.

(H. J. E.)

¹ *Garden and Forest*, i. 465 (1888).

CELTIS CRASSIFOLIA, HACKBERRY

Celtis crassifolia, Lamarck, *Encycl.* iv. 138 (1797); Michaux, *Hist. Arb. Amer.* iii. 228, t. 9 (1813); Loudon, *Arb. et Frut. Brit.* iii. 1418 (1838); Britton, *Man. Fl. North. States and Canada*, 339 (1901).

Celtis cordata, Persoon, *Sp. Pl.* i. 292 (1805).

Celtis Audibertiana, Spach, *Ann. Sc. Nat. sér. 2*, xvi. 41 (1841).

Celtis occidentalis, Sargent, *Silva N. Amer.* vii. 67 (1895), and *Trees N. Amer.* 299 (1905). (In part.)

A tree, attaining rarely as much as 130 feet in height, and 10 feet in girth. Bark as in *C. occidentalis*. Young branchlets pubescent. Leaves usually about $2\frac{1}{2}$ inches long by $1\frac{1}{2}$ inch broad, but on isolated branches, commonly found in the inner part of the crown, often 6 inches long and 3 inches broad; ovate, unequal, and shortly cuneate at the base, shortly acuminate at the apex, serrate, as a rule, only in the upper half; upper surface scabrous to the touch; lower surface pubescent on the nerves; petiole, $\frac{1}{4}$ inch or more, pubescent. Fruiting pedicels long, $\frac{3}{4}$ inch or more. Drupe purple, red or black when ripe, globose or ovoid, about $\frac{2}{8}$ inch in diameter.

This species, which is not distinguished by Sargent, even as a variety, from *C. occidentalis*, is remarkably distinct in foliage, and appears to be a more upright and faster-growing tree in cultivation than that species. Michaux states that it is one of the finest species of the genus, remarkable for its great height and straight trunk, and that it is common in the states west of the Alleghanies, especially in Ohio and Kentucky, where, however, its timber was little esteemed on account of its weakness and liability to speedy decay on exposure to the weather. Its distribution has been confused with that of *C. occidentalis*; but, according to Britton, it occurs from New York to South Carolina, Ohio, Illinois, Missouri, and Tennessee.

(A. H.)

Ridgway¹ speaks of this species of Hackberry under the name of *C. occidentalis*, as "a very tall and beautiful tree in rich bottoms, growing frequently 120 to 130 feet high and 3 feet in diameter, with a tall straight trunk of 60 to 70, or even 80 feet to the first limb. When growing to its full perfection in a dense forest, there is an individuality about the aspect of this tree which it is difficult to describe, owing to the extreme slenderness and great length of the trunk, which not unfrequently comprises three-fourths of the total height of the tree; and the smooth grey bark conspicuously clouded on the north side with blackish moss or lichen for its entire length. This striking appearance is sometimes increased by vines of the Virginia creeper ascending to the topmost branches, which are wreathed and matted with its foliage. One tree was seen whose silvery shaft gleamed among the surrounding tree tops, in a wood where the summit level was considerably more than 100 feet aloft, and though only 10 feet in circumference must have been upwards of 90 feet

¹ *Proc. U.S. Nat. Museum*, 1882, p. 72.

to the first limb, which grew not more than 25 feet from the extreme summit of the tree."

Though I was not fortunate enough to find any such trees standing, when I visited the remains of this forest in 1904, yet I saw enough to make me wish that an area of this unique forest could be preserved to show what the virgin forests of the Wabash valley were once like; for there is no other part of the temperate world where so many species of hardwood trees grow to such a size as they formerly did here.

This species appears to have been introduced about the beginning of the nineteenth century; several trees, 10 to 15 feet in height, being mentioned by Loudon.

At Kew it appears to be straighter and more vigorous in growth than *C. occidentalis*; and all the specimens have a few branches mainly in the upper and inner parts of the tree, which bear very large leaves. One of the trees, growing on the walk behind the Aroid House, is 38 feet high by $3\frac{1}{2}$ feet in girth.

(H. J. E.)

CELTIS MISSISSIPPIENSIS

Celtis mississippiensis, Bosc, *Dict. Agric.* x. 41 (1810); Sargent, *Silva N. Amer.* vii. 71, t. 318 (1895), and *Trees N. Amer.* 300 (1905).

Celtis levigata, Willdenow, *Berlin Baumz.* 81 (1811); Loudon, *Arb. et Frut. Brit.* iii. 1420 (1838).

Celtis occidentalis, Linnæus, var. *integrifolia*, Nuttall, *Gen.* i. 202 (1818).

Celtis occidentalis, Sargent, *Forest Trees N. Amer.*, 10th Census U.S. ix. 125 (1884) (in part); and *Garden and Forest*, iii. 39 (in part), ff. 9, 10, 11 (1890).

A tree, attaining in America, 80 feet high and 9 feet in girth. Bark bluish-green, and covered with prominent excrescences. Young branchlets glabrous. Leaves (Plate 267, Fig. 9), up to 3 inches long and $1\frac{1}{4}$ inch wide, ovate-lanceolate or lanceolate, unequal and rounded or broadly cuneate at the base, long-acuminate at the apex; margin usually entire, occasionally irregularly serrate towards the apex; light green and glabrous, except for slight axil tufts at the base beneath; petiole, about $\frac{1}{2}$ inch, glabrous. Fruiting-pedicels, about $\frac{3}{4}$ inch. Drupes, ovoid, $\frac{1}{8}$ to $\frac{1}{4}$ inch, bright orange red, with thin dry flesh and a smooth light brown stone.

This species is distributed from southern Indiana and Illinois, through Kentucky, Tennessee, and Alabama to Florida, and through Missouri, Arkansas, and Texas to Nuevo Leon. It is also a native of the Bermudas. It is very abundant and of its largest size in the basin of the lower Ohio River, a tree measured by Schneck in Richland County, Illinois, being 95 feet high and $5\frac{1}{2}$ feet in girth. Here it is often associated with *C. crassifolia*, from which it may be distinguished¹ by its usually smaller size, shorter trunk, entire leaves, and bright orange-red fruit. It is the most common species in Kentucky and Tennessee; but is rare in the Gulf States. Though apparently found in Texas and Nuevo Leon, it is replaced to the

¹ Elwes noticed that the wrinkled bark of this species easily distinguished it in the forest from *C. crassifolia*.

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westward by *Celtis reticulata*, Torrey,¹ which occurs in Texas, New Mexico, Arizona, Utah, Nevada, and Lower California, and has not yet apparently been introduced.

C. mississippiensis was probably introduced, by the elder Michaux, into France, where the species was first described in 1810 from a tree cultivated at Paris. It was not introduced into England in Loudon's time. The only cultivated specimen known to us is a small tree in Kew Gardens.

(A. H.)

¹ *Ann. Lyc. N. York*, ii. 247 (1828). *C. occidentalis*, var. *reticulata*, Sargent, *Forest Trees N. Amer.*, 10th Census, U.S. ix. 126 (1884); *Garden and Forest*, iii. 40 f. 12 (1890). *C. mississippiensis*, var. *reticulata*, Sargent, *Silva N. Amer.* vii. 72, t. 319 (1895), and *Trees N. Amer.* 301 (1905).

ALNUS

Alnus, Linnæus, *Gen. Pl.* 285 (1737); Bentham et Hooker, *Gen. Pl.* iii. 404 (1880); Winkler, in Engler, *Pflanzenreich*, iv. 61, *Betulaceae*, 101 (1904).

Betula, Linnæus, *Gen. Pl.* 485 (1764) (in part).

Alnaster and *Clethropsis*, Spach, *Ann. Sc. Nat. sér. 2*, xv. 200, 201 (1841).

Semidopsis, Zumaglini, *Fl. Pedem. i.* 249 (1849).

Alnobetula, Schur, *Verhand. Siebenb. Ver. Naturw.* iv. 68 (1858).

DECIDUOUS trees or shrubs, belonging to the order Betulaceæ. Leaves alternate, simple, stalked, usually serrate or dentate, rarely entire, penninerved. Stipules¹ enclosing the leaf in the bud, caducous or deciduous. Flowers opening either in early spring before or with the unfolding of the leaves, or in two species in autumn, monœcious, unisexual, without petals, in few-flowered cymes in the axils of short-stalked peltate scales of pedunculate catkins. Staminate catkins, at first naked and erect, afterwards pendulous, in the axils of the last leaves or of leafy bracts; scales three-flowered; bracteoles, three to five, adnate to the base of the scale; calyx, four-partite; stamens four, filaments short, undivided; anthers dorsi-fixed, not pilose at the apex. Pistillate catkins erect, solitary or racemose, in the axils of the leaves and produced in autumn, or terminal on a short leafy branch and produced in spring; scales two-flowered; bracteoles, two to four, adnate to the base of the scales; calyx absent; ovary two-celled; styles two, stigmatose at the apex; ovule, solitary in each cell, suspended. Fruit, a strobile or cone, formed by the scales of the pistillate flower becoming, when ripe, thick, woody, obovate, three- to five-lobed or truncate at the thickened apex. Cones persistent on the branch after the opening of the closely imbricated scales and the escape of the nutlets. Nutlet, compressed, minute, bearing at the apex the remains of the styles, marked at the base by a scar, with or without lateral wings. Seed, solitary by abortion, filling up the cavity of the nutlet.

About twenty-five species are distinguished, inhabiting Europe, Algeria, extra-tropical Asia, North America, Central America, and the Andes of South America from Colombia to Peru.

The following key includes all the species in cultivation, with the exception of *Alnus serrulata*, Willdenow, a North American shrub.

I. *Buds sessile, with several (two to six) outer scales, which are unequal in length.*

1. *Alnus firma*, Siebold et Zuccarini. Japan. See p. 952.

¹ Cf. Lubbock, "On Stipules of the Alder," in *Journ. Linn. Soc. (Bot.)*, xxx. 527 (1895).

Leaves ovate-lanceolate, green beneath, with fifteen or more pairs of lateral nerves.

2. *Alnus viridis*, De Candolle.¹ Mountains of Central Europe, plains of Northern Russia, Siberia, Labrador, and Greenland.

Leaves broadly oval, green beneath, with eight to ten pairs of lateral nerves.

This species is a shrub, rarely attaining more than 10 feet in height, and will not be further dealt with by us.

II. *Buds stalked, with two outer scales, almost equal in length.*

A. *Leaves white or grey beneath.*

3. *Alnus incana*, Mœnch.² Europe, Caucasus, North America. See p. 945.
Branchlets pubescent, buds rounded at the apex. Leaves grey beneath, with the lateral nerves running to the tips of serrated lobules; margin not revolute.
4. *Alnus rubra*, Bongard. Western North America. See p. 956.
Branchlets glabrous, buds beaked at the apex. Leaves whitish beneath, with nerves as in *A. incana*; margin revolute.

B. *Leaves green beneath.*

* *Leaves simply serrate, not lobulate, rounded or acute at the apex.*

5. *Alnus elliptica*, Requier. A hybrid between *A. cordata* and *A. glutinosa*, occurring wild in Corsica. See full description under *A. cordata*, p. 949.
Branchlets glabrous and covered with wax glands. Leaves elliptic, rounded at both base and apex, with prominent brown axil-tufts beneath.
6. *Alnus rhombifolia*, Nuttall. Western North America. See p. 958.
Branchlets pubescent. Leaves ovate or oval, rounded at the base, acute or rounded at the apex, pubescent throughout beneath.
- ** *Leaves simply serrate, not lobulate, conspicuously acuminate at the apex.*
7. *Alnus cordata*, Desfontaines. Corsica, Southern Italy. See p. 949.
Branchlets glabrous, covered with wax glands. Leaves broadly ovate, cordate at the base, cuspidate-acuminate at the apex, with conspicuous axil-tufts beneath.
8. *Alnus japonica*, Siebold et Zuccarini. Japan, Manchuria, Korea, Formosa. See p. 953.
Branchlets glabrous. Leaves lanceolate, cuneate at the base, long-acuminate at the apex, with minute axil-tufts beneath.
9. *Alnus maritima*, Nuttall. Delaware, Maryland, Indian Territory. See p. 955.
Branchlets glabrous. Leaves ovate or obovate, cuneate at the base, shortly acuminate at the apex, glabrous beneath.
10. *Alnus nitida*, Endlicher. North-west Himalaya. See p. 954.
Branchlets densely and minutely pubescent. Leaves ovate-elliptical, cuneate

¹ *Fl. Franç.* iii. 304 (1805). *Alnus Alnobetula*, Hartig, *Naturges. Forst. Kulturpfl.* 372 (1851). *Betula Alnobetula*, Ehrhart, *Beil.* ii. 72 (1788).

² *Alnus tinctoria*, Sargent, a closely allied species, occurring in Japan and Manchuria, is distinguished by its large, broadly ovate leaves, acuminate at the apex. *A. incana* has small, narrowly ovate leaves, acute at the apex. Cf. p. 946.

or rounded at the base, short- or long-acuminate, with slight axil-tufts beneath.

*** *Leaves with serrate lobules.*

11. *Alnus glutinosa*, Gærtner. Europe, Siberia, Western Asia, North Africa. See below.
Branchlets usually glabrous. Leaves obovate, cuneate at the base; obtuse, truncate or rounded at the apex; with prominent axil-tufts beneath.
12. *Alnus glutinosa*, Gærtner, var. *barbata*, Ledebour (*Alnus barbata*, C. A. Meyer). Caucasus. See p. 938.
Branchlets pubescent. Leaves elliptical, rounded at the base and apex, covered on both surfaces with pubescence, densest on the midrib and nerves beneath.
13. *Alnus tenuifolia*, Nuttall. Western North America. See p. 957.
Branchlets glabrous. Leaves ovate, broad and rounded at the base, acute or shortly acuminate at the apex, pubescent on the midrib beneath with inconspicuous axil-tufts.
14. *Alnus subcordata*, C. A. Meyer. Caucasus, North Persia. See p. 951.
Branchlets pubescent. Leaves ovate-oblong, unequal and rounded or subcordate at the base, cuspidate-acuminate at the apex, pubescent on the midrib and nerves beneath.

ALNUS GLUTINOSA, COMMON ALDER

Alnus glutinosa, Gaertner, *De Fruct.* ii. 54 (1791); Loudon, *Arb. et Frut. Brit.* iii. 1678 (1838); Willkomm, *Forstliche Flora*, 339 (1887); Mathieu, *Flore Forestière*, 421 (1897); Winkler, *Betulaceæ*, 115 (1904).

Alnus nigra, Gilibert, *Exerc.* ii. 401 (1792).

Alnus communis, Desfontaines, *Tabl. Hort. Paris*, 213 (1804).

Alnus vulgaris, Persoon, *Syn.* ii. 550 (1807).

Betula Alnus glutinosa, Linnæus, *Sp. Pl.* 983 (1753).

Betula Alnus, Scopoli, *Fl. Carn.* ii. 233 (1772).

Betula glutinosa, Lamarck, *Dict.* i. 454 (1783).

Betula palustris, Salisbury, *Prod.* 395 (1796).

A tree, occasionally attaining 100 feet in height and 12 feet or more in girth. Bark of young trees smooth and greenish; after twenty years old becoming brownish-black and divided on the surface into broad flattened plates. Young branchlets, three-angled at the tip, usually glabrous, occasionally pubescent, covered with glands, which secrete a waxy resin, often seen on the dried twigs as a bluish bloom. Leaves (Plate 268, Fig. 6) averaging 3½ inches long and 3 inches broad, variable in shape, but nearly always broadest above the middle, obovate, sub-orbicular or elliptical; cuneate at the base; obtuse, truncate, or retuse at the apex; margin entire in the basal third, elsewhere lobulate, each lobule serrate or dentate; upper surface dark green, shining, glabrous; lower surface light-green, pubescent along the midrib and

nerves, with conspicuous tufts of rusty-brown hairs in the axils; petioles, glabrous or pubescent, $1\frac{1}{2}$ to 1 inch long; stipules conspicuous, deciduous, ovate to lanceolate, obtuse, fringed with glandular hairs. The leaves turn blackish in autumn.

Flowers appearing very early, before the leaves, in February or March. Catkins, three to six in a raceme, at the tip of a branchlet. Staminate catkins, 2 to 4 inches long, at first erect and rigid, afterwards lax and pendent; stamens,¹ four, yellow, opposite the segments of the four-lobed calyx. Pistillate catkins, always erect, at first about $\frac{1}{4}$ inch long, smooth, with reddish-brown stigmas; afterwards $\frac{1}{2}$ inch long, ovoid, cone-like, the scales ending in purple shield-like expansions, each with a central brown point. Cones at first green, ultimately black, persistent on the tree after the escape of the nutlets. Nutlets obovate, blunt-angled, wingless or with a very narrow coriaceous wing.

The nutlets² are gradually shaken out of the cones by the wind during autumn and winter. Their walls are provided with small air-tight cavities, which enable them to float in water, and secrete an oil, which protects them from being wetted. Usually falling into streams and ditches, they float undamaged and unchanged during winter, and germinate in the water in early spring. The young seedlings, drifting to the bank, establish themselves where they happen to be stranded in a suitable place.

In winter, the twigs are glabrous and usually covered with a thin waxy secretion. Leaf-scars pentagonal or rhomboid, parallel to the twig on a projecting cushion, five-dotted, the lowermost three dots coalesced together. Stipule-scars linear, one on each side of a leaf-scar. Terminal bud present, similar to the lateral buds; all conspicuously stalked, ovoid, obtuse, with two external scales, viscid-glandular, and often covered with a purplish bloom. Pith triangular in section.

The common alder coppices freely from the stool; but rarely if ever produces root-suckers.

VARIETIES

The common alder, distributed over a wide area, shows considerable variation in the wild state, and several varieties have been described.

1. Var. *barbata*, Ledebour, *Fl. Rossica*, iii. 657 (1851); Winkler, *Betulaceæ*, 118 (1904). *Alnus barbata*, C. A. Meyer, *Verz. Pfl. Kauk.* 43 (1831).

This variety is remarkably distinct in the foliage, but has the flowers and fruit of typical *A. glutinosa*. Young branchlets pubescent. Leaves, about 3 inches long and 2 inches wide, rounded at the base, rounded or occasionally acute at the apex, margin with serrate lobules, ciliate; nerves eight or nine pairs, running parallel and curved to the margin; upper surface dark green, shining, minutely pubescent; lower surface pubescent, the pubescence densest along the midrib and nerves; petiole $\frac{3}{4}$ inch, pubescent. Buds pubescent.

¹ Kerner, in *Nat. Hist. Plants*, Eng. trans. ii. pp. 119, 133, 135, gives an elaborate account of the way in which pollination is effected by the wind, and of the devices for the protection of the pollen in rainy weather.

² Cf. Miall's account of the fruit of the alder in *Round The Year*, p. 279.

This variety occurs in the Caucasus, and is very similar to var. *denticulata*,¹ occurring in the same region and in north Persia, which is less pubescent. Var. *barbata* is in cultivation at Kew.

2. Var. *quercifolia*, Willdenow, *Berlin Baumz.* 44 (1796). Oak-leaved alder. Leaves obovate, lobed like the common oak. This variety has been found wild in Sweden.

3. Var. *sorbifolia*, Dippel, *Laubholzkunde*, ii. 161 (1892). Service-leaved alder. Leaves oval, lobed like those of *Pyrus intermedia*. This variety has been found wild in Finland.

4. Var. *laciniata*, Willdenow, *loc. cit.* Cut-leaved alder. Leaves (Plate 268, Fig. 7), divided half-way to the midrib into three to six pairs of non-serrated triangular segments; petiole slender, about an inch long.

The cut-leaved alder, according to Duhamel, occurs wild in the north of France, particularly in Normandy, and in the woods of Montmorency near Paris. Thouin states, according to Loudon, that it was first found by Trochereau de la Berlière, and planted by him in his garden near St. Germain, where the stool remained in 1838, from which all the nurseries of Paris were supplied with plants. The largest trees we have seen of this variety are described on p. 942.

5. Var. *imperialis*, Petzold and Kirchner, *Arb. Musc.* 599 (1864). *Alnus imperialis*, Desfossé-Thuillier, *Illust. Hort.* vi. 97, fig. (1859).

Leaves (Plate 268, Fig. 8) oval, divided more than half-way to the midrib, into six or seven pairs of long narrow lanceolate non-serrated curved segments. This variety, so far as we know, does not attain to as large a size as the ordinary form of the cut-leaved alder. A specimen at Ponfield, Hertford, is 25 feet high by 1 foot 8 inches in girth.

6. Var. *incisa*, Willdenow, *Sp. Pl.* iv. 335 (1805) (var. *oxyacanthæfolia*, Loddiges, *Catalogue*, 1836). Thorn-leaved alder. Leaves (Plate 268, Fig. 10) small, deeply incised, resembling those of the common hawthorn. A fine specimen, 44 feet high by 2 feet 8 inches in girth, is growing in the arboretum at Barton, near Bury St. Edmunds.

7. Var. *rubrinervia*, Dippel, *loc. cit.* A tree, pyramidal in habit, with large and shining leaves, furnished with red petioles and nerves, vigorous in growth and handsome in appearance. In cultivation at Aldenham.

8. Var. *pyramidalis*, Dippel, *loc. cit.* Branches erect, leaves as in the type.

9. Var. *aurea*, Verschaffelt, *ex* Dippel, *loc. cit.* Lemaire, *Illust. Hort.* 1866, t. 490. Leaves yellow. Found as a seedling in Vervaene's nursery at Ledebergles-Gand. In cultivation at Aldenham.

10. Var. *maculata*, Winkler, *loc. cit.* Leaves variegated with yellow. There is a small specimen at Aldenham, which is slow in growth.

Hybrids² between *Alnus glutinosa* and *Alnus incana* are common in the wild state, where the two species are growing together, and have been observed in

¹ Ledebour, *loc. cit.* *Alnus denticulata*, C. A. Meyer, *loc. cit.*

² *A. glutinosa* × *incana*; *A. spuria*, Callier. Schneider, *Laubholzkunde*, 130 (1904), distinguishes three forms of this hybrid.

Sweden, Norway, Russia, Denmark, Bosnia, and Montenegro. These hybrids are intermediate in the characters of the leaves and fruit; and so far as we know, are not in cultivation in England.

A hybrid¹ between *A. glutinosa* and *A. serrulata* has also arisen in cultivation in Silesia and Brandenburg.

DISTRIBUTION

The common alder is distributed through nearly the whole of Europe, Siberia, Western Asia, and North Africa. In Europe, its northerly limit extends from lat. 63° 52' in southern Norway at Anderoen, to lat. 63° 20' on the west side of the Gulf of Bothnia in Sweden, reaching Uleaborg in Finland in lat. 65°, where, however, it only exists as a shrub, and is continued through the interior of Finland and Russia along the parallel of 62°. In Siberia, its distribution is not accurately known; but it occurs in the Ural and Altai mountains, and in the district around Lake Baikal. Its southern limit, commencing in the province of Talysch in the Caucasus, between 39° and 40° lat., extends through Asia Minor and Greece to Sicily, where it reaches at Catania, lat. 37° 25', its most southerly point in Europe. It occurs in Spain and Portugal, as far south as the Sierra Morena, about lat. 38°. It is also distributed through the mountains of Algeria and Morocco. A variety,² recorded for Japan, is probably a distinct species.

According to Sir Herbert Maxwell³ the Anglo-Saxon name for alder was *alr*, in Norse *olr* (now, according to Schübeler, *aar*, *older*, and *or*); and the Gaelic name *fearn*, the names surviving in place names such as Allerton, Allerbeck, Ellerslie, Balfarn, Farnie, Glenfarne.

It is generally distributed throughout the British Isles, growing usually on river banks, along the sides of lakes, and in wet or marshy places; and ascends in the Grampians to 1600 feet.

It is common throughout France, in similar situations, and ascends to 5700 feet in the Pyrenees. Although most usual on siliceous soils, it grows on chalk in Champagne; and in Germany, has been shown to be indifferent to the mineral constituents of the soil, provided a sufficient quantity of moisture is present. It is met with as pure woods, on peat-bogs and marshy places, in north Germany, in the Baltic provinces and Lithuania in Russia, and also in Hungary; but more usually is mixed with birch and aspen, and more rarely grows in company with other hardwoods. It ascends in the mountains of Norway to 1100 feet, in the Central Alps in Switzerland to 3200 feet, and in the Carpathians to 3800 feet. The alder is susceptible to late frosts and is injured by cold dry winds, and on this account thrives best in the colder parts of Europe on slopes with a westerly aspect.

It is naturalised in various localities in the eastern United States, particularly in southern New York and in New Jersey. It succeeds well in North America, when

¹ *A. glutinosa* × *serrulata*; *A. silesiaca*, Fiek. Cf. Schneider, *loc. cit.*

² Var. *japonica*, Matsumura, *Journ. Coll. Sci. Tokyo*, xvi, 2, p. 9 (1902).

³ Green's *Encyclopedia of Agriculture*, i. 62.

planted in wet situations; but is not, as a rule, a long-lived tree, and never grows to be so large as it does in England.¹ (A. H.)

PROPAGATION AND CULTURE

Though old writers tell us that the alder was often planted by inserting long cuttings, or by burying pieces of the root in the soil; and though layering is the mode usually adopted by nurserymen for propagating the varieties; yet, as a general rule, it is best raised from seed. The cones ripen in autumn and are freely produced almost every year so far as I have observed. As soon as they begin to open, they should be gathered when quite dry; and though it is said that the seeds will keep for two years or more in the cone, yet, as a rule, they should be sown in autumn or in early spring and lightly covered with earth. Though I have not tried it myself, I believe that the germination is more rapid and regular if the seed is soaked in water before sowing, but seedlings can be procured so cheaply from nurserymen that I have always bought them at one or two years old. They are easy to transplant and grow fast if the soil is moist, being fit to plant out at three or at most four years old; and I have had as good or better success by planting them in spring as in autumn. The alder bears coppicing well, if not cut too near the ground, but the stools have a tendency to decay in the centre and to spread outwardly. True suckers are not produced, though the roots when exposed by running water will throw up shoots. The usual age for coppicing is fifteen to twenty years, and I am informed by Sir Hugh Beevor that he obtained a yield of 1700 poles per acre, which at seventeen years' growth from the stool averaged 20 feet long with a girth of 7 to 11 inches, giving a yield of about 1100 cubic feet per acre. If the trees are allowed to stand for timber they should be cut at fifty to seventy years, when they may average 50 to 70 feet high by 4 to 5 feet in girth. The only lot of alders I ever sold standing, 300 in number, realised £100, being at the rate of 4d. or 5d. per foot. Sir Herbert Maxwell states, that as long as clogs remain in common use, there will be little difficulty in realising £40 per acre for mature alder coppice, and this on land so wet as to be worthless for any other purpose. Except in localities where a good and regular market is assured, I should not recommend the planting of alder except in places too cold, wet, and marshy for willow or poplar to thrive; but Selby,² whose opinion of the tree as an ornamental one was better than my own, states as the result of his own experience, that the nature of the roots of the alder causes the tree to attract and retain the moisture in the soil, to such an extent that it will convert into a morass, land which, if drained and planted with other trees, might be rendered dry and productive. He adds that from experiments he has made he is "fully convinced that a plantation of alders would soon render the ground (even if previously of tolerably sound and dry quality) soft and spongy, and in time convert it into a decided bog." I cannot learn that this observation has been confirmed by others, and am inclined to doubt its being of general application.

¹ Hough, *Trees N. States and Canada*, 131 (1907).

² *British Forest Trees*, p. 218 (1842).

The common alder is rarely planted as an ornamental tree, and only on wet situations or on the banks of ponds and streams is it able to attain its full dimensions. But if desired for ornament in such a situation, I should recommend the cut-leaved alder in preference to the common one; and for drier ground either the grey or the Italian alder.

REMARKABLE TREES

Among the finest trees that we have seen or heard of, those at Pain's Hill take a high place. One of these on an island is probably over 90 feet, but we could not measure it. Another growing by the lake has seventeen stems about 75 feet in height, growing from a stool which is 19 feet in girth. I estimated the contents of these poles at about 200 cubic feet. At Whitton there is a tall slender tree about 90 feet by 6 feet without a branch for 46 feet, and with a clean stem to 70 feet up. At Betchford Park, Surrey, Henry measured a tree 90 feet high by 11 feet 4 inches at 3 feet from the ground, dividing into two stems at 4 feet. At Enville Hall, Stourbridge, he saw one which was 87 feet by 8 feet 2 inches. Sir Hugh Beever tells us of a large one at Shottisham, Norfolk, 70 feet high and 18 feet in girth near the ground, out of the base of which a mountain ash of large size is growing.

At Holme Lacy there is a large tree near the home farm, which has a short bole 6 feet high by 18 feet in girth, dividing into four main stems about 60 feet high; I estimated the contents of this tree to be not far short of 300 cubic feet.

On the banks of the Nene near Lilford Hall, Northamptonshire, there is a fine row of large and picturesque alders, of which Plate 252 gives a good representation, but I was unable to measure them on account of the water.

In Boughton Park, near Kettering, the property of the Duke of Buccleuch, a remarkable alder is growing near the Broad Avenue, in comparatively dry ground. It measures 70 feet by 9½ feet, and has the lower part of the trunk covered with bark so like that of an elm that it was difficult to recognise it as an alder, by the trunk alone.

At Aldermaston Park there is a very large old tree which looks as if it had been pollarded, and which in 1906 was 17 feet 4 inches in girth.

At Elvaston Castle, Derby, Mr. A. B. Jackson has seen a remarkably fine tree, which he estimates at 90 feet by 7½ feet, with a clean bole 60 to 70 feet long.

In Wales the finest alder I have seen is in a wood at Penrhyn Castle which is about 75 feet by 6 feet 9 inches, with a clean bole 40 feet long. The contents of this tree were estimated by me at over 100 feet of timber.

Of the cut-leaved alders the finest I have seen is about 68 feet by 10½ feet on the banks of the lake at Syon. At Melbury there is a tree very similar in size and appearance to that at Syon; and Henry measured, in 1905, one at Cassiobury Park, 85 feet by 11½ feet; and another at Belton, 85 feet by 10 feet 2 inches. Colonel Birch Reynardson sends me a photograph of a tree at

Holywell Hall, Stamford, which is 65 feet high and no less than 17 feet in girth at two and a half feet, dividing into two trunks of equal height. At Audley End, Henry measured, in October 1908, a fine specimen, 65 feet high, and 15 feet in girth at a foot from the ground, dividing above into three great stems, with a spread of branches 80 feet in diameter.

In Scotland the alder attains as large a girth and perhaps a greater age than in England. One of the oldest and largest on record is in the flower gardens at Gordon Castle, and was figured in 1881.¹ It was only 35 feet high but 14 feet 9 inches in girth and with a spread 63 yards in circumference. The late Mr. J. Webster supposed it to be nearly three centuries old, but when I saw it in 1907, nothing remained but a hollow stump 16½ feet in girth. At Fasnakyle, in Strathglass, there is a very large old alder, of which Mr. Stevenson Clarke sends me a photograph, and which in 1904 measured 18 feet in girth at two feet from the ground. It has a rowan tree 2 feet in diameter growing on it.

At Shanbally, near Dumfries, Henry measured an alder in 1904 which was 65 feet by 10 feet 5 inches, dividing at eight feet into two stems; and at Scone he saw a cut-leaved alder, which was 66 feet by 6 feet 3 inches in the same year.

Some of the most remarkable alders in Ireland grow in the old Deer Park at Kilmacurragh on strong wet land covered with tall bracken and rushes. Henry thinks that in former times this park may have been part of the virgin forest of Wicklow. The trees are scattered in groups as if self-sown; and though fully mature, are in most cases sound. They average 55 to 60 feet in height, and in some cases have clean boles 30 to 40 feet high and 8 to 10 feet in girth. The one figured (Plate 253), was about 60 feet by 11 feet 4 inches, and stands near the top of the park.

At Powerscourt, an immense alder was felled in 1902, the butt being 20 feet in girth near the ground. At Churchill, Armagh, a tree growing in peat soil, measured, in 1904, 94 feet in height by 6 feet 4 inches in girth, with a clean stem to 60 or 70 feet.

TIMBER

Alder is now a wood of third-rate importance in the English timber trade, and though still used for making the clogs² which are worn in Lancashire, is so low in value that it will not bear much cost for carriage. On this account it is usually worked up on the ground where it grows into pieces suitable for clog soles by men who travel about from place to place, and this work is carried on by preference in summer.

In Scotland, however, alder is still used for making herring barrels, in districts where it is plentiful, though imported staves as usual are taking its place. The timber is said to be most valuable for piles, and to be certainly durable under water,

¹ *Trans. Scot. Arbor. Soc.* ix. pl. 1 (1881).

² A complete set of specimens, illustrating the manufacture of clog-soles from alder wood, was sent to the Kew Museum, in 1904, from Enniscorthy, Ireland. Cf. *Kew. Bull.* 1904, p. 6, where the clog-sole industry is described.

so that where milldams, weirs, or similar work is being done on an estate, it may be profitable to use it in preference to more costly wood.

It is useless for posts or fencing, as it decays quickly when exposed to wet and dry conditions. It makes very good panelling, and is strong enough for inside work such as window-sills, and may be used for cheap furniture, but is said to be subject to the attacks of wood-boring beetles, unless previously steeped for some time in lime water. The colour is a pale reddish brown; and the large burrs which are commonly found on old trees show a very pretty figure when cut in slices, but are usually too small and full of flaws to have any marketable value, though Sir Thomas Dick Lauder says that handsome tables can be made of them.¹ Loudon quotes Mitchell to the effect that in Dorsetshire the local saying used for willow and poplar in the midland counties, is applied to alder poles when peeled, viz.—

Thatch me well and keep me dry
Heart of oak I will defy;

but, according to Cobbett, the bark must be taken off with a draw knife as soon as possible after the poles are cut, and even then they will only last a year or two as hop poles.

Alder wood which is dug up from peat bogs is said to become as black as ebony, but I have seen none large or sound enough to be used like bog oak. As fuel the wood is little valued in England, though Mouillefert says that in France it is considered specially suitable for heating ovens and glass works, though considerably inferior in heating power to beechwood. The charcoal made from it was at one time in great demand for making gunpowder, but, so far as I can learn, is now little used for that purpose. The wood is said to be used on the continent for making cigar boxes; this may be the case for very cheap cigars, but all the cigar boxes I have seen appear to be made of the wood of the West Indian "cedar," *Cedrela odorata*. The bark was used for tanning in the north, but only contains about 16 per cent of tannin, and Mouillefert says that in France a black dye used for felt is made from the bark and sulphate of iron.

Another use for alder wood which seems to be little known is the making of hat-blocks, an industry carried on in Dunstable, Luton, and other towns near the principal hat factories. For this purpose the larger sized trees are preferred, cut into plank of not less than 10 inches wide and 3 inches in thickness. I am informed that in consequence of the increasing difficulty in procuring this wood in England, it is now imported from the continent, and as much as 1s. 3d. a foot is paid at the ports on the north-east coast.

The following details of the cost of making clog soles from alder were taken on my own estate in 1908:—

About 100 trees, estimated at 56 years old, growing on the bank of a stream at Colesborne, on an area of about one-third of an acre, were sold at 7d. and 8d. a

¹ Alder burrs seem to have been a favourite wood with cabinet-makers in Sweden in former times, as I saw several handsome cabinets veneered with this wood in the Northern Museum at Stockholm.

foot, and as measured down to 3 inches diameter, produced 817 cubic feet and realised	£24 10 0
Deduct expenses of cutting and hauling out	£2 16 0
„ „ loading and delivering to station at	
6s. per ton	2 8 0
	5 4 0

Leaving a net return of £19 6 0

Four men were occupied for 42 days in working the timber up on the ground and produced:

196½ dozen pair 1st size, men's, at a cost of 1s. 4d. per dozen	£13 2 0
209 „ „ 2nd „ women's, „ 1s. 2d. „	12 3 10
98½ „ „ 3rd „ boys', „ 10d. „	4 2 1
119½ „ „ 4th „ children's, „ 8d. „	3 19 8

Total for labour £33 7 7

The maker informed me that the cost of carriage to Oldham was £8, 2s. at the rate of £1 per ton, and that the sum realised was £72, in addition to which he had the whole of the waste and chips to sell for firewood.

ALNUS INCANA, GREY ALDER

Alnus incana, Mœnch, *Meth.* 424 (1794); Willdenow, *Sp. Pl.* iv. 335 (1805); Loudon, *Arb. et Frut. Brit.* iii. 1687 (1838); Willkomm, *Forstliche Flora*, 349 (1887); Mathieu, *Flore Forestière*, 426 (1897); Winkler, *Betulaceæ*, 120 (1904).

Alnus lanuginosa, Gilibert, *Exercit. Phyt.* ii. 402 (1792).

Alnus glauca, Michaux, f., *Hist. Arb. Amer.* iii. 322 (1813).

Betula Alnus incana, Linnæus, *Sp. Pl.* 983 (1753).

Betula incana, Linnæus, f., *Suppl.* 417 (1781).

A tree, attaining about 70 feet in height and 6 feet in girth. Bark smooth and silvery grey, only fissuring slightly at the base of old trunks. Young branchlets greyish pubescent. Leaves (Plate 268, Fig. 1) about 3 inches long and 2 inches wide, ovate or oval, rounded or cuneate at the base, acute or slightly acuminate at the apex; lateral nerves nine to twelve pairs, running straight to the margin, each ending in a short acute lobe, which is finely serrate and ciliate; upper surface dull, dark green, pubescent; lower surface greyish, covered with soft hairs, densest on the midrib and nerves, without axil-tufts; petiole, ¾ inch long, pubescent.

Catkins in number and position like those of *A. glutinosa*; but male catkins looser, with distant shining red-brown scales and yellow anthers. Cones smaller than in *A. glutinosa*, with more numerous scales, thinner and less distinctly five-lobed. Nutlets depressed, pentagonal, reddish-brown, with wing almost as broad as the body.

In winter the twigs are three-angled at the tip, and densely covered with a fine

pubescence. Leaf-scars and stipule-scars as in the common alder. Buds reddish-brown, ovoid, conspicuously stalked, with two external scales, finely pubescent on the surface and only slightly glandular. Pith triangular or three-lobed.

The grey alder exhibits in the wild state considerable variation in the shape and pubescence of the leaves, and the cones may be sessile or shortly stalked. Many varieties are mentioned by Winkler and Schneider, most of which are scarcely worth discriminating; but the following are noteworthy:—

1. Var. *argentata*, Norrlin. Leaves silvery on both surfaces, and covered with a dense silky pubescence. Observed in Finland, Silesia, Saxony, and Switzerland.
2. Var. *glauca*, Regel. Leaves bluish-green and nearly glabrous beneath.
3. Var. *orbicularis*, Callier. Leaves small, almost orbicular, with five pairs of lateral nerves, wild in Silesia. This is occasionally cultivated under the name of var. *parvifolia*; but var. *parvifolia*, Regel, which occurs in Sweden and Finland has still smaller leaves, only $\frac{1}{2}$ inch in length, and ovate in shape.
4. Var. *acuminata*, Regel.¹ Leaves (Plate 268, Fig. 9) divided more than half-way to the midrib, into three to six pairs of long, narrow, triangular, serrate segments. This form has been observed wild in Sweden, and has been much confused with another wild variety in the same country, var. *pinnatifida*, Wahlenberg,² which resembles in the shape of the leaves *A. glutinosa*, var. *incisa*; and has not been seen by us in cultivation. Var. *acuminata* is common in gardens, and is usually known as var. *incisa* or var. *pinnatifida*.
5. Var. *aurea*, Schelle. Leaves and fruit yellow. This variety is growing well at Aldenham, and is striking in appearance.
6. Var. *montrosa*, Dippel. A dwarf shrub, with the tips of the branches ribbon-like and fasciated, which originated in Spath's nursery. In cultivation at Aldenham.

DISTRIBUTION

The grey alder is widely distributed throughout the greater part of Europe and the Caucasus. It is also met with in North America, where, however, it is only a shrub, commonly growing in swamps and on river banks, and forming dense thickets rarely more than 10 or 12 feet high, and is spread throughout British territory from Newfoundland to the eastern base of the Rocky Mountains, descending in the United States to New York, Pennsylvania, Wisconsin, and Nebraska.

Alnus incana is replaced in northern and eastern Asia by two closely allied species: *A. hirsuta*,³ Turczaninow, not in cultivation, a native of Siberia, Kamtschatka, Manchuria, Saghalien, and Japan; and *A. tinctoria*, Sargent,⁴ which is confined to Manchuria and Japan. The latter species differs mainly from *A. incana*, in the larger size and different shape of the leaves, which are broadly

¹ *Mem. Soc. Nat. Mosc.* xiii. 158, t. 17, f. 8 (1861).

² *Bull. Soc. Nat. Mosc.* 1838, p. 101. *Alnus incana*, var. *hirsuta*, Spach.

³ *Bull. Soc. Nat. Mosc.* 1838, p. 101. *Alnus incana*, var. *glauca*, Shirasawa, *Icon. Ess. Forest. Japon*, t. 19, ff. 1-17 (1900). This species is known in Japan as *yama-harinoki*, or mountain alder, and is much used for making small articles in the Hakone mountains. Cf. Rein, *Industries of Japan*, 239, 336 (1889).

⁴ *Fl. Suec.* 622 (1824).

ovate, 4 to 6 inches long, $3\frac{1}{2}$ to 5 inches wide; base broad and rounded or truncate, occasionally cuneate; apex acuminate or cuspidate; pubescent on both surfaces, glaucous or brownish beneath; with 9 to 12 pairs of nerves, each ending in a triangular serrated lobule; petiole an inch or more in length. The amount of pubescence on the branchlets, petioles, and leaves is variable; but the buds appear to be always densely pubescent. The cones are much larger than those of *A. incana*, attaining about $\frac{3}{4}$ inch in length and $\frac{1}{2}$ inch in diameter. *A. tinctoria* grows in Yezo, according to Sargent, on low slopes in rich moist ground, usually at some distance from the banks of streams, which are generally occupied by *A. japonica*. *A. tinctoria* attains in Japan 60 feet in height, and 6 feet in girth; and was collected by Elwes at Asahigawa in Yezo. It was formerly in cultivation at Coombe Wood, where it was probably raised from seed sent by Maries; but no specimens can now be found there; and the only one which we have seen in England is a tree at Aldenham,¹ about 15 feet in height, which is reported to be growing vigorously. There are trees of *A. tinctoria* in the Arnold Arboretum, Massachusetts, which were raised from seed collected by Sargent in Japan in 1892.

The grey alder extends in Europe much farther to the northward than the common alder, its northern limit in Scandinavia being about lat. $70^{\circ} 30'$. In Finmark it reaches the mouth of the river Tana, and following the shore of the Arctic Sea, the northern limit extends throughout Russia along the Arctic Circle. Its distribution is divided into two areas, a northern one extending southward in the plains of Russia to the 55th N. parallel; and a southern area, which comprises the mountain ranges of the Carpathians, Alps, Jura, and Apennines, where the tree grows at high elevations in the mountains, and descends along the river valleys to lower altitudes, as along the Rhone, Isère, Drôme, Durance, and Var in France, and along the Rhine and its tributaries in Germany, and along the Danube in Austria. Its southern limit passes westwards from Russia through Transylvania to Banat and Servia; but the tree is not found in Croatia, Dalmatia, or Istria. In Italy it descends along the Apennines as far south as lat. $43^{\circ} 40'$, and grows as a rule between 4000 and 6000 feet, occasionally as low as 3000 feet. It ascends in the Erz mountains to 2100 feet, in the Swiss Alps and the Tyrol to 5000 feet, and in France thrives at 6000 feet altitude near Barcelonnette and Briançon.

In Scandinavia the grey alder is common in the pine and spruce forests, usually occurring as underwood; but in favourable situations near streams attaining a considerable size. There are many fine specimens in the beautiful natural park, close to Gefle on the Baltic. These trees, many of which are suckers from the roots of old trees that had been felled, are narrowly pyramidal in habit. The largest measured 75 feet in height and 5 feet in girth. In Denmark, Mr. Prytz of the forest service, who has measured trees 65 feet high and $7\frac{1}{2}$ feet in girth, informed me that the wood had been tested, and clogs made of *A. incana* had worn as well as those manufactured from the common alder. I saw several trees in a beech forest near Nykjöbing averaging 60 feet in height and 3 or 4 feet in girth. In Denmark it grows better on dry soil than the common alder.

¹ At Aldenham, and in gardens on the Continent, this species is cultivated under the erroneous name, *A. incana*, var. *hirsuta*. Cf. Schneider, *Laubholzkunde*, i. 134 (1904).

In the Baltic Provinces of Russia it is common as coppice treated with a short revolution; and often takes possession of forests, when the larger trees have been cut away, and succeeds in doing so, as it is able to grow very well on dry soil. In Germany and Austria it grows chiefly on the banks of streams and rivers, but is also met with on hilly ground and on mountain precipices. It is very rarely met with on peat-bogs. In the Alps it is especially common on gravelly soil, and it is the most common species in many places, where the mountain torrents form vast areas of gravel and sand, through which their branches spread in all directions. One of the most remarkable and beautiful of these woods is situated at 2500 feet elevation on the river Romanche near Bourg d'Oisans in Isère. The whole area is about 200 acres, one-half of which is composed of a dense wood of grey alder, mixed with a small number of aspens and ashes, the other half being more open and consisting of a mixture of grey alder and white willow. The dense wood is treated as coppice, with a revolution of thirty years, forty standards per acre being reserved each time of felling. When cut, the grey alder produces vigorous shoots, which grow rapidly till they are thirty-five or forty years old; after which time growth ceases and the shoots begin to die. At Bourg d'Oisans natural seedlings are very numerous.

The grey alder, unlike the common alder, suckers freely from the root, often at a great distance from the parent stem. It layers easily, and can also be propagated by cuttings. This facility of reproduction renders it of great service for the re-forestation of the mountains in France, especially in the difficult work of planting trees on the sides of the torrents, where the soil is easily washed away.

Alnus incana is not a native of the British Isles, and has not yet been discovered in the fossil state there. (A. H.)

CULTIVATION

Though the tree is hardly known to English foresters, I believe that it may become an exceedingly useful one on account of its extreme hardiness, rapidity of growth and ability to thrive in very cold heavy soil, and in places subject to late and early frosts. I have used it with great success as a nurse to trees like *Thuja plicata*, in situations which were too wet and cold for that tree when young, and believe that it might be economically used for quickly suppressing rank herbage which would smother more tender and slower-growing trees in low and damp situations. It can be procured quite cheaply from French nurseries as one- or two-year seedlings, and grows with extraordinary rapidity on any soil, providing a dense cover, and rendering the land fit for planting. It soon overtops other trees, and if left standing requires the branches to be lopped so as to allow their heads to get up. It seems to thrive equally well on wet ground, and to grow much better than the common alder on soil too dry for that tree. I believe that the wood is at least as good, and according to Mouillefert is less brittle, than that of the common alder.

Though Loudon says that it was introduced as long ago as 1780, I have never seen a tree of any size in England; but Sir Hugh Beevor has sent me a photograph of one at Hargham in Norfolk, which measures about 72 feet high by 3 feet

in girth, being drawn up in a wood by other trees. It is growing on good loam over clay, and is the only big pole of the species in the wood; others which have been cut throw up many shoots from the stool, of which the majority die. On Lord Castletown's property at Doneraile, Co. Cork, there is a wood,¹ partly composed of grey alder, which has in places covered the ground with its suckers. (H. J. E.)

ALNUS CORDATA, ITALIAN ALDER

Alnus cordata, Desfontaines, *Tabl. Hort. Paris*, 244 (1815); Winkler, *Betulaceæ*, 110 (1904).
Alnus cordifolia, Tenore, *Flor. Neap.* i. *Prod.* p. lxiv. (1811), and ii. 340 (1820); Loudon, *Arb. et Frut. Brit.* iii. 1689 (1838); Baillon, *Nat. Hist. Plants*, vi. 223, figs. 158-164 (1880); Masters, *Gard. Chron.* xix. 284 f. 42 (1883); Mathieu, *Flore Forestière*, 428 (1897).
Betula cordata, Loiseleur, *Notiz.* 139 (1810), ex Loiseleur, *Fl. Gall.* ii. 317 (1828).

A tree, attaining 80 feet in height. Bark greyish-brown, smooth or slightly warty. Young branchlets, three-angled at the tip, stout, glabrous. Leaves (Plate 268, Fig. 4) about 4 inches long and 3 inches broad, oval or ovate, cordate at the base, shortly and abruptly acuminate at the apex; margin not lobulate, regularly serrate; nerves six to ten pairs, looping before reaching the margin; upper surface dark green, shining, glabrous; lower surface light green, glabrous, except for axil-tufts of rusty brown pubescence; petiole 1 to 2 inches, glabrous. Male catkins, three to four in a terminal raceme. Cones, solitary or two to three in an erect terminal raceme, 1 to 1½ inches long, ovoid. Nutlet, sub-orbicular, with a thin narrow wing.

In winter the twigs are glabrous, with leaf-scars and stipule-scars like those of the common alder. Buds long-stalked, arising from the twigs at a wide angle, ovoid, beaked at the apex, glabrous and covered with wax glands; scales ciliate in margin.

*Seedling*²:—Cotyledons oblong-oval, slightly fleshy, pale green, about ½ inch long, with a very short grooved petiole. Caulicle pubescent, about ½ inch long, ending in a tapering flexuose tap-root. Young stem brown, pubescent. Leaves alternate; first pair broadly ovate, acute or cuspidate, irregularly and acutely serrate, with pubescent petioles; ultimate leaves cordate, cuspidate.

This species shows no variation in the wild state, except that the leaves are occasionally rounded and not acuminate at the apex. It differs considerably from *A. subcordata*, which has been supposed to be a variety of it; and is readily distinguished from all other species by the conspicuous cordate base of the leaves.

Alnus elliptica, Requier, *Ann. Sc. Nat.* v. 381 (1825) is a remarkable natural hybrid between *A. cordata* and *A. glutinosa*, which was originally found growing on the banks of the river Salenzara in Corsica. It has leaves, similar in size to those of *A. cordata*, but thinner in texture, oval or elliptical, rounded at the base and apex; margin not lobulate, finely and equally serrate; glabrous on both surfaces, except for axil-tufts beneath. The fruits are not so large as in *A. cordata*, and are inter-

¹ Described by Prof. Fisher in *Quarterly Journal of Forestry*, ii. 95 (1908).

² Cf. Lubbock, *Seedlings*, ii. 531, f. 666 (1892).

mediate between that species and *A. glutinosa*. The branchlets are glabrous and covered with wax glands. This hybrid, which in general aspect strongly resembles *A. cordata*, but is readily distinguished by the thinner leaves, not cordate at the base, appears to be very vigorous in growth at Kew, where there is a tree growing beside the lake, which is 72 feet in height and 5 feet in girth. The bark is like that of *A. cordata*, being greyish in colour and slightly warty on the surface.

Alnus cordata has a very restricted distribution, being confined to Corsica and southern Italy. In Corsica it ascends to 3000 feet, as at Vizzavona, where I saw it in a beech forest, growing not only beside a stream, but also on the side of the hill at some little distance off. Here the trees were about 70 feet high and 5 feet in girth, with clean timber to 50 feet, and were narrowly pyramidal in habit, with ascending branches. It grows in southern Italy from the Bay of Naples southwards; and according to Tenore occurs both on marshy ground and in the mountains. It forms woods on Mt. Serino.

This elegant species, with foliage somewhat resembling at a distance that of the Caucasian lime, which is retained late in the autumn, was introduced, according to Loudon,¹ in 1820. It flowers in March, before the leaves appear; and seems to grow as fast and to be as hardy as the common alder.

It supports well the climate of the north of France; and at Nancy, where the winters are severe, flowers and fruits regularly, and has attained 7 inches in diameter after twelve years' growth. According to Mouillefert,² it succeeds better on dry soils than either the common or the grey alder; and has been planted on the chalky soil of Champagne, where it is treated as coppice with a short revolution. At Grignon it has borne -4° Fahr. without injury, but suffered in 1880, when the temperature fell to -13° Fahr. Here on poor chalky soil it has attained, at thirty-five years old, 48 feet in height and 2 feet 8 inches in girth; and on better soil, 64 feet by 3 feet 1 inch.

The finest tree that we have seen of this species grows on the lawn at Tottenham House, Savernake, Wilts, and is a well-shaped tree, measuring no less than 69 feet high by 9 feet 3 inches in girth at four feet from the ground (Plate 254). When Elwes found it on April 3, 1908, it was in full flower, and covered with the cones of the previous year. It does not appear to be a very old tree, and is growing in a deep and rather heavy soil overlying chalk, at an elevation of about 400 feet.

In the new park at Merton Hall, Thetford, a tree, growing in a wind-swept situation, on very dry, light, sandy soil, measured in 1908, 50 feet high and 10 feet in girth, with a spread of branches 56 feet in diameter. Lord Walsingham believes that this tree was planted about 1843, as the new park was enclosed in the preceding year. The bark at the base is deeply fissured and scaly.

¹ *Arb. et Frut. Brit.* 1689 (1838); but in Loudon, *Gard. Mag.* 1837, p. 143, and 1839, p. 39, a tree at Britwell House, Bucks, growing on gravelly soil, was reported to be 60 feet high; and this would show that the date of introduction was earlier than 1820. So far as we can learn, this tree no longer exists.

² *Essences Forestières*, 252 (1903). However, two trees at Verrières near Paris, about 80 years old, have only attained 60 feet in height and 5 feet 8 inches in girth; and M. Philippe L. de Vilmorin states (*Hortus Vilmorinianaus*, 54 (1906)), that their growth seems to have come long ago to a standstill.

A specimen is growing at Milford House, near Godalming, which was planted by the famous botanist and traveller, Phillip Barker Webb. The present owner, R. W. Webb, Esq., informed us in 1905 that it was very healthy, measuring 8 feet in girth, and estimated to be about 50 feet in height.

There is a fine tree growing near the pond in front of the palm-house in Kew Gardens, which is 71 feet high by 5 feet 8 inches in girth. At Tortworth, a tree measures 60 feet high by 6 feet in girth; and at Waterer's Nursery, Knaphill, Woking, another is 50 feet by 5 feet 10 inches.

At Nuneham Park, Oxford, a tree, growing on hilly dry ground, on the green-sand formation, measures 51 feet by 5 feet 5 inches, and is very thriving. Elwes has seen a tree at Bicton, measuring 65 feet by 5 feet 10 inches, and another at Melbury, where it grows vigorously and fruits.

In the playing fields at Eton, on the banks of the Thames, there are two trees, the larger of which is 40 feet high by 6 feet 4 inches in girth. These were in full foliage on 17th November 1907, having scarcely lost a leaf, and were bearing fruit. They have not developed tall straight stems, as in the other places where the tree is thriving; and this is probably owing to their position being exposed to easterly and north-easterly winds. At Ponfield, Herts, a young tree 35 feet by 2 feet 4 inches in 1906 is doing well on dry soil; and there is a good specimen in the Cambridge Botanic Garden. Another at Yattendon Court, Berks, is 50 feet by 3 feet 8 inches.

In Scotland it also grows well at the Botanic Gardens, Edinburgh, where there is a tree 60 feet by 5 feet 10 inches; and in the west at Castle Kennedy, and at Monreith, where Elwes saw a tree 30 feet high, bearing cones in September 1906.

There is a fine specimen in the Glasnevin Botanic Garden, which is 64 feet high by 5 feet 4 inches in girth. (A. H.)

ALNUS SUBCORDATA, CAUCASIAN ALDER

Alnus subcordata, C. A. Meyer, *Verz. Pfl. Kauk.* 43 (1831); Winkler, *Betulacea*, 112 (1904).
Alnus cordifolia, Tenore, var. *subcordata*, Regel, in *Mém. Soc. Nat. Mosc.* xiii. 170 (1861), and in DC. *Prod.* xvi. 2, p. 185, (1868).

A tree, attaining about 60 feet in height. Bark grey, warty on the surface, ultimately scaling at the base of old trunks. Young branchlets pubescent. Leaves (Plate 268, Fig. 5) about 4 inches long and $2\frac{1}{2}$ inches broad, ovate-oblong, rounded and unequal or subcordate at the base, cuspidate-acuminate at the apex; coarsely serrate or bi-serrate in the upper half, finely serrate in the lower half; nerves, about eight pairs, running to the margin; upper surface dark green, slightly pubescent; lower surface light green, pubescent throughout, the pubescence densest along the nerves and in the axils; petiole, $\frac{3}{4}$ inch, pubescent. Staminate catkins, three to five in a raceme. Cones solitary or several, ovoid-elliptic, about an inch long; nutlets broadly ovoid, with a very narrow wing.

This is a moderate-sized tree, occurring in the province of Talysch in

the Caucasus, and in the provinces of Asterabad and Ghilan in Persia, where Dr. Stapf informs me that he has seen large trees south of the Caspian Sea.

It is closely allied to, if not identical with *Alnus orientalis*, Decaisne, a native of Asia Minor and Cyprus. The latter has not been introduced, so far as we know, into English or continental gardens.

It was known in cultivation a good many years ago in France, as Gay records¹ a tree 30 feet high growing at Verrières in 1861; but we are unaware of the exact date of its introduction into England. It appears to grow as well and to be as hardy in England as *A. cordata*; and a fine tree, growing near the lake in Kew Gardens, is 52 feet high and 4 feet 10 inches in girth. There is a small specimen at Aldenham.

(A. H.)

ALNUS FIRMA

Alnus firma, Siebold et Zuccarini, *Abh. Akad. München*, iv. 3. p. 230 (1845); Sargent, *Forest Flora Japan*, 63 (1894); Winkler, *Betulaceae*, 102 (1904).

Alnus Sieboldiana, Matsumura, *Journ. Coll. Sci. Tokyo*, xvi. 5, p. 3 (1902).

Alnus yasha, Matsumura, *op. cit.* p. 4 (1902).

Alnus pendula, Matsumura, *op. cit.* p. 6 (1902).

Alnus multinervis, Schneider, *Laubholzkunde*, 123 (1904).

A tree, attaining in Japan a height of 30 feet, but usually smaller. Young branchlets three-angled at the tip, pubescent. Leaves (Plate 268, Fig. 2) about 4 inches long and $1\frac{3}{4}$ inch broad, plicate; nerves deeply immersed above and very prominent beneath, about fifteen to eighteen pairs, running parallel and straight to the margin; ovate-lanceolate, rounded and unequal at the base, acuminate at the apex; upper surface dark green, shining, glabrous; lower surface light green, pubescent, the pubescence strongest on the midrib and nerves; margin finely and regularly serrate, ciliate; petiole $\frac{1}{2}$ inch, pilose; stipules often persistent, ovate-lanceolate, $\frac{1}{2}$ inch long, membranous, glabrous. Buds sessile, conical, long-pointed, curved, green, glabrous, with two external scales.

Flowers appearing in spring. Staminate catkins terminal or lateral, 1 to $2\frac{1}{2}$ inches long. Pistillate catkins, one, two, or three to five, arising from one bud. Cones, solitary or racemose, variable in size, $\frac{1}{2}$ to 1 inch long, in the different varieties. Nutlets, obovate-oblong or sub-rhomboid with a membranous wing.

This alder displays great variation in Japan, no less than three distinct species being recognised by Matsumura and Schneider. These appear to be geographical varieties:—

1. Var. *multinervis*, Regel in *Bull. Soc. Nat. Mosc.* xxxviii. 2. 423 (1865), and in DC. *Prod.* xvi. 2, p. 183 (1868). *Alnus pendula*, Matsumura. *Alnus multinervis* Schneider.

Branchlets pubescent. Leaves with numerous lateral nerves, eighteen pairs or more. Cones in pendulous racemes, $\frac{3}{8}$ inch long. This form is the

¹ Note with a specimen in Kew Herbarium. This tree is not mentioned in *Hortus Vilmorinianus* (1906).

only one in cultivation, and grows on the banks of streams in sub-alpine regions in Yezo and Hondo.

2. Var. *Sieboldiana*, Winkler, *loc. cit.* *Alnus Sieboldiana*, Matsumura.

Branchlets glabrous. Lateral nerves twelve to fifteen pairs. Cones solitary, 1 inch long. A native of the sea-coast in Hondo.

3. Var. *yasha*, Winkler, *loc. cit.* *Alnus yasha*, Matsumura.

Branchlets pubescent. Lateral nerves twelve to fifteen pairs. Cones solitary or racemose, $\frac{3}{4}$ inch long. Occurs in mountain woods in Kiusiu, Shikoku, and Hondo.

According to Sargent, *Alnus firma* is largely planted along the borders of rice-fields near Tokyo, to afford support for the poles on which the freshly cut rice is hung to dry. He observed var. *multinervis* on the mountains of Hondo, where it grows on dry rocky soil and reaches 5000 feet elevation, and describes it as a graceful tree 20 to 30 feet in height. The species, as mentioned above under the varieties, is widely distributed throughout the whole of Japan.

It was introduced by Sargent into New England in 1892; and, according to Winkler, was brought by Zabel into the forest garden of Münden in Germany. There are trees 6 to 10 feet in height in the collection at Kew. It is a remarkably distinct species, with plicate many-nerved leaves, recalling those of two other Japanese trees, viz.: *Carpinus japonica* and *Acer carpinifolium*; and is worthy of a place in collections of shrubs, as it scarcely can be considered to be a tree.

(A. H.)

ALNUS JAPONICA, JAPANESE ALDER

Alnus japonica, Siebold et Zuccarini, *Abh. Akad. München*, iv. 3, p. 320 (1845); Sargent, *Garden and Forest*, vi. 343, f. 53 (1893), and *Forest Flora, Japan*, 63, t. 20 (1894); Shirasawa, *Icon. Ess. Forest. Japon.*, text 38, t. 19, ff. 18-34 (1900); Winkler, *Betulaceae*, 114 (1904).

Alnus maritima, Nuttall, var. *japonica*, Regel, in DC. *Prod.* xvi. 2, p. 186 (1868).

Alnus maritima, Nuttall, var. *formosana*, Burkill, *Journ. Linn. Soc. (Bot.)* xxvi. 500 (1899).

A tree attaining about 80 feet in height. Young branchlets usually glabrous. Leaves (Plate 268, Fig. 12) about 4 inches long and $1\frac{1}{2}$ to $1\frac{3}{4}$ inch wide, lanceolate or narrowly elliptical, cuneate at the base, long-acuminate at the apex; margin not lobulate, finely serrate; nerves, about twelve pairs, mostly running to the margin; upper surface dark green, shining, pubescent on the midrib and nerves; lower surface light green, glabrous except for minute axil-tufts; petiole about $\frac{1}{2}$ inch, slightly pubescent. Buds minute, stalked, glabrous, glandular.

Flowers,¹ appearing in spring, the fruit ripening in autumn; otherwise similar to *Alnus maritima*.

This species occurs in Japan, Manchuria, Korea, and Formosa. In Manchuria² it grows along the sea-coast from St. Olga Bay southwards, and also inland, either solitary or in groups, in sandy soil along the rivers. It has been collected in Korea

¹ In Formosa, according to Burkill, the flowers are produced later, in summer; and he adduces this as a reason for uniting this species with the American *A. maritima*.

² Komarov, *Flora Manchuriae*, ii. 60 (1904).

at Port Chusan; and in Formosa, it grows near Tamsui at the north end of the island. According to Sargent, it is the most beautiful and largest of the alders in Japan, forming a pyramidal tree, often 70 or 80 feet in height, and well furnished to the ground with branches clothed with large dark green lustrous leaves. It differs from *A. maritima* in the larger, differently shaped and coloured leaves, and in the time of flowering.

Sargent states that it is perfectly hardy in New England, where it grows rapidly and promises to become a large and handsome tree. It was introduced, according to Nicholson,¹ in 1886. There are small healthy trees in the collection at Kew; and at Aldenham a specimen is about 14 feet high. (A. H.)

ALNUS NITIDA, HIMALAYAN ALDER

Alnus nitida, Endlicher, *Gen. Pl. Suppl.* IV. ii. 20 (1847); Brandis, *Forest Flora N.-W. India*, 460, t. 57 (1874), and *Indian Trees*, 623 (1906); Hooker, *Flora Brit. India*, v. 600 (1888), and *Bot. Mag.* t. 7654 (1899); Gamble, *Indian Timbers*, 670 (1902); Winkler, *Betulaceae*, 108 (1904).

Clethropsis nitida, Spach, *Ann. Sc. Nat. sér. 2*, xv. 202 (1841); Cambessedes in Jacquemont, *Voy. dans l'Inde, Bot.* 159, t. 159 (1844).

A large tree attaining 100 feet in height and 15 feet in girth. Bark blackish, with thin quadrangular scales. Young branchlets densely and minutely pubescent. Leaves (Plate 268, Fig. 3) about 5 inches long, and 2½ inches broad, ovate-elliptical or elliptical, base rounded or cuneate, apex acuminate; margin entire, obscurely crenate, or remotely and slightly serrate; thin in texture; nerves, nine to twelve pairs, looping before reaching the margin; upper surface dark green, glabrous, shining; lower surface light green, glabrous except for slight axil-tufts; petiole, ¾ to 1 inch, minutely pubescent. Male catkins, 2 inches long, in terminal erect, often leafy racemes. Cones, ¾ to 1½ inch long, three to five in erect lateral racemes; nutlet with a narrow thickened margin. The flowers in this species open in September.

Alnus nitida occurs in the north-western Himalaya, from Kashmir to Kumaon, usually at low elevations, 2000 to 4000 feet, fringing the banks of rivers, and not uncommonly descending with them into the plains. It occasionally, however, ascends as high as 9000 feet; and is common on the Sutlej in the dry region of Kunawar, as far as Spui on the right bank and Namgia on the left bank, according to Brandis, who states that it attains 100 feet high and 15 feet in girth; but Gamble has never seen it so big, and says it is usually crooked and branching. An attempt was made recently to float out the wood from the Tons river forest, but failed, as the timber quickly became waterlogged. The bark is used for tanning and dyeing.

Alnus nitida is one of the few Himalayan broad-leaved trees which have

¹ *Diet. Gardening, Suppl.* 34 (1900).

succeeded in this country, where, however, it is little known, the only trees in cultivation¹ that we know of being three thriving specimens which are growing near the lake in Kew Gardens. The largest of these is now 40 feet by 2 feet 3 inches in girth. They were raised from seed sent by Mr. R. E. Ellis of the Indian Forest Department in 1882. (A. H.)

ALNUS MARITIMA

Alnus maritima, Nuttall, *Sylva*, i. 34 (1842); Sargent, *Garden and Forest*, iv. 268, t. 47 (1891), *Silva N. Amer.* ix. 81, t. 458 (1896), and *Trees N. Amer.* 215 (1905); Winkler, *Betulaceae*, 114 (1904).

Alnus oblongata, Regel, *Mém. Soc. Nat. Mosc.* xiii. 171 (1861) (in part).

Betula-Alnus maritima, Marshall, *Arb. Am.* 20 (1785).

A tree attaining in America 30 feet in height and 1 foot in girth. Bark smooth, greyish-brown. Young branchlets slightly pubescent, three-angled at the tip. Leaves (Plate 268, Fig. 11) in cultivated specimens 2½ inches long, 1¾ inch wide, somewhat larger in wild specimens, ovate or obovate, cuneate at the base; acute, slightly acuminate, or rounded at the apex; nerves, eight to twelve pairs, running to the margin; margin not lobulate, remotely serrate in the upper two-thirds with minute incurved glandular teeth; upper surface dark green, shining, glabrous; lower surface light green, glabrous; petioles ½ inch, slightly pubescent. Buds minute, stalked, ovoid, glabrous, slightly glandular.

Flowers appearing in July on the branches of the year, and opening in September. Staminate catkins in scurfy pubescent racemes in the axils of the upper leaves. Pistillate catkins usually solitary from the axils of the lower leaves. Cones ripening in the following September, so that both flowers and ripe fruit occur simultaneously on the tree, ovoid, ⅝ inch long; nutlet obovate, narrowed and apiculate at the apex, with a thin membranous border.

This alder grows on the banks of streams and ponds in Delaware and Maryland, usually near, but not immediately upon the sea-coast, as its name would seem to imply. However, it abounds on the banks of the Nanticoke and Wicomico rivers in Maryland, near the high-water mark. What appears to be the same species was collected by Hall on the Red River in Indian Territory.

It was introduced into cultivation by Thomas Meehan, who sent it in 1878 to the Arnold Arboretum, where it is tolerably hardy, flowering and fruiting freely, though it was killed to the ground in 1885. There are now two trees, about 6 feet high, growing in the nursery at Kew, which were sent by Prof. Sargent in 1899. These flower in September, and produce fruit in quantity. (A. H.)

¹ Mr. A. B. Jackson has lately seen a tree at Grayswood, Haslemere, which is 18 feet high and 9 inches in girth.

ALNUS RUBRA, OREGON ALDER

Alnus rubra, Bongard, *Mém. Acad. St. Pétersb.* ii. 162 (1833); Winkler, *Betulaceae*, 124 (1904); Sargent, *Bot. Gazette*, xlv. 226 (1907).
Alnus oregona, Nuttall, *Sylva*, i. 28, t. 9 (1842); Sargent, *Silva N. Amer.* ix. 73, t. 454 (1896), and *Trees N. Amer.* 210 (1905).
Alnus incana, Moench, var. *rubra*, Regel, *Mém. Soc. Nat. Mosc.* xiii. 157 (1861).

A tree attaining 80 feet in height and 10 feet in girth. Bark greyish or whitish, thin, roughened by minute wart-like excrescences. Young branchlets glabrous, three-angled at the tip, scarcely viscid except at the beginning of the season. Leaves (Plate 268, Fig. 16) about 4 or 5 inches long and $2\frac{1}{2}$ inches wide, ovate or elliptical, rounded or cuneate at the base, acute at the apex; nerves, about 15 pairs, each running straight and parallel to the apex of a lobule, which is furnished with minute gland-tipped serrations; margin slightly revolute and ciliate; upper surface dark green, slightly pubescent; lower surface whitish or greyish, covered with a minute brown pubescence; petiole, $\frac{3}{4}$ inch, with a few scattered hairs. Buds beaked at the apex, glabrous, stalked. Stipules ovate, acute, tomentose, $\frac{1}{8}$ to $\frac{1}{4}$ inch long.

Flowers opening in spring before the leaves. Staminate catkins, three to six in a raceme, 4 to 6 inches long when fully opened. Cones, three to six in a raceme, $\frac{1}{2}$ to 1 inch long, with truncate scales, much thickened at the apex; nutlet orbicular or obovate, surrounded by a membranous wing.

This species can only be confused with *A. incana*, from which it differs in the glabrous branchlets and the usually larger leaves with revolute margins. The buds also differ, those of *A. rubra* being elongated, pointed, and glabrous, whilst those of *A. incana* are shorter, rounded at the apex, and pubescent.

Alnus rubra, according to Sargent, ranges from Sitka, where it often clothes mountain-sides to elevations of 3000 feet above the sea, southwards through the islands and coast ranges of British Columbia, and through western Washington and Oregon, and the cañons of the Californian coast ranges, to the Santa Inez mountains near Santa Barbara. It grows to its largest size in the neighbourhood of Puget Sound, where it commonly fringes the banks of streams and grows in wet places.¹

This species was introduced into cultivation a few years ago, and there are two trees in Kew Gardens about 15 feet in height. Elwes has raised seedlings from these trees, which grow very rapidly in heavy soil at Colesborne, but being planted in a situation very subject to late frosts, have suffered on several occasions, when the grey and common alders standing near were quite untouched.

The wood is light, soft, brittle, and not strong, but close-grained and takes a fine polish; and is now largely used in Washington and Oregon for making furniture.

(A. H.)

¹ In Vancouver Island, the stem and branches are often covered with *Polypodium falcatum*, the creeping rhizomes of which find anchorage in its moss-covered bark. Cf. *Postelsia*, 1906, p. 76. A figure of the tree, growing in a moist part of the forest and surrounded by devil's club (*Echinopanax horridum*), is given in Piper, *Flora of the State of Washington*, plate vii. (1906).

ALNUS TENUIFOLIA

Alnus tenuifolia, Nuttall, *Sylva*, i. 32 (1842); Sargent, *Silva N. Amer.* ix. 75, t. 455 (1896), and *Trees N. Amer.* 211 (1905); Winkler, *Betulaceae*, 124 (1904); Schneider, *Laubholzkunde*, 133 (1904).
Alnus incana, Moench, var. *glauca*, Regel, *Mém. Soc. Nat. Mosc.* xiii. 154 (1861) (in part).
Alnus incana, Moench, var. *virescens*, Watson, in Brewer and Watson, *Bot. Calif.* ii. 81 (1880).
Alnus occidentalis, Dippel, *Laubholzkunde*, ii. 158 (1892); De Wildeman, *Icon. Select. Hort. Thenensis*, ii. 147, t. 75 (1901).

A tree attaining 30 feet in height and 2 feet in girth. Bark bright red-brown, broken on the surface into small scales. Young branchlets glabrous. Leaves (Plate 268, Fig. 15) about 3 inches long by 2 inches wide, ovate, broad and rounded at the base, acute or shortly acuminate at the apex; nerves, nine or ten pairs, running parallel and straight to the margin, and ending in acute triangular lobes, which are finely serrate; upper surface dark green, pubescent on the midrib and nerves; lower surface yellowish green, glandular, pubescent on the midrib with slight axil-tufts; petioles pubescent, $\frac{3}{4}$ to 1 inch long. Buds stalked, pubescent at the base. Stipules deciduous, lanceolate, acute, pubescent. Staminate catkins, three to four, in slender-stemmed racemes; stamens four. Cones, ovoid-oblong, $\frac{1}{3}$ to $\frac{1}{2}$ inch long, three to four in a raceme; scales thickened, three-lobed and truncate at the apex; nutlets nearly circular, surrounded by a thin membranous border.

This species, distributed over a wide area, shows two well-marked geographical varieties:—

1. Var. *virescens*, Callier. This is the commonest form, and has been described above (Plate 268, Fig. 15).

2. Var. *occidentalis*, Callier. *Alnus occidentalis*, Dippel. Leaves (Plate 268, Fig. 14) larger, 4 to 5 inches long and 3 to 4 inches wide; nerves, twelve pairs; slightly bluish-green and pubescent throughout beneath; stipules ovate, broad, obtuse. This variety is rare, and has only been observed in British Columbia and Oregon.

This species is widely distributed in western North America. It occurs in British Columbia, from Francis Lake in lat. 61° to the valley of the Lower Fraser River, and extends eastward along the Saskatchewan River to Prince Albert. It extends southwards along the Rocky Mountains to northern New Mexico, and is the common species in the northern interior region, east of the divide of the Cascade Mountains, in eastern Washington, Oregon, Idaho, and Montana. It is very abundant on the southern California Sierra, forming great thickets at 6000 to 7000 feet above the sea, along the head-waters of the rivers of southern California flowing to the Pacific Ocean. It is equally abundant and attains its largest size in Colorado and northern New Mexico, and is met with in Nevada and Utah.

This species is rare in cultivation. There are two or three trees of each variety in the alder collection at Kew, which are about 15 feet in height, and show no special beauty or vigour. Var. *virescens* is thriving at Aldenham; and a fine specimen

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at Grayswood, Haslemere, planted in 1888, is now about 30 feet in height and 1 foot 8 inches in girth.

According to De Wildeman, var. *occidentalis* was introduced from British Columbia in 1891, by Dieck and Purpus, into the arboretum at Zoschen.

ALNUS RHOMBIFOLIA

Alnus rhombifolia, Nuttall, *Sylva*, i. 33 (1842); Sargent, *Silva N. Amer.* ix. 77, t. 456 (1896), and *Trees N. Amer.* 212 (1905); Winkler, *Betulaceae*, 115 (1904).
Alnus oblongifolia, Watson, in Brewer and Watson, *Bot. Calif.* ii. 80 (1880) (in part).

A tree attaining 80 feet in height and 9 feet in girth. Young branchlets pubescent. Leaves (Plate 268, Fig. 13) on young trees up to 5 inches long and 3 inches broad, on old trees 3 inches long and $1\frac{1}{2}$ inch broad, ovate or oval, rounded and unequal at the base, acute or rounded at the apex; margin slightly thickened and reflexed, finely and irregularly serrate, and ciliate; nerves, ten or eleven pairs, running parallel and slightly curved to the margin; upper surface dark green, shining, glabrous; lower surface light green, pubescent, the pubescence strongest on the midrib and nerves; petiole, $\frac{1}{2}$ inch, pubescent. Buds stalked, pubescent. Staminate catkins, in pubescent racemes, deciduous before the opening of the leaves; stamens, two or three, rarely one. Cones oblong, $\frac{1}{3}$ to $\frac{1}{2}$ inch long, fully grown at midsummer, but remaining closed till the trees flower in the following year; nutlet broadly ovate with a thin, acute margin.

This species grows on the banks of streams from northern Idaho to the eastern slope of the Cascade Mountains in Washington and Oregon, extending southward over the coast ranges and along the western slopes of the Sierra Nevada to the mountains of southern California. It is the common alder of central California, and the only species at low altitudes in the southern part of this state.

It is extremely rare in cultivation, the only specimen which we have seen being a small plant in Lord Aldenham's remarkable collection of shrubs and trees at Aldenham, Herts. According to Nicholson,¹ it was introduced into cultivation in 1888.

¹ *Dict. Gardening, Suppl.* 34 (1900).

BETULA

Betula, Linnæus, *Sp. Pl.* 982 (1753); Bentham et Hooker, *Gen. Pl.* iii. 404 (1880); Winkler, in Engler, *Pflanzenreich*, iv. 61, *Betulaceae*, 56 (1904).
Betulaster, Spach, in *Ann. Sc. Nat. sér. 2*, xv. 198 (1841).
Aptercaryon and *Chamabetula*, Opiz, in *Lotos*, v. 258 (1855).

DECIDUOUS trees or shrubs belonging to the order Betulaceæ. Bark smooth with longitudinal lenticels, often peeling off in papery strips, and becoming on old trunks thick and furrowed near the base. Branchlets of two kinds: long shoots with several leaves and axillary buds, no true terminal bud being formed; and short shoots or dwarf spurs, each with two (rarely one or three) leaves and a terminal bud. Buds viscid, elongated, ovoid, fully grown and green at midsummer, composed of imbricated scales, but with the two basal ones short and lateral, usually only four scales being visible externally; inner scales accrescent, and marking in falling the base of the shoots with ring-like scars. Leaves alternate, simple, stalked, penninerved; serrate, dentate or incised. Stipules lateral, enclosing the leaf in the bud, fugacious. Flowers monœcious, fertilised by the wind, in cylindrical catkins, composed of closely imbricated three-lobed scales, with three flowers on each scale. Male catkins,¹ formed in the preceding autumn, clustered in the axils of the upper leaves of a long shoot, erect and naked during winter, pendulous in spring. Staminate flowers, with a one- to four-lobed calyx; stamens two, with short bifurcated filaments, each of the four branches bearing an erect half-anther, there being thus apparently twelve stamens on each scale. Pistillate catkins, solitary, or two to four in a raceme, terminal on the short shoots, and appearing with the leaves in spring. Pistillate flowers, without a calyx, two-celled, with one ovule in each cell; styles two, stigmatic at the apex. Cones, ripening² usually in autumn, composed of woody three-lobed scales and small fruits, deciduous together; nutlets oval or obovate, compressed, bearing the persistent styles at the apex, and with the outer shell produced into a marginal transparent wing, interrupted at the apex; seed solitary, pendulous, without albumen.³

In winter, species of *Betula* are readily distinguished by the short shoots on the older wood, which end in a terminal bud, and are densely clothed with scars, as each season's growth is very short and marked by two crescentic leaf-scars in addition to the ring-like scars left by the fall of the scales of the bud of the previous spring. The long shoots show similar ring-like scars at the base, and bear axillary buds

¹ In some of the shrubby species the male catkins are solitary on the ends of the short shoots, and remain enclosed in the buds during winter, appearing in spring.

² In *B. nigra* the fruit ripens in May or June.

³ The cones, scales, and fruits shown in Plates 269 and 270, were all drawn by Miss F. H. Woolward, except in the case of Figs. 8 and 16.

arranged alternately. The leaf-scars, semicircular or crescentic, and three-dotted, have on each side a linear stipule-scar. The pith of the twigs is oblong in section.

About thirty species of *Betula* are known, all natives of the northern hemisphere, extending from the Arctic circle to Texas in the New World, and to southern Europe, the Himalayas, China, and Japan in the Old World. A considerable number are shrubs, the treatment of which does not come within the scope of our work. Of the arborescent species, a few, either not introduced or imperfectly known, are not included in the following account.

B. corylifolia, Regel et Maximowicz, though not yet introduced, is included in the key and fully described below, as it is very distinct and has been much confused with other Japanese species.

There are young plants in the nursery at Kew, received from the Arnold Arboretum, as *B. globispica*, Shirai,¹ which appear to be a very distinct species; but, as there is no authentic material in the Kew Herbarium with which to compare them and ascertain if they are correctly named, it is inadvisable to deal with this species at present.

Similarly, young plants of *B. alnoides*, Buchanan-Hamilton, var. *pyrifolia*, Franchet, growing at Coombe Wood, which were raised from seed sent from central China by Wilson in 1901, are left undescribed, as they show considerable variation, and we cannot be certain, until they have borne fruit, of their identification.

KEY TO ARBORESCENT SPECIES OF BETULA IN CULTIVATION

I. Branchlets and leaves quite glabrous.

1. *Betula verrucosa*, Ehrhart. Europe, Northern and Eastern Asia. See p. 966.
Leaves bi-serrate, shortly acuminate.
2. *Betula populifolia*, Marshall. North America. See p. 987.
Leaves lobulate and irregularly serrate, ending in a long caudate acumen.

II. Branchlets or leaves or both pubescent.

- * *Leaves cordate at the base.*
3. *Betula Maximowiczii*, Regel. Japan. See p. 976.
Leaves 5 or 6 inches long, broadly ovate.
 4. *Betula ulmifolia*, Siebold et Zuccarini. Japan. See p. 979.
Leaves, 3 inches long, narrowly ovate.
** *Leaves cuneate at the base.*
 5. *Betula pubescens*, Ehrhart. Europe, Northern Asia, Greenland. See p. 962.
Leaves light green beneath, rhombic-ovate, bi-serrate, with six pairs of nerves.
Branchlets not glandular, clothed with minute dense erect pubescence.
 6. *Betula davurica*, Pallas. Manchuria, Korea, North China. See p. 974.
Leaves light green beneath, narrowly ovate, bi-serrate, with six to eight pairs of nerves. Branchlets glandular, with minute erect pubescence interspersed with a few long hairs.

¹ The Japanese name of this species, according to Matsumura and Goto, is *Jizo-kamba*.

7. *Betula nigra*, Linnæus. North America. See p. 988.

Leaves greyish beneath, ovate, acute, with large serrated teeth, and six to eight pairs of nerves. Branchlets glandular, tomentose.

*** *Leaves rounded or truncate at the base.*

A. Leaves orbicular or oval.

8. *Betula corylifolia*, Regel et Maximowicz. Japan. See p. 975.

Leaves acute, pale beneath with conspicuous silky hairs on the midrib and nerves; nerves twelve to fourteen pairs.

B. Leaves ovate-oblong, considerably longer than broad, and widest near the middle.

9. *Betula lutea*, Michaux. North America. See p. 990.

Leaves, with nine to twelve pairs of nerves, pilose on the midrib and nerves of both surfaces, and on the petiole. Branchlets pilose.

10. *Betula lenta*, Linnæus. North America. See p. 991.

Leaves with nine to twelve pairs of nerves, pilose on the midrib and nerves of both surfaces; petiole glabrescent. Branchlets glabrous, except for a few hairs above the leaf-insertions.

11. *Betula utilis*, Don. Himalayas, China. See p. 980.

Leaves, with nine to twelve pairs of nerves; lower surface with dense axil-tufts of pubescence; petiole tomentose. Branchlets tomentose.

C. Leaves ovate, not much longer than broad, widest near the base.

† *Branchlets very glandular.*

12. *Betula Ermani*, Chamisso. Eastern Siberia, Manchuria, Japan. See p. 977.

Leaves truncate at the base, with ten to twelve pairs of nerves, glabrescent and conspicuously glandular beneath. Branchlets glabrous.

13. *Betula fontinalis*, Sargent. Western North America. See p. 992.

Leaves thin in texture; rounded, truncate, or subcordate at the base, with six pairs of nerves; both surfaces minutely glandular, with scattered long hairs. Branchlets with long pale hairs.

‡ *Branchlets not conspicuously glandular.*

14. *Betula papyrifera*, Marshall. North America. See p. 983.

Leaves about 3 inches long, with six to eight pairs of nerves; lower surface glandular and with conspicuous axil-tufts. Branchlets pubescent or glabrous.

15. *Betula utilis*, Don, var. *Jacquemontii*, Regel. Himalayas. See p. 981.

Leaves about 3 inches long, with seven or eight pairs of nerves; lower surface glandular, with long hairs on the midrib and nerves, and without conspicuous axil-tufts. Branchlets with short, erect, dense pubescence.

16. *Betula luminifera*, Winkler. Central China. See p. 980.

Leaves, 5 or 6 inches long, with ten to fourteen pairs of nerves, pubescent on both surfaces. Branchlets with dense erect pubescence.

(A. H.)

BETULA PUBESCENS, COMMON BIRCH

Betula pubescens, Ehrhart, *Beit. Naturk.* vi. 98 (1793); Mathieu, *Flore Forestière*, 415 (1897); Winkler, *Betulaceæ*, 81 (1904).

Betula tomentosa, Reitter and Abel, *Abbild. Holzart*, i. 17 (1790).

Betula alba, Linnæus, *Sp. Pl.* 982 (1753) (in part); Roth, *Tent. Fl. Germ.* i. 404 (1788); Willkomm, *Forstliche Flora*, 302 (1887); Schneider, *Laubholzkunde*, i. 116 (1904).

Betula alba, Linnæus, var. *pubescens*, Loudon, *Arb. et Frut. Brit.* iii. 1691 (1838).

Betula odorata, Bechstein, *Diana*, i. 74 (1797).

A tree, usually attaining 70 or 80 feet in height, and 5 or 6 feet in girth, occasionally larger. Branches ascending or spreading, branchlets usually not pendulous. Bark smooth, white, and papery, often peeling off in transverse shreds, with black triangular markings below the insertion of the branches; thick and deeply furrowed at the base of old stems. Young branchlets covered with short, erect pubescence, often minute and only discernible with a lens, usually retained in the second year. Leaves (Plate 269, Fig. 1), $1\frac{1}{2}$ inch to 2 inches long, $\frac{3}{4}$ inch to $1\frac{1}{2}$ inch wide, rhomboid-ovate or ovate, usually cuneate at the base, acute or acuminate at the apex; margin ciliate and coarsely serrate; nerves, five or six pairs; upper surface with scattered pubescence; lower surface pubescent on the midrib and nerves; petiole, $\frac{1}{2}$ inch, pubescent and glandular.

Fruiting-catkins (Plate 269, Fig. 1), cylindrical, about 1 inch long, $\frac{1}{3}$ inch wide, at first erect, afterwards pendulous, on long pubescent stalks; scales, puberulous, ciliate, with the central lobe more prolonged than is the case in *B. verrucosa*, and with the lateral lobes angular and usually erect, but occasionally recurved.¹

In winter the twigs are slender, dark brown, densely covered with short, erect pubescence. Buds, $\frac{1}{5}$ inch long, ovoid, rather blunt at the apex, viscid, with glabrous, ciliate scales.

Seedling.²—Cotyledons, about $\frac{1}{6}$ inch long, oblong-ovate, obtuse, glabrous, with pubescent petioles, about $\frac{1}{8}$ inch long. Caulicle short, pubescent, raising the cotyledons above the ground. Stem pubescent and non-glandular, bearing primary leaves, which are alternate, ovate, cordate at the base, simply and coarsely serrate, and pubescent.

The birch,³ under ordinary conditions of growth, does not produce root-suckers; however, when cut down, although coppice shoots are not given off from the stool, the roots give rise to numerous tomentose shoots, which bear leaves larger than those of ordinary branches, cordate at the base, dentate in margin, and pubescent on both surfaces.

¹ When the lateral lobes are recurved, the scales are similar in shape to those of *B. verrucosa*; and in such cases we may suspect a hybrid between the two species or an intermediate form. The pubescent stalks of the catkins and the puberulous scales are, however, apparently characteristic of *B. pubescens*.

² Cf. Lubbock, *Seedlings*, ii. 541, fig. 672 (1892).

³ Cf. Dubard, in *Ann. Sc. Nat.* xvii. 169, plate 2, fig. 4 (1903).

The witches' brooms, which are so common on birch trees, are generally supposed to be due to a fungus, *Exoascus betulinus*, the threads of which penetrate the young growing twigs, causing them to branch repeatedly and thus form large, irregular, nest-like clusters. Miss Ormerod,¹ however, states that these abnormal growths are caused by the development of unhealthy buds, which have been attacked by a gall-mite.² It is possible that in some cases it is the fungus, and in other cases the gall-mite, which is the cause of these witches' brooms.

A large number of birches were killed in 1900 in Epping Forest by a fungus, identified, by Paulson,³ with *Melanconis stilbostoma*, Tulasne, which attacks the young growing branches.

VARIETIES

This species is very variable in the wild state, both as regards the stature of the tree and the shape, size, and pubescence of the foliage. A large number of varieties have been distinguished by Continental botanists, of which the nomenclature is very confused; and as most of these are separated by inconstant characters and are of no value from the cultivator's point of view, it will be sufficient here to refer the reader to the works of Willkomm, Winkler, and Schneider, where the different forms are fully dealt with. The following varieties are, however, worthy of note:—

1. In Alpine and northern localities this species is often met with as a small shrub with twisted branchlets, but with leaves very variable in character. This group of forms may be distinguished as var. *tortuosa*, Koehne, *Deut. Dend.* 109 (1893).

2. Var. *Murithii*, Gremlin, *Excursionsfl. f. d. Schweiz*, 365 (1893).

B. Murithii, Gaudichaud, *Fl. Helv.* vi. 178 (1830); Christ, *Ber. Schweiz. Bot. Ges.* v. 16 (1895).

An Alpine shrub, occurring in the Bagnes valley, near Mauvoisin (Valais), in Fribourg, and in the Joux valley (Vaud) in Switzerland. This has broadly ovate or ovate-triangular leaves, with large simple serrations, and prominent reticulate venation beneath.

3. Var. *denudata*, Grenier et Godron, *Fl. France*, iii. 147 (1855). This name may be given to a series of forms, characterised by rhombic leaves, cuneate at the base, and glabrous beneath or with only slight axil-tufts. This is often cultivated as var. *pontica*,⁴ var. *carpatica*,⁵ var. *odorata*, etc., and is usually a tree of considerable size.

4. Var. *urticifolia*, Spach, in *Ann. Sc. Nat.*, sér. 2, xv. 187 (1841); Schneider, *Laubholzkunde*, i. 117 (1904).

Betula urticifolia, Regel, in *Mém. Soc. Nat. Mosc.* xiii. 115 (1860); Willkomm, *Forstliche Flora*, 313 (1887); Winkler, *Betulaceæ*, 80 (1904).

¹ *Injurious Insects*, 212 (1890).

² Gillanders, *Forest Entomology*, 25 (1908), identifies the gall-mite with *Eriophes rudis*, Canestrini; and gives a figure of swollen buds on the branch of a birch tree. These had been found in close proximity to a witches' broom.

³ *Essex Naturalist*, xi. 1, p. 273 (1901). Cf. also *Nature*, lxxii. 599 (1900). Mr. Massee thinks that root-rot or unsuitable soil conditions, rather than the fungus, were the cause of death of these trees.

⁴ There is a good-sized healthy tree in the Botanic Garden at Glasnevin, under the name of *B. alba*, var. *pontica*, which was mentioned by Loudon as being, in 1838, thirty-five years old and 35 feet high.

⁵ The true var. *carpatica* (*B. carpatica*, Waldstein and Kitaibel, in Willdenow, *Sp. Pl.* iv. 464 (1805)) is a low tree allied to var. *tortuosa*, the distinctive characters of which are given in Schneider, *op. cit.* 119.

This variety, which was long considered to be a distinct species, has been shown by Beissner and Schneider to be an abnormal form of *B. pubescens*. It differs from the type in the longer, more acuminate, slightly lobed leaves; and in the fruiting-catkins, which are very long ($1\frac{1}{2}$ inch or more) and slender, with pubescent ciliate scales, the middle lobe of which is elongated. The leaves and fruit are shown in Plate 269, Fig. 2.

This peculiar form has been found wild in the province of Wermland, in Sweden, and is only a tree of small dimensions. It is often planted in botanical gardens.

5. Some peculiar forms have arisen in cultivation, as var. *aurea*, young foliage tinted with yellow, sent out a few years ago by G. Paul, Cheshunt Nurseries; and var. *nana*, a dwarf form.

HYBRIDS

1. Hybrids have often been observed between this species and *B. verrucosa*, and have received various names, as *B. hybrida*, Bechstein, in *Diana*, i. 80 (1797); *B. aurata*, Borkhausen, *Forstbot.* i. 498 (1800); *B. glutinosa*, Wallroth, *Sched. Crit.* 497 (1822); and *B. ambigua*, Hampe, in Reichenbach, *Fl. Sax.* 120 (1842). These hybrids are intermediate in the characters of the branchlets, foliage, and fruit; and may be suspected in cases where the branchlets are more or less glandular and show slight pubescence.

2. *B. intermedia*, Thomas, in Gaudichaud, *Fl. Helvet.* vi. 176 (1830), a hybrid between *B. pubescens* and *B. nana*, is a shrub about 10 feet high, with small leaves, which is found in the Swiss Jura, Greenland, Iceland, northern Europe, and Siberia. This has been collected¹ in a few localities in the Highlands of Scotland.

DISTRIBUTION

This species is widely distributed through Europe and northern Asia, extending farther northward than *B. verrucosa*, but not descending so far south. It is the most northerly tree in Europe, growing on the shores of the Arctic Sea from North Cape (lat. 71°) to the mouth of the White Sea; its northern limit eastward through north-eastern Russia and Siberia to Kamtschatka being near the Arctic circle, though in some localities it ascends a degree or two higher. Its southern limit in Russia and Siberia appears to be the edge of the steppes, on which the tree does not grow; but it occurs in the Caucasus and Armenia. Farther westward the southern limit is the Carpathians and the Alps; and the tree is not found in the Apennines or in the Pyrenees, its most southerly point in France being near Grenoble. It is also a native of Iceland and of south-western Greenland. The distribution may then be roughly described as the northern hemisphere, from Greenland in the west to Kamtschatka in the east, between the parallels of 45° and 71° .

As compared with *B. verrucosa*, this species is found on the continent of Europe on wetter soils and in moister climates, and is the birch which grows on marshy ground and on undrained peat-mosses.

¹ Cf. E. S. Marshall, in *Journ. Bot.* xxxix. 271 (1901), and *Bot. Exchange Club Report* for 1904, p. 33.

In Norway, Schübeler distinguishes this species as the highland birch, and speaks of *B. verrucosa* as the lowland birch, the latter not being found north of Snaasen in lat. $64^\circ 12'$, or on the fells higher than 1600 to 1800 feet.

In Russia it forms large pure forests in the provinces of Olonetz and Vologda; while in Esthonia, Livonia, and Finland, it is mixed with pine, spruce, and aspen; farther south it is gradually replaced by *B. verrucosa*, with which, however, it is sometimes associated. Von Sivers¹ states that in the Baltic provinces this species is the characteristic tree of the low-lying moors, and on account of its resistance to May frosts, holds its own with the spruce and common alder. On better soils it forms immense forests, where *Betula humilis* and *Rhamnus frangula* are the underwood, and which are the favourite summer resort of the elk. It never attains such large dimensions as *B. verrucosa*, scarcely ever surpassing 100 feet in height.

In northern Germany, large forests, composed mainly of this species and common alder, are common on marshy ground. In France it is usually met with in the moister parts of the forests or on peat-mosses.

It appears to be much more common, as a wild tree, in the British Isles, than *B. verrucosa*, the moist climate being favourable to its development; and the extensive birch forests of the Highlands of Scotland are usually *B. pubescens*. As the two species have not as a rule been distinguished by collectors, and no discrimination has been made between planted and wild trees, it is impossible at present to give an accurate account of the distribution of the two species in this country. (A. H.)

The distinction between the two forms or species of common birch which is almost universally admitted by Continental botanists and foresters appears to have been generally overlooked in Great Britain; and though most local floras admit both, yet, after much inquiry and investigation, I have found it impossible to define their distribution as indigenous trees. In many districts where the birch now reproduces itself by seed abundantly, the original parents were of both forms, which are not distinguished by nurserymen, though the name "silver birch" is supposed to be, and should correctly be used for the rough-twigged form. The bark of this being more silvery—though this character is variable and disappears with age—and the habit more pendulous and graceful, it should be chosen as an ornamental tree. But, where birch is planted on peat bogs or wet moors in order to produce a timber crop, and to prepare the ground for planting other trees, as has been recommended by Mr. G. U. Macdonald,² or to act as a nurse for other trees, it would be preferable to use the downy-twigged form, which is considered to be more naturally at home and to thrive better on wet than on dry rocky soil.³

But both forms as well as their hybrids grow together in many parts of England and Scotland, and my experience in planting them does not justify me in saying that there is a marked difference in their relative growth or size. However,

¹ *Forst. Verhält. Balt. Prov.* 18 (1903).

² "Protection of Young Spruce from Frost," in *Trans. Roy. Scot. Arb. Soc.* xix. 287 (1906).

³ M. Bommer, Director of the Botanic Garden at Brussels, pointed out to me in the Museum there, characters in the bark by which he could distinguish the two common birches. It seems to me, however, that bark is, especially in the birch, so much influenced by climate, soil, and the age and vigour of the trees, that these characters were not reliable.

when visiting the nursery at Balmoral in 1904, I noticed self-sown seedlings of both forms, in which the distinction was very striking, and took some away with me, which I planted on my trial beds at Colesborne. Of these the growth of *B. verrucosa* has been immensely superior; and Mr. J. Michie, Commissioner to His Majesty at Balmoral, writing to me on the subject, says, "I have no doubt about the rough and smooth twigged birches remaining constant through life; they are distinct varieties, and in nature grow side by side frequently. I do not say that the rough-twigged variety always develops a pendulous habit with age, but it grows larger and has a lighter colour of bark. It generally weeps, on the same ground where the other remains rigid, of less size, and with darker bark."

Birch is the most Alpine tree in Great Britain, and ascends in the Highlands to about 3000 feet.

The Gaelic name of the birch is *beith* (pronounced bey), and according to Sir Herbert Maxwell,¹ is found in various forms in Scottish place-names, as Drumbae, the birch-ridge, Auchenvèy and Largvey in Galloway (*achadh-na-beith*, birch field, and *learg-bheith*, birch hill-side). Beòch in Ayrshire, Galloway, and Dumfriesshire is *beitheach* (beyagh), birch-land.

In Ireland, this word² occurs in many names of places, as Ballybay in Monaghan (mouth of the ford of the birch), Kilbehenny, a village in Tipperary (birch-wood), Aghavea in Fermanagh (birch-field). Beagh is also a common place-name in different parts of Ireland.

(H. J. E.)

BETULA VERRUCOSA, SILVER BIRCH

Betula verrucosa, Ehrhart, *Beit. Naturk.* vi. 98 (1791); Willkomm, *Forstliche Flora*, 314 (1887); Mathieu, *Flore Forestière*, 407 (1897); Winkler, *Betulaceae*, 75 (1904).

Betula pendula, Roth, *Tent. Fl. Germ.* i. 405 (1788); Schneider, *Laubholzkunde*, i. 113 (1904).

Betula alba, Linnæus, *Sp. Pl.* 982 (1753) (in part).

Betula alba, Linnæus, var. *pendula*, Aiton, *Hort. Kew*, iii. 336 (1789); Loudon, *Arb. et Frut. Brit.* iii. 1691 (1838).

Betula rhombifolia, Tausch, in *Flora*, xxi. 2, p. 752 (1838).

Betula lobulata, Kanitz, in *Linnaea*, xxxii. 351 (1863).

Betula odorata, Reichenbach, *Icon. Fl. Germ.* xii. 2, t. 626, f. 1288 (1850) (not Bechstein).

A tree, attaining in Russia 120 feet in height and about 12 feet in girth. Bark like that of *B. pubescens*, but more silvery white in colour. Main branches ascending, smaller branches and branchlets pendulous. Young branchlets glabrous, with scattered minute glands, which are persistent in the second year.

Leaves (Plate 270, Fig. 9) about 1½ to 2 inches long, and 1 to 1½ inch broad, deltoid, with a broadly cuneate base and an acuminate apex; margin biserrate; nerves five or six pairs; both surfaces glabrous and glandular; petiole ¾ inch, glabrous, glandular.

Fruiting-catkins (Plate 270, Fig. 9) cylindrical, about 1 inch long and ½ inch wide, directed towards the apex of the branchlet, on a slender, glabrous, glandular

¹ *Scottish Land Names*, 109 (1894).

² Joyce, *Irish Names of Places*, i. 506 (1883).

stalk, about ½ inch long; scales glabrous, ciliate, with rounded, recurved lateral lobes larger than the middle lobe.

The twigs in winter are slender, shining, glabrous, covered with scattered glands and waxy patches. Buds ovoid, acute, ¼ inch long, appressed to the branchlet, with brown glabrous scales.

The shoots, which spring, as in *B. pubescens*, from the roots, after a tree is felled, are covered with numerous glandular warts and layers of wax, and bear large, incised, pubescent leaves. The seedlings of this species have simply serrate, pubescent leaves resembling those of seedlings of *B. pubescens*,¹ but conspicuously glandular on both surfaces; the stem is pubescent, but bears numerous glands.

VARIETIES

1. Var. *dalecarlica*, Linnæus, f., *Suppl.* 416 (1781), Fern-leaved Birch. Leaves (Plate 270, Fig. 10) produced into a long acuminate apex, and with the margin cut into pinnatifid serrated lobes. This variety has been found growing wild in the provinces of Dalecarlia and Wermland in Sweden, and is occasionally seen in cultivation, there being a good specimen in Kew Gardens.² It is sometimes known in nurseries as *var. laciniata*.

2. Shrubby forms, with leaves smaller than in the type, have been distinguished as *var. oycowiensis*, Regel, in DC. *Prod.* xvi. 2, p. 164 (1868), found growing wild in Silesia and Galicia; and *var. arbuscula*, Winkler, observed by Fries in the wild state in Dalecarlia.

3. Var. *japonica*, Rehder, in Bailey, *Cycl. Am. Hort.* i. 159 (1900); Schneider, *Laubholzkunde*, i. 112 (1904).

Betula japonica, Siebold, *Verh. Batav. Gen.* xii. 25 (1830); Winkler, *Betulaceae*, 78 (1904).

Betula latifolia, Tausch, *Fl. Ratisb.* 751 (1838); Komarov, *Act. Hort. Petrop.* xxii. i. p. 38 (1904).

Betula alba, Linnæus, sub-species *latifolia*, Regel, in *Bull. Soc. Nat. Mosc.* xxxviii. 399 (1865), and in DC. *Prod.* xvi. 2, p. 165 (1868).

Betula alba, Linnæus, var. *Tauschii*, Shirai, in *Tokyo Bot. Mag.* viii. 319 (1894).

In eastern Asia, in Manchuria, Saghalien, and Japan, the common birch is represented by a series of forms which have been grouped together by Winkler under the name *B. japonica*, Siebold. In some respects they approach more closely *B. verrucosa* than *B. pubescens*, and are perhaps best treated as a geographical variety of the former species. Trees of Japanese origin cultivated in Kew Gardens show the following characters:—Young branchlets sparingly glandular, glabrous or with a few scattered hairs. Leaves, 2 inches long, 1½ inch wide, ovate, cuneate at the base, acuminate at the apex; margin ciliate, sharply and simply serrate; nerves seven or eight pairs; upper surface with scattered pubescence; lower surface light green, glandular, glabrous except for slight pubescence on the midrib and nerves; petiole, ¾ inch, glabrous, glandular. Fruiting-catkins about 1 inch long, ½ inch wide,

¹ Cf. Watson, *Compendium*, 560 (1870); and Kerner, *Nat. Hist. Plants*, Eng. Trans. ii. 514 (1898).

² According to Schübeler, p. 461, this beautiful variety was first found in 1767 at Lilla Ornäs, about seven English miles south of Falun in Sweden, when it was quite a small tree, 6 feet high, but grew to be in 1878, 64½ feet high, with a trunk 6 feet 8 inches in girth. An excellent illustration of it is given by Schübeler (Fig. 86) with outlines of the leaves (Fig. 87).—(H. J. E.)

cylindrical, on long, slender, minutely pubescent, glandular stalks; scales long-stalked, veined, puberulous, ciliate, with the triangular central lobe slightly longer than the broad, rounded, recurved, lateral lobes; nutlets with rather broad wings.

This variety¹ is distinct in the larger number of nerves in the narrower, longer, slightly pubescent leaves, which are simply serrate in margin; and in the characters of the fruit-scales. The bark of cultivated trees is more like that of *B. Ermani* than the common birch, as it is uniformly white in colour, with raised whitish lenticels, and scales off in transverse shreds. According to Sargent,² it is a slender tree, attaining about 80 feet in height in Yezo.

There are three trees of this variety in Kew Gardens, about 20 to 25 feet in height, which were raised from Japanese seed sent by Sargent in 1891 under the erroneous name *B. ulmifolia*. A similar tree,³ 25 feet high, cultivated at Kew as *B. alba*, var. *latifolia*, was obtained from Madrid in 1887. These trees are narrowly pyramidal in habit, and very ornamental on account of their beautiful white bark; and appear to be fast in growth and very thriving.

4. Several varieties have arisen in cultivation, of which the most noteworthy are:—

Var. *Youngi*, Schneider, Young's weeping birch; and var. *elegans*, Schelle, Bonamy's⁴ weeping birch. Both these forms have long, slender, pendulous branchlets; and are usually grafted on stems 6 to 8 feet high, when they assume the habit of the weeping sophora. A fine specimen is growing in Smith's nursery at Worcester.

Var. *fastigiata*, Schelle, is characterised by its upright branches, the tree resembling in its appearance a Lombardy poplar. According to a writer in *Woods and Forests*, this variety retains its foliage later in autumn than any other form of the silver or common birch.

Var. *purpurea*.⁵ Leaves purple, resembling in colour those of the purple beech, valuable for ornamental planting.

DISTRIBUTION

This species is widely distributed in Europe, and in northern and eastern Asia. The northern limit, beginning in Scotland, crosses Norway in lat. 64°, Sweden in lat. 65°, and ascends in Russian Lapland to Lake Ruanjärvi; and thence, crossing Lake Onega, passes through the province of Vologda to Siberia, where its exact distribution has not been made out. In eastern Asia, var. *japonica* is met with in Manchuria, Saghalien, and Japan. The type occurs in the mountains of north China, and was found near Lake Kokonor (lat. 37° 50') by Przewalski; and it appears to be the common birch in the Altai and Ural mountains. It is not found in Persia or Afghanistan, but occurs on the higher mountains of the Caucasus and in Armenia and Asia Minor. In Europe the southern limit extends from the

¹ The Japanese name for this variety is *Shira-Kamba*.

² *Forest Flora of Japan*, 61 (1894).

³ This tree has broadly ovate leaves, subcordate or rounded at the base, and larger than those of the trees raised from Japanese seed, sent by Sargent; but in other respects is identical, and is probably also of Japanese origin.

⁴ This originated in Bonamy's nursery at Toulouse, and is usually known in gardens as *B. alba pendula elegans*. Cf. *Rev. Hort.*, 1869, p. 135, fig. 33, and *Gard. Chron.*, 1869, p. 1278.

⁵ Probably identical with var. *atrosanguinea*, stated by Schübeler to have originated in France, and to be growing in the Botanic Garden at Christiania.—(H. J. E.)

Rhodope mountains in Bulgaria, through Servia, Bosnia, and Istria to the Venetian Alps; and following the southern limit of the Alps in northern Italy, it extends from the maritime Alps along the Apennines to Aspromonte in Calabria, crossing over to Sicily, where it reaches its extreme southerly point on Mount Etna in lat. 37° 40'. It does not occur in Corsica or Sardinia. It is common in the forests of the plains and lower mountains of France in the north, east, and west; but towards the south only grows at high elevations, as in the mountains of Auvergne and in the Pyrenees. It grows in Portugal in the Sierra de Gerez; and in Spain throughout the northern mountains, in Catalonia, Aragon, Navarre; and also in the Sierra Guadarrama, the mountains of Toledo, and the Sierra de Gata.

The largest forests of the species occur on the plains of the Baltic and central provinces of Russia, where it grows either pure or in mixture with aspen and grey alder, or with the common pine and spruce. Von Sivers¹ points out that the two species of birch occur in the Baltic provinces in different soils and situations. *B. verrucosa* grows on the glacial drifts, where it reaches large dimensions, and often forms pure forests of clean, straight stems, which on the better class of soil, amongst spruce, often reach 100 to 130 feet in height.

There are also extensive pure woods in the plains of northern and central Germany; but farther south the tree is more at home in the mountains, as in the Alps and Carpathians, and only forms small woods, or grows scattered or in groups amidst other trees.

This species is most common in continental Europe on dry soils, thriving best in localities where the common pine does well, as in loamy sands with a moderately moist subsoil; but dwindles and ceases to grow on marshy ground or on undrained peat-mosses. It requires more light than the other species, and in woods of *B. verrucosa* the soil is usually covered with grass; the leaf mould and moss, so common on the ground in woods of *B. pubescens*, being usually absent.

(A. H.)

CULTIVATION OF THE COMMON AND SILVER BIRCH

After the oak, there is perhaps no tree which has been so generally attractive to artists and lovers of the picturesque as the birch, which will grow almost anywhere, and is often looked on by English foresters and woodmen as a weed. This it may be on land fit to grow fine timber; where, however, it is not often so prevalent as on poor dry soils, or on wet, boggy land; but when the question of covering waste land with timber of some sort at a low cost has to be considered, there is no tree that will do it so cheaply and so surely as the birch.

It seeds very profusely, and the seed is so light that it spreads with great rapidity, and germinates in places where hardly any other tree will live. It is absolutely the hardiest tree we have, and though its economic value is low at present, yet probably it will, when our coal gets scarce and dear, be looked on as the cheapest and best of firewood.

¹ *Forst. Verhält. Balt. Prov.* 18 (1903).

In north Russia it is the usual fuel for railway engines, and all over Scandinavia is the principal firewood, but though our climate does not produce the tree as well as that of more northern regions, where the bark is almost the only material used for covering the roofs of common buildings; yet, having regard to the great beauty of the tree in landscape, it should be much more generally grown than it is. All this was well brought out by Loudon many years ago in his great work, and yet the birch remains a neglected tree. But it has another virtue which must appeal to many in these days. It is of all trees the one most distasteful to rabbits, and on my property is the only tree which grows up from self-sown seed, on land which on account of its poverty has been treated as a rabbit warren.

As a nurse for other trees on poor land, whether of a dry and rocky nature, or wet and peaty, the birch seems to me to have a greater value than most writers on forestry have admitted. For wherever the soil is naturally covered by self-sown birch, or a fairly thick crop can be obtained by sowing, the land will be made fit for the planting of more valuable trees, such as larch or Corsican pine, at a lower cost; and after providing shelter for smaller plants than could otherwise be used, it can, when the permanent crop has been established, be cut and sold at an age when spruce or Scots pine of the same age would be worthless.

A very successful instance of its use in this way has been described¹ by G. U. Macdonald, forester at Raith, Fifeshire, the object here having been to plant moorland with spruce, in a locality where the late and early frosts were so severe that the spruce would hardly grow at first without some protection.²

On very dry oolite soil, birch is the only tree which reproduces itself naturally among long coarse grass, which it will, if thick enough, eventually suppress; and, though a large quantity of small birch wood may not be always saleable at as good a price as at Raith (20s. per ton for crate-wood), yet it is such excellent firewood, even when quite small, that having regard to the low cost of its seed, I can suggest no means whereby the desired result could be obtained so cheaply.

If desired to establish a birch covert by sowing, I would advise the careful selection of seed from trees naturally growing on land of similar character, because though foresters in this country have not yet realised the preference shown by the rough twigged birch for dry rocky land, it is universally accepted as a fact in Germany, whilst for wet or boggy land the downy twigged birch is preferable.

To raise birch from seed is not always easy; and whether it is better to sow in autumn directly the seed is ripe, or in spring, is a question which, after trying both plans, I have not yet decided to my own satisfaction. But, as a rule, I would follow nature and sow in autumn, not attempting to cover the seed with earth, but covering with some fir boughs, fern, or leaves, until it began to germinate. So far

¹ *Trans. Roy. Scot. Arb. Soc.* xix, 287 (1906).

² It has been used with great success as a nurse for beech in some of the plantations, which were made by the Danish forester, Ulrich, near Copenhagen, and which were shown to the Royal English Arboricultural Society, in August 1908. The object here was to protect young beech trees from spring frosts, and afford shade during their youth. Birches were planted in lines about 8 feet apart, and the beech planted between the rows of birch eight or ten years later. When the beech are sufficiently tall, the birch are thinned and finally cut out entirely and used as firewood. This system seemed to me to be one well worthy of adoption in England for other trees which require shade in youth.

as I have seen the germination is slow and irregular, and seems to depend a good deal on the maturity and age of the seed. For though birch seed is best sown the first year, I have had fair results from seed which had been kept a year in a bag, whilst I have sometimes obtained poor results from fresh seed sown in spring. I always sow the seed of exotic birches in pots or under glass, and prick out the seedlings at a year old.

As a rule the seedlings grow fast, and must not be left long in the nursery, as they do not transplant well when old, but there is much variation among the different species; and it seems that some of the American birches do not grow well or live long in this country, unless grafted on the roots of the common birch.

As a rule the birches seem to grow best in nature when unmixed with other trees; and in some of the best birch woods I have seen in Norway, Japan, and America are almost pure, but if mixed with conifers or other hardwoods, and not suppressed by their shade, they often attain large dimensions.

REMARKABLE TREES, COMMON AND SILVER BIRCH

Among the numerous birches which I have measured in England, I cannot mention any tree which is equal in height to some that I have seen in Norway and Russia, as the tallest do not exceed about 90 feet. Along the road which passes through Savernake Forest from Marlborough to Andover there are a great number of large and beautiful trees, planted as an avenue on both sides; but of their age I can obtain no record. Near the school is one of the finest (Plate 225), which measured in 1908 about 90 feet high by 8 feet in girth. Another near it was covered with large witches' brooms; and a third, from which a large branch had been recently torn off by the wind, was pouring out sap in such quantity that a pool of it had formed on the ground. In this park a birch, which was considered by the woodman to be the largest, and which like the rest appeared to be *B. pubescens*, measured 77 feet by 10 feet 7 inches.

Plate 256 shows the graceful habit of a fine birch in front of Lord Walsingham's house at Merton, Norfolk. Plate 257 shows a group of self-sown birches in Sherwood forest, close to the Queen oak, described on page 322 of this work.

At Dropmore there is a birch (*B. pubescens*) about 55 feet high, with an immense bole 21 feet in girth at a foot from the ground, and dividing a little way up into three main stems, 9 feet 10 inches, 8 feet 2 inches, and 6 feet 3 inches in girth respectively. One large limb has rested on the ground for many years, but does not seem to have rooted.

In Windsor Park there are numerous fine birches, one of the handsomest of which, growing by Prince Albert's chapel, was in 1904 71 feet by 8 feet 8 inches. At Longleat there is a fine tree of which Colonel Thynne has sent me a photograph, and which measured 76 feet by 9 feet 4 inches in 1906. At Barton there is a tree from 80 to 85 feet high, with a clean stem about 50 feet long and 5 feet 7 inches in girth, and drooping branches. This tree is still young and vigorous, and is one of the finest we have seen anywhere.

At Beauport, Henry saw one dividing at 5 feet into five stems, and girthing below the fork 11 feet. At Arley Castle he measured one 76 feet by 8 feet 1 inch in 1905. At Croome Court there is a tree 77 feet high, of which one large stem has been broken off short. Mr. J. Smith mentions¹ a birch growing at Embley Park, Hants, in 1887, which was 85 feet by 6 feet 7 inches, with a bole of 25 feet.

In Wales the birch, so far as I have seen, does not attain so large a size as in England and Scotland, the finest I know of being at Ogwenbank, near the entrance to the great slate quarry at Penrhyn. This, though only about 50 feet high, spreads over an area 25 paces in diameter, and has two main stems which are 13 feet and 12 feet 2 inches in girth respectively.

In Scotland, Mr. Renwick considers a birch (*B. verrucosa*) at Auchendrane, in Ayrshire, to be the finest in the west of Scotland. He gives an account of this tree, with a photograph, in *Trans. Nat. Hist. Soc. Glasgow*, vii. 262 (1905). It is 67 feet in height, with a bole of 13 feet, girthing 10 feet 8 inches; and was planted, according to Miss Cathcart, by her mother in 1818, having been purchased from Booth's nursery near Hamburg as a cut-leaved weeping birch.

A still larger tree at Newton Don, near Kelso, which was cut down in 1901, measured, in 1893, 80 feet high, with a short bole, 13 feet in girth at 1 foot 7 inches above the ground, and dividing at 3 feet up into two main stems. Captain C. B. Balfour informs us that Jeffrey, in his *History of Roxburghshire*, describes it in 1859 as being then 74 feet high and 14 feet in girth at the base.

At Monzie there are some tall birches, drawn up by other trees, one measuring 90 feet high by 8 feet in girth. At Blair Drummond there are several old birches, all with large boles, some with remarkable burrs, and one with low spreading branches layering. One of these measured 60 feet by 13 feet 10 inches; and another 70 feet high is 10 feet 8 inches in girth.

In Darnaway Forest there are many fine birch trees on the banks of the Findhorn, one of which was stated by Sir Thomas Dick Lauder to girth 13 feet; but I am informed by Mr. D. Scott, forester to the Earl of Moray, that many of these have died, and those remaining are fast decaying. The largest measure 9 to 10 feet in girth, and many of them contain 70 to 75 cubic feet of timber. The rough twigged birch predominates here, but does not as a rule assume a pendulous habit until it is of some age.

At Gordon Castle there is a fine tree in the park, which in 1904 was 68 feet by 9 feet; and at Murthly, in the drive from Dunkeld, I measured in 1906 a very tall and slender birch (*B. verrucosa*) which was 89 feet high and only 3 feet 9 inches in girth.

In the Pass of Killiecrankie and many other Highland glens the birch grows freely mixed with oak on the rocky slopes, and in the wide valley of the Spey there are beautiful open woods of pure birch, covering a large extent of the gravelly flats and terraces which every traveller on the Highland Railway between Kingussie and Grantown must have admired. In the swampy flat at the head of Loch Morlich, in Glenmore, there is an open wood of curiously distorted, twisted, and stunted

¹ *Trans. Scot. Arb. Soc.* xi. 532 (1887).

birches, mixed with alders, in the hollow trunks of which the goosander occasionally breeds, and the goldeneye duck may also sometimes do so (Plate 258).

In no part of Great Britain do the birches assume the same tall, clean growth, or have the same smooth, silvery bark that they do in the forests of Scandinavia, where pure woods of birch are in some districts very prevalent on the lower land, whilst on the fjelds and mountains it ascends as a scrubby and stunted tree to a greater elevation than any other. Schübeler¹ describes and figures some instances of abnormal growths in birch. His figure 88 shows a fallen trunk from which six healthy-looking young trees are growing in a line, and I have a similar though less striking instance in my own woods. The tallest birch he knew in Norway was at Drobak in Sœterdalen, 30 kilometres south of Christiania, and measured 100 feet by 5 feet 9 inches. Another at Sondre Tveten, in Eidanger, was 79 feet by 11 feet. He figures a remarkable tree at Dunserud, in Eker, which divides into six large trunks, and measures 75 feet in height. Perhaps the most shapely and beautiful of those which he figures, are a tree at the farm of Hohls, in south Trondhjem Amt, measuring 80 feet by 11 feet, and another at Gravrok, 18 kilometres south of Trondhjem, which measured 80 feet by 16 feet. It seems from these particulars that the birch is the largest deciduous tree in Norway, and attains greater dimensions than in this country; but though I have spent several months in the forests of north and south Trondhjem in the pursuit of my favourite quarry, the elk, I never saw such trees as those above mentioned, and believe that they all grow in the neighbourhood of farms on unusually fertile soil.

TIMBER AND BARK

The timber of the birch can hardly be said to have any general recognised value in England, though in some districts it can be sold to coopers, chairmakers, and clogmakers;² in others, especially since charcoal burning has ceased in most places to be a profitable industry, it can only be looked on as firewood. It is so perishable in contact with the soil, that it is of no use for fencing unless creosoted; and though in former times,³ according to Sang, the Highlanders made everything that they used of it—rafters, ploughs, harrows, carts, and fences—yet now it would only be used as a makeshift, when other wood could not be had. I have seen large old burry birches, which when cut into boards, were fit for small cabinet panels; but the wood twists a good deal in drying, and is usually inferior, in grain, texture, colour, and figure to the wood of several species of American birch which can be imported in larger size and at a low price. As underwood it has an uncertain value for making brooms and tool handles and is also used for bobbins.

In Sweden and Russia the burrs found on the trunks of this tree are converted into many ornamental articles of great beauty. Beer-pots carved out of these burrs, and hooped with wood or silver, are often heirlooms in Scandinavian houses;

¹ *Viridarium Norvegicum*, 469.

² Birch clog soles are used in the Yorkshire manufacturing towns, whilst in Lancashire alder is preferred.

³ Pennant, *Tour in Scotland*, 112 (1772), says that wine was extracted from the live tree.

and as the wood takes a high polish, it is highly valued in Siberia for work-boxes, cigarette cases, and other small fancy articles.

In northern Sweden and Russia the wood is sometimes found full of undulations, which make it very ornamental for furniture, and some bedroom furniture made by the Nordiska Kompaniet (Lundberg and Laja) of Stockholm, was almost equal in beauty to satinwood. I have also seen it used as veneer with the best effect for decorating cabins in steamers built in Denmark and Sweden. This is known in Sweden as "Flammig björk." Another curious form of birch wood is that known in Finland and Sweden as "Masur." I was informed by Mr. Jacobssen, Swedish Vice-Consul at Åbo, that this variety in Finland is only found in certain places, Karku, Tyrois, and Kalvola. A number of logs which I saw in the works of the Finska Colorit Aktiebolag at Åbo were covered on the outside with small pitted depressions, somewhat similar to those which produce bird's-eye maple, and when cut into veneer, are dyed of various colours, of which French grey seemed to me the most effective; and made up into furniture which commands a high price.

At St. Petersburg this form of birchwood is known as "Karelsky," being supposed to come from the Karelian peninsula; and is largely used both in the solid and as veneer for furniture making. Though not so elegant as the waved form, or as the bird's-eye maple which it somewhat resembles, it is very quaint and striking in appearance, and can be imported at very reasonable prices.

The bark,¹ when taken off in sheets, is used in Scandinavia for covering the roofs of houses, and remains for many years undecayed between the inner boarding and the outer sod of turf. A strong smelling oil, obtained by destructive distillation from birch wood, is, when mixed with alcohol and rubbed on the skin, the best protection I know of against the swarms of midges and mosquitoes which make life almost unbearable in the short summer of the far north. This oil is used as a preservative, and gives the fragrant odour to Russia leather. Birch bark has no equal for lighting fires, and in the dripping forests of the north I have often had good reason to value it when nothing else would start a fire. (H. J. E.)

BETULA DAVURICA

Betula davurica, Pallas, *Fl. Ross*, i. 60, t. 39 (1784); Winkler, *Betulaceae*, 86 (1904).

Betula Maximowiczii, Ruprecht, in *Bull. Phys. Math. Acad. Pétersb.* xv. 139 (1856) (not Regel).

Betula Maackii, Ruprecht, in *Bull. Phys. Math. Acad. Pétersb.* xvi. 380 (1857).

A tree, attaining 60 or 70 feet in height. Bark purplish brown, separating in small, papery scales, which remain attached, curled and ragged, to the trunk, giving the tree a peculiar appearance. Young branchlets glandular, covered with a minute erect pubescence, interspersed with a few long hairs. Leaves, about 3 inches long and 1½ to 2 inches wide, narrowly ovate or ovate-rhombic, cuneate at the base,

¹ Pyrobutulin, obtained by sublimation from the outer bark of birch, is used for depositing films on glass, about to be engraved, and for covering lint with an antiseptic layer. Cf. Wheeler, in *Pharm. Journ.* ix. 494 (1899).

acute or acuminate at the apex; margin ciliate, coarsely and irregularly serrate; nerves, six to eight pairs; upper surface at first pubescent on the midrib and nerves, ultimately glabrescent; lower surface glandular, with scattered pubescence on the midrib and nerves; petiole, ½ inch, slightly pilose.

Fruiting catkins, ¾ to 1 inch long, ovoid-cylindrical, acute at the apex; scales glabrous with scattered glands on the margin and outer surface, middle lobe triangular, lateral lobes broad, rounded and spreading; nutlet obovate, with narrow wings, broadest in their upper part.

This species, which is readily distinguished by its peculiar bark, is widely spread throughout Amurland, Manchuria, Korea, and north China. According to Komarov,¹ it grows throughout the whole of Manchuria, in the drier parts of the valleys and in open places on the mountains, on rocky or sandy soil, occasionally forming small woods, but is never seen in the dense virgin forests.

It is extremely rare in cultivation, the only specimen which we have seen being a small tree in Kew Gardens, about 15 feet high, which was raised from seed sent by Bretschneider from Peking in 1882. (A. H.)

BETULA CORYLIFOLIA

Betula corylifolia, Regel and Maximowicz, in *Bull. Soc. Nat. Mosc.* xxxviii. 417, t. 8 (1865); Regel, in *DC. Prod.* xvi. 2, p. 178 (1868); Winkler, *Betulaceae*, 59, fig. 17 (1904).

A tree, the dimensions of which are not stated. Young branchlets slightly pubescent. Leaves (Plate 270, Fig. 14), 2½ to 3 inches long, about 2 inches wide, oval; rounded or truncate (rarely cuneate) at the base, acute at the apex; coarsely serrate; nerves, twelve to fourteen pairs, impressed above and very prominent beneath; upper surface pilose on the midrib, elsewhere glabrous; lower surface pale in colour, with conspicuous long silky hairs on the midrib and nerves, elsewhere glabrescent; petiole, ¾ inch, at first pilose, later glabrescent. Fruiting catkins (Plate 270, Fig. 14), 1½ to 2 inches long, ¾ inch wide, cylindrical, often curved; scales large, slightly pubescent, ciliate in margin, deeply three-lobed, lobes linear-oblong, the middle one about twice as long as the lateral lobes; seeds with very narrow wings.

This remarkable species,² peculiar in the shape of the leaf and in the stout, long fruiting catkins, was found on the high mountains of the provinces of Senano and Nambu in the main island of Japan, by Tschonoski. Very little is known about it in the wild state, and it has never apparently been introduced into cultivation in Europe. (A. H.)

¹ *Flora Manchuria*, ii. 49 (1903).

² The Japanese name of this species, according to Matsumura and Goto, is *Urajiro-kamba*.

BETULA MAXIMOWICZII

Betula Maximowiczii,¹ Regel, in *Bull. Soc. Nat. Mosc.* xxxviii. 418 (1865); Winkler, *Betulaceae*, 89 (1904).

Betula Maximowicziana, Regel, in DC. *Prod.* xvi. 2, p. 180 (1868); Shirasawa, *Icon. Ess. Forest. Japon.*, text 45, t. 23, ff. 1-8 (1900); Mayr, *Fremdländ. Wald- u. Parkbäume*, 449 (1906).

A tree, attaining in Japan, according to Mayr, 100 feet in height. Bark grey, smooth, peeling off in thin, papery strips. Young branchlets, with scattered glands; glabrous, except for slight pubescence above the insertions of the leaves. Leaves (Plate 269, Fig. 6) about 6 inches long and 4 inches wide, broadly ovate, deeply and narrowly cordate at the base, acuminate at the apex; margin non-ciliate, biserrate; nerves, ten to twelve pairs, each ending in a long-pointed serration; upper surface at first pubescent with erect hairs, later glabrescent; lower surface with scattered pubescence throughout, or glabrous, except for pubescence on the midrib and nerves, gland-dotted; petiole an inch or more in length, pubescent or glabrous.

Fruiting catkins (Plate 269, Fig. 6), two to four in a raceme, about $2\frac{1}{2}$ inches long, and nearly $\frac{1}{2}$ inch in diameter; scales glabrous, shortly three-lobed, the lateral lobes spreading and shorter than the middle lobe; nutlets very small, with broad wings.

A variety of the species is in cultivation in Kew Gardens, distinguished by having smaller leaves, with more shortly pointed serrations, and with their under surface (as well as the young branchlets and petioles) covered with long, soft pubescence.

This species is readily distinguished by its large leaves, deeply and narrowly cordate at the base. In winter the twigs are stout, shining, yellowish, nearly glabrous; buds about $\frac{3}{8}$ inch long, appressed to the branchlet, curved laterally and ending in a sharp beak, with glabrous scales.

B. Maximowiczii occurs in Japan, in the central chain of Hondo, but is more common in Yezo,² where, according to Sargent,³ it is a shapely tree, 80 or 90 feet in height, with a trunk 2 or 3 feet in diameter, covered with pale, smooth, orange-coloured bark. Towards the base of old trees the bark becomes thick and ashy-grey, separating into long, narrow scales.

The largest that Elwes saw in Japan were growing in a mixed forest of maple, poplar, ash, spruce, and silver fir, on volcanic soil, at about 3000 feet elevation, near the Crater Lake, Shikotsu, in Yezo; and one measured 90 feet high by 9 feet 9 inches in girth. The Japanese name⁴ of this species is *Udai-kamba*.

¹ This species, with *B. luminifera*, Winkler, *B. Baumkeri*, Winkler, both natives of central China, and *B. alnoides*, Buchanan-Hamilton, distributed throughout the Himalayas and in central and southern China, constitute the section *Betulaster*, distinguished by elongated fruiting catkins and broad-winged nutlets.

² Mayr, *op. cit.*, plate 31, gives a picture of this tree growing in a forest in Yezo.

³ *Forest Flora of Japan*, 62 (1894).

⁴ According to Matsumura, in *Shokubutsu Mei-I*, 48 (1895). The same name is given in Goto's *Forestry of Japan*.

It was introduced into cultivation in England by J. H. Veitch,¹ who sent home seeds from Yezo in 1888; and a large number of seedlings were raised at the Arnold Arboretum, in 1893, from seed received by Sargent² from the forestry officers of Yezo.

Sargent has spoken highly of the beauty and value of this tree, which, wherever we have seen it in this country, is thriving. It is one of the most beautiful of the young trees in Messrs. Walpole's lovely garden at Mount Usher, County Wicklow.

A tree at Kew, raised from seed obtained in 1893 from the Arnold Arboretum, was 25 feet high and 13 inches in girth in 1907. At Tortworth, a tree, probably of the same age, 30 feet high and 17 inches in girth, is growing vigorously. At Grayswood, Haslemere, a tree obtained as a small plant from Lemoine in 1894, was 29 feet by 21 inches in 1906, and is very healthy.

This species is common on the Continent in botanical gardens, and is very hardy, having borne without injury the severe winter climate of Grafrath, near Munich; and on this account, and because of its rapid growth, it is recommended by Mayr as worth cultivating as a forest tree.

Shirasawa says that the wood is rather hard, showing no difference in the colour of the sap and heart wood, and is used in Japan for house-building. The fishermen of Yezo make torches out of the bark, as it takes fire easily, even when wet. (A. H.)

BETULA ERMANI

Betula Ermani, Chamisso, in *Linnaea*, vi. 537, t. vi. f. 8 (1831); Erman, *Reise*, t. 17 (1835); Komarov, *Flora Manshurica*, ii. 49 (1903); Winkler, *Betulaceae*, 66 (1904).

A tree,³ attaining about 100 feet in height in Manchuria. Bark creamy-white, with raised whitish lenticels, and peeling off in irregular shreds. Young branchlets glabrous, except for a few hairs above the insertions of the leaves, and covered with numerous glands which roughen the shoot in the second year.

Leaves (Plate 270, Fig. 12), about 3 inches long, 2 inches broad, ovate, with a broad truncate or slightly cordate base, acuminate at the apex; margin slightly ciliate at first, coarsely and irregularly serrate; nerves, ten to twelve pairs; upper surface with scattered hairs; lower surface glandular, glabrous except for slight pubescence in the axils and on the midrib and nerves; petiole, $\frac{1}{2}$ inch, glabrescent, glandular.

Fruiting catkins (Plate 270, Fig. 12), ovoid-oblong, about 1 inch long and $\frac{5}{8}$ inch in diameter, sessile or shortly stalked; scales glabrous on the surface, ciliate and glandular in margin, with linear-oblong lobes, the middle lobe longer than the two lateral divergent lobes; nutlets with narrow wings, broadest above.

¹ *Hortus Veitchii*, 357 (1906).

² *Forest Flora of Japan*, 62 (1894).

³ According to Matsumura, *Shokubutsu Mei-I*, 47 (1895), var. *nipponica* of this species is known as *Take-kamba*, while the type is called *Ezo-no-take-kamba*, i.e. *B. Ermani* of Yezo.

Var. *nipponica*,¹ Maximowicz, *Mél. Biol.* xii. 923 (1888). This differs from the type in the branchlets not being so densely glandular, and in the longer, narrower cones, which are cylindrical, $1\frac{1}{2}$ inch long, and $\frac{1}{2}$ inch in diameter. This variety was found by Maximowicz in the Nikko mountains, and is probably the form of the species occurring in the main island of Japan.

B. Ermani is widely distributed in eastern Asia, occurring in Kamtschatka, Manchuria, Korea, Saghalien, Kurile Isles, and Japan. According to Komarov,² it grows in Manchuria, near the sea-coast, from the river Amur to St. Olga Bay, in the Sichote-Alin mountains, in the north-eastern part of the province of Mukden, and in the Korean main range; and is a native of mountain forests at elevations between 2000 and 7000 feet. Komarov informs us that it is the largest of the birches, which he found in Manchuria, attaining a height of 60 to 100 feet.

According to Sargent,³ it is the most common birch in the high mountains of the main island of Japan, where it is scattered through the coniferous forests at 4000 to 6000 feet, and is very conspicuous from the white bark of the trunk, and the bright, orange-coloured bark of the principal branches. It appears to be the birch figured and described by Shirasawa,⁴ as *Betula alba*, var. *communis* (not Regel), which he states to be a tree of vigorous growth, attaining 70 feet in height and 3 feet in diameter, occurring in the central chain of Honshu, especially at Shimotsuke, in Nikko, Musachi, in Chichibu, and Kiso, in Shinano. At Kiso the bark is used as material for writing on, and for envelopes; and also for torches, as it contains a considerable amount of resin. Elwes saw a birch, which he believes to be *B. Ermani*, growing in great abundance in the forest north of Asahigawa, and also on the volcanic cone near Lake Shikotsu, in Hokkaido. Here it seemed to be commoner than, but not so large, a tree as *B. Maximowiczii*.

This species was introduced into cultivation through the agency of the St. Petersburg Botanic Garden; and is not uncommon in gardens both on the Continent and in England, where it is often wrongly named *B. ulmifolia*, *B. corylifolia*, etc. At Kew there are small trees, 20 to 25 feet in height, both of the typical form and of var. *nipponica*. The former⁵ is the first of the birches to come into leaf, the foliage often being fully developed at the end of March; and, in consequence, the trees are usually much injured by spring frosts. The largest tree we have seen of this species is in the arboretum at Westonbirt, and when measured by Elwes in 1908, was 51 feet by $2\frac{1}{2}$ feet. There is a good specimen apparently of the typical form at Benmore, in Argyleshire, which is grafted near the ground, and has yellowish scaly bark like that of *B. lutea*. In 1907 Elwes found it to be about 40 feet by 3 feet. Var. *nipponica* is later in leafing, and is not usually injured by frost. Two trees of this variety at Grayswood, Haslemere, are about 30 feet in height.

(A. H.)

¹ This variety appears to be identical with a specimen in the Kew herbarium collected by Tschonoski on "high mountains not far from Fuji-yama," which is labelled *B. Bhojpattra*, var. *subcordata*, Regel, in DC. *Prod.* xvi. 2, p. 177 (1868).

² *Flora Manshurica*, ii. 50 (1903).

³ *Forest Flora of Japan*, 62 (1894).

⁴ *Icon. Essences Forest. Japon*, text 42, t. 21 ff. 1-15 (1900). *Betula alba*, var. *communis*, Regel, is *B. papyrifera*, an American species, which certainly does not occur wild in Japan.

⁵ The trees of the typical form were raised from seed sent by the Arnold Arboretum in 1893.

BETULA ULMIFOLIA

Betula ulmifolia, Siebold et Zuccarini, in *Abh. Bayer. Akad. Wiss.* iv. 3, 228 (1846); Winkler, *Betulaceae*, 62 (1904) (in part); Schneider, *Laubholzkunde*, i. 101 (1904).

A tree, attaining in Japan 70 feet in height and 8 feet in girth. Bark described as greyish-brown, smooth, shining, not separating into thin layers, and resembling that of *Prunus pseudocerasus*. Young branchlets covered with a white, short, somewhat appressed pubescence. Leaves, about 3 inches long, $1\frac{1}{2}$ inch wide, narrowly ovate or ovate-oblong, unequally cordate¹ at the base, acuminate at the apex; margin ciliate, bi-serrate, with falcate serrations; nerves twelve to fourteen pairs; upper surface with appressed, long, brownish hairs both on the midrib and nerves, and in bands between the nerves; lower surface similarly pilose on the midrib and nerves, gland-dotted and glabrous between the nerves; petiole $\frac{1}{2}$ inch, pilose.

Fruiting catkins, on short pilose peduncles, about $\frac{3}{4}$ inch long and $\frac{1}{2}$ inch in diameter, ovoid; scales pubescent, ciliate, strongly veined, with the central lobe oblong and obtuse, nearly twice as long as the ovate rounded lateral lobes; nutlets with narrow wings.

This species is extremely rare in cultivation, the only specimen which we have seen being a tree, about 8 feet high, in Kew Gardens, which was raised from seed, received under the name *B. grossa*,² S. et Z., from Tokyo in 1896. It is identical with the type specimen of *B. ulmifolia*, S. et Z., preserved in the Munich herbarium, with which we have compared it.

This species, together with *B. grossa*, S. et Z., *B. carpiniifolia*, S. et Z., both natives of Japan, and *B. costata*, Trautvetter, a native of Manchuria, are closely allied; and our knowledge of their exact relationship and distribution is very imperfect. It is possible that *B. grossa* and *B. carpiniifolia* are varieties or hybrids of *B. ulmifolia*, while *B. costata* is the continental geographical form of the same species.

Shirasawa,³ whose figures of *B. grossa* and *B. ulmifolia* do not in either case exactly agree with the type specimen of the latter species, says that both these species are spread throughout the central chain of Hondo, and occur also in Kiushiu and Shikoku. *B. ulmifolia*, which is the representative in Japan of the American *B. lutea*, differs much in bark and other characters from *B. Ermani*, with which it has been confused.

(A. H.)

I saw a very fine birch which my guide and companion, Mr. Mochizuki of the Japanese Forest Service, called *B. grossa*, growing in the forest of central Japan, at Ongawa, about 3000 feet above the sea; and measured specimens 80 to 90 feet high.

¹ The leaves on the lower part of the branchlet and on the short shoots are markedly cordate; those on the upper part of the branchlet are usually truncate or rounded at the base.

² Similarly a dried specimen at Kew, collected in the Etchu province on Mt. Tateyama, and labelled *B. grossa* by the Tokyo University Science College, is identical with *B. ulmifolia*. It bears the Japanese name *Yoguso-minebari*.

³ *Icon. Ess. Forest. Japon*, text, 42, 43, t. 22 (1900).

The timber, of which I brought home a specimen now at Kew, is a hard wood of a bright pinkish brown colour, and is used for flooring. It seems at least as good as the best American birch timber. It was, however, very difficult to identify the species of birch, of which no less than five¹ are said to be found in this district, and the foresters of Japan were not themselves sure of their scientific names.

(H. J. E.)

BETULA LUMINIFERA

Betula luminifera, Winkler, *Betulaceae*, 91, fig. 23 (1904).

A tree, the dimensions of which are not known. Young branchlets covered with dense, erect, pale pubescence, non-glandular. Leaves (Plate 270, Fig. 16), about 5 inches long and $3\frac{1}{2}$ inches wide, broadly ovate, sub-cordate or truncate at the broad base, acuminate at the apex; margin ciliate, irregularly serrate, the serrations ending in cartilaginous points; nerves ten to fourteen pairs; covered more or less on both surfaces with white, short pubescence; petiole $\frac{3}{4}$ inch, pubescent. Fruiting catkins (Plate 270, Fig. 16), solitary, cylindrical, elongated, about 3 inches long and $\frac{2}{3}$ inch in diameter; on a peduncle $\frac{3}{4}$ inch long; scales lanceolate, auricled on each side a little below the middle; nutlets pubescent, with broad wings.

This species, which is the representative in central China of *B. Maximowiczii* of Japan, was discovered by Père Farges in the north-eastern mountains of Szechwan, and was introduced into cultivation in 1901 by E. H. Wilson, who sent seeds from the same locality. A young tree in Veitch's nursery at Coombe Wood is now 16 feet high at seven years old, and is very flourishing. This species is remarkable for its fine foliage, and is worthy of cultivation as an ornamental tree.

(A. H.)

BETULA UTILIS, HIMALAYAN BIRCH

Betula utilis, Don, *Prod. Fl. Nepal.* 58 (1825); Hooker, *Fl. Brit. India*, v. 599 (1888); Gamble, *Indian Timbers*, 668 (1902); Winkler, *Betulaceae*, 61 (1904); Schneider, *Laubholzkunde*, 102 (1904); Brandis, *Indian Trees*, 622 (1906).

Betula Bhojpattra, Wallich, *Pl. As. Rar.* ii. 7 (1832); Brandis, *Forest Flora, N.-W. India*, 457 (1874).

Betula Jacquemontii, Spach, in *Ann. Sc. Nat. sér. 2*, xv. 189 (1841).

A tree, attaining in the Himalayas about 60 feet in height, but becoming a shrub at high elevations. Bark on young trees thin, smooth, brownish red, with

¹ Matsumura, in *Shokubutsu Mei-I.* 47 (1895), enumerates eight distinct species of birch as occurring in Japan; but of these, *B. utilis*, as explained in a note under our account of that species, and *B. grossa*, mentioned above, are doubtful. There remain six distinct species, undoubted natives of Japan, viz.:—*B. Maximowiczii*, *B. corylifolia*, *B. Ermani*, *B. globispica*, *B. ulmiifolia*, and *B. verrucosa*, var. *japonica*; all of which are referred to in this account of the genus *Betula*, and under each species is given its native name.

darker coloured horizontal lenticels, peeling off in transverse rolls; on older trees darkened and thickened at the base. Young branchlets, non-glandular, covered with a dense, greyish tomentum; older branchlets smooth, glabrous. Leaves (Plate 269, Fig. 7) coriaceous, about $3\frac{1}{2}$ inches long and $2\frac{1}{4}$ inches wide, oval or ovate-oblong, rounded at the base, acuminate at the apex; margin slightly ciliate, irregularly serrate; nerves nine to twelve pairs; upper surface shining, dark green, with scattered pubescence; lower surface yellowish green, glandular, glabrous between the nerves, which are slightly pubescent, and with dense axil-tufts of pubescence; petiole $\frac{3}{4}$ inch, tomentose.

Fruiting catkins (Plate 269, Fig. 7),¹ cylindrical, $1\frac{1}{2}$ inch long, $\frac{1}{3}$ inch in diameter, on tomentose peduncles, variable in length; scales with glabrous, ciliate, spatulate lobes, the central lobe dilated above and obtuse at the apex, and often trifid, about twice as long as the erect or slightly divergent lateral lobes; nutlets with narrow wings.

VARIETIES

In addition to the type, described above, which occurs in the Himalayas and China, the following varieties can be recognised:—

1. Var. *sinensis*, Franchet, *Journ. de Bot.* xiii. 207 (1899).

Betula albo-sinensis, Burkill, in *Journ. Linn. Soc. (Bot.)* xxvi. 497 (1899).

Leaves glabrescent beneath. Fruit-scales glabrous, not ciliate; nutlets smaller than in the type. Discovered in north-eastern Szechwan by Père Farges. Not yet introduced.

2. Var. *Prattii*, Burkill, *Journ. Linn. Soc. (Bot.)* xxvi. 499 (1899). Leaves more pubescent than in the type, the pubescence extending over the whole under surface, and very dense in the axils and along the midrib. Fruit-scales strongly ciliate, with spatulate lobes, the lateral lobes spreading and not erect. This variety occurs in western Szechwan, at high elevations (13,500 feet), and has not yet been introduced.

3. Var. *Jacquemontii*, Regel, in DC. *Prod.* xvi. 2, p. 177 (1868).

Betula Jacquemontii, Spach, in *Ann. Sc. Nat. sér. 2*, xv. 189 (1841); Cambessedes, in Jacquemont, *Voyage dans l'Inde, Botanique*, 157, t. 158 (1844); Regel, *op. cit.* 178 (1868).

A tree, with white bark, marked by brownish horizontal lenticels, and peeling off in transverse strips. Young branchlets slightly glandular, and covered with a dense, erect, short pubescence. Leaves (Plate 270, Fig. 15), about $2\frac{1}{2}$ inches long, and $1\frac{3}{4}$ inch broad, ovate, rounded or slightly cuneate at the base, acuminate at the apex, bi-serrate; nerves seven to nine pairs; upper surface with scattered pubescence or glabrescent; lower surface gland-dotted and glabrous except for long hairs on the midrib and nerves; petiole $\frac{3}{4}$ inch, glabrescent, glandular. Fruiting catkins (Plate 270, Fig. 15), $1\frac{1}{2}$ inch long, $\frac{1}{3}$ inch wide, cylindrical, on long pubescent stalks; scales glabrous, ciliate, with an elongated linear central lobe,

¹ In this figure the middle lobe of the scale is represented short and trifid at the apex, as is occasionally the case; but as a rule it is more elongated, and broadened and rounded at the apex.

acute at the apex, and two or three times as long as the divergent short rounded lateral lobes; nutlets with narrow wings.

This variety is represented in Kew Gardens by two trees obtained from St. Petersburg in 1891 and 1894, and 25 feet and 20 feet high respectively. It is very distinct in appearance from the typical form of the species, having white bark; smaller, few-nerved, thinner leaves; and different catkins. Moreover, the branchlets and fruiting peduncles are shortly pubescent in the variety, and tomentose in the type.

This variety,¹ judging from the material in the Kew Herbarium, is common in the Himalayas, and probably constitutes a distinct species, which a careful study in the field may show to occupy a different area of distribution from that of typical *B. utilis*, which is so readily recognisable by its reddish bark and other characters.

DISTRIBUTION

*B. utilis*² is widely distributed in the Himalayas and in China. It occurs in West Tibet, and in the Himalayas from the Kurram valley and Kashmir, to Sikkim and Bhotan, at altitudes usually ranging from 10,000 to 14,000 feet, but descending in the north-west to 7000 feet. It is often gregarious at the upper limit of arborescent vegetation, where it is commonly associated with *Rhododendron campanulatum*. According to Brandis, it attains 50 to 60 feet in height, and sometimes 10 or 12 feet in girth. Gamble's account of the bark includes that of the type and of var. *Jacquemontii*; as he describes it as smooth, shining, reddish white or white, the outer bark consisting of numerous distinct, thin, papery layers, peeling off in broad horizontal rolls; the thicker lower part of the bole becoming rough and dark as in the European birch. He states that the growth is slow, with an average of fifteen rings per inch of radius. The wood is extensively used in the inner arid Himalayan region for building purposes; it is elastic, does not warp, and seasons well. The bark is the most valuable part of the tree, and is used for paper, umbrellas, hookah-tubes, and roofs of houses.

In China it is a moderate-sized tree, growing only at high elevations, between 8000 and 13,500 feet, in the provinces of Szechwan, Hupeh, and Kansu. It was seen in the latter province by Przewalski,³ who describes the bark as reddish, peeling off and hanging from the tree in long festoons.

This species is very rarely seen in cultivation, and the typical form from the Himalayas, like most of the broad-leaved trees from that region, for some unexplained reason, does not appear to have succeeded in this country. At Grays-

¹ Shirai, in *Tokyo Bot. Mag.* viii. 320, ff. 23, 24 (1894), states that this variety occurs in Japan; but the plant figured by him seems to be identical with a specimen gathered by Maximowicz in the province of Shinano, and labelled *B. Bhojpatra*, var. *typica*, Regel, which is certainly not that species, and appears to be *B. ulmifolia*, S. et Z. Shirai's account of the bark of this tree, as not being papery, but greyish brown, smooth, cracking, and falling off in patches, confirms this identification.

² There is no evidence that *B. utilis* occurs in Japan, where it is represented by the closely allied species *B. Ermani*. Shirasawa, in *Icon. Ess. Forest. Japon.* text 44, t. 23, ff. 9-22 (1900), figures a tree as *B. Bhojpatra* which is not this species (*B. utilis*), as is confirmed by his account of the bark, as being hard, compact, and falling off in scaly facets. *B. Ermani*, var. *nipponica*, has also been considered erroneously to be a form of *B. utilis*.

³ Cf. Bretschneider, *Europ. Bot. Discoveries*, 987 (1898).

wood, Hašlemere, a tree planted in 1882, which was obtained from a nursery at Newry, was 30 feet high and 2 feet 1 inch in girth in 1906.

There are three trees about 20 feet high in the Botanic Garden of Trinity College, Dublin, which, according to Burbidge,¹ were raised from seed sent by Sir Joseph Hooker in 1881. At Castlewellan there are some young trees, about 8 feet high, which were obtained by grafting branches of the Dublin trees on the common birch. (A. H.)

BETULA PAPYRIFERA, PAPER BIRCH, CANOE BIRCH

- Betula papyrifera*, Marshall, *Arbust. Am.* 19 (1785); Sargent, *Silva N. Amer.* ix. 57, t. 451 (1896), and *Trees N. Amer.* 202 (1905); Winkler, *Betulaceae*, 83 (1904).
Betula lenta, Wangenheim, *Nordam. Holz.* 45 (1787) (not Linnæus).
Betula papyracea, Aiton, *Hort. Kew.* iii. 337 (1789); Loudon, *Arb. et Frut. Brit.* iii. 1708 (1838).
Betula grandis, Schrader, *Ind. Hort. Bot. Goett.* 2 (1833).
Betula latifolia, Tausch, in *Flora*, xxi. 2 p. 751 (1838).
Betula alba, Linnæus, var. *papyrifera*, Spach, in *Ann. Sc. Nat. sér. 2*, xv. 188 (1841).
Betula cordifolia, Regel, *Monog. Betulaceae*, 86 (1861).
Betula macrophylla, Hort., ex. Schneider, *Laubholzkunde*, i. 115 (1904).

A tree, usually attaining in America, in its typical form, 60 or 70 feet in height and 2 or 3 feet in diameter, the variety found on the lower Fraser River in British Columbia being usually much larger in size. Bark thin, smooth, creamy-white, marked with long, narrow, horizontal lenticels, and separating into thin papery layers; becoming on old trunks near the base $\frac{1}{2}$ inch thick, dull brown or blackish, fissured, and scaly. Young branchlets, with scattered long hairs, mostly falling off in summer; in the second year dark brown and glabrous.

Leaves (Plate 269, Fig. 5), 2 to 3 inches long, $1\frac{1}{2}$ to 2 inches wide, ovate; rounded or slightly cordate at the base, acuminate at the apex; margin ciliate and irregularly bi-serrate; nerves six to eight pairs; upper surface dull green, slightly pilose on the nerves; lower surface paler, with numerous minute brown glands, usually glabrous except for dense axil-tufts of pubescence and a few long hairs on the midrib and nerves, occasionally minutely pubescent between the nerves; petiole at first pilose, ultimately glabrescent.

Fruiting catkins (Plate 269, Fig. 5), cylindrical, about $1\frac{1}{2}$ inch long, $\frac{1}{3}$ inch thick, hanging on slender stalks; scales pubescent or glabrous, ciliate, with the middle lobe longer than broad; lateral lobes rounded, erect, spreading or recurved. Nutlet with broad wings.

In winter the twigs usually show a few scattered long hairs; buds, $\frac{3}{8}$ inch long, appressed to the branchlet, ovoid, acute, with glabrous, ciliate scales, glistening with resin.

VARIETIES AND HYBRIDS

This species, spread over a vast territory in North America, is very variable in the wild state; and the forms occurring on the Rocky Mountains and in the Pacific

¹ *Proc. Roy. Hort. Soc.* 1901, p. xxxviii.

Coast region have not yet been fully studied in the field. The following varieties are noteworthy:—

1. Var. *cordifolia*, Regel, in *Bull. Soc. Nat. Mosc.* xxxviii. 401 (1865); Fernald, in *Rhodora*, iii. 173 (1901); Sargent, *Silva N. Amer.* xiv. 55, t. 724 (1902).

Leaves distinctly cordate at the base, smaller than in the type. An alpine tree, moderate in size, scarcely exceeding 40 feet in height, which occurs on Mount Katahdin in Maine, on the White Mountains in New Hampshire, and in the northern Rocky Mountain region.

2. Var. *kenaica*.

Betula kenaica, Evans, *Bot. Gazette*, xxvii. 481 (1899); Sargent, *Silva N. Amer.* xiv. 53, t. 723 (1902), and *Trees N. Amer.* 205 (1905).

A tree in Kew Gardens, about 20 feet high, obtained from Dieck in 1891, and said to be a native of Alaska, has been identified by Sargent with *B. kenaica*. Judging from this specimen and the description given by Sargent, this species is only a small-leaved variety of *B. papyrifera*, from which it cannot be separated by any characters of importance. The branchlets are minutely pubescent and slightly glandular. The leaves are about 2 inches long, with five to seven pairs of nerves. The fruiting catkins are smaller than in the type, about an inch long, with glabrous ciliate scales, the middle lobe of which is narrow, oblong, not much longer than the rounded broad lateral lobes. The bark is like that of ordinary *B. papyrifera*, but the white colour is slightly tinged with orange.

Betula kenaica was discovered in 1897 by Dr. Evans in Alaska, in the Kenai Peninsula, near Cook Inlet; and was found on Kodiak Island by Coville in 1899. It is described as being a small tree, only reaching 40 feet in height. It is probable¹ that the variety extends south from Alaska through British Columbia; and is a form with small leaves growing on poor soil and in mountainous regions, while var. *Lyalliana*, with large leaves, occurs at nearly sea-level in rich alluvial soil.

3. Var. *Lyalliana*,² Koehne, in Beissner, Schelle, and Zabel, *Laubholz-Benennung*, 55 (1903); Schneider, *Laubholzkunde*, i. 115 (1904).

Betula occidentalis, Lyall, in *Journ. Linn. Soc. (Bot.)*, vii. 134 (1864) (in part) (not Hooker); Sargent, in *Bot. Gazette*, xxxi. 237 (1901), *Silva N. Amer.* xiv. 57, t. 725 (1902), and *Trees N. Amer.* 204 (1905) (not Sargent, in *Silva N. Amer.* ix. 65, t. 453 (1896)).
Betula Lyalliana, Koehne, in *Mitt. Deut. Dend. Ges.* viii. 53 (1899).

This variety, which is considered to be a distinct species by Sargent, differs from the type in the greater size of the tree, in the orange tint of the bark, and in the larger leaves, which are thin and membranous in texture, and not so thick and coriaceous as is usual in this species. The leaves are about 4 inches long and 3 inches broad, with seven to nine pairs of nerves, and are coarsely and doubly serrate, broadly ovate, with a broad, truncate base and a slightly acuminate apex.

¹ Specimens just received from trees cultivated in the Arnold Arboretum, U.S., labelled *B. occidentalis*, Sargent, and *B. kenaica*, Evans, are so similar, that they cannot be distinguished even as varieties. This confirms the opinion that var. *kenaica* and var. *Lyalliana* (*B. occidentalis*, Sargent) are merely geographical forms of *B. papyrifera*, the differences in the size of the leaves and fruiting catkins being due to soil and climate. Under cultivation in this country they maintain these differences.

² This name is preferable to *B. papyracea*, var. *occidentalis*, Dippel, *Laubholzkunde*, ii. 177 (1892), as the plant described there is apparently var. *grandis*, Schneider, a cultivated variety which originated from the eastern form of the species. Cf. our remarks on *B. occidentalis*, Hooker, given in p. 993.

The young branchlets have a minute, dense, erect pubescence, interspersed with long hairs and a few scattered glands. The fruiting-catkins are like those of the type, with slightly thinner scales, the middle lobe of which is triangular and elongated.

This splendid tree, which attains a height of 100 or 120 feet, and a diameter of 3 or 4 feet, on the alluvial banks of the lower Fraser River, appears to be confined to the lower basin of that river in south-western British Columbia and north-western Washington. It was first collected by Lyall in 1859, "in woods by river banks, on the Sumas and Chilukeveyuh prairies and other low grounds to the westward of the Cascade Mountains"; and his specimens preserved in the Kew Herbarium are identical with my own collected near New Westminster.

Piper¹ recognises the typical variety as occurring in north-western Washington, where he says that it is a tree with dark grey bark, occasionally 3 feet in diameter. He mentions a similar tree, smaller in size and often white-barked, which grows in Stevens County and the Blue Mountains of Washington State. This smaller tree, which also occurs in Idaho, is a connecting link between var. *Lyalliana* and the form of the species which occurs in the Rocky Mountains.

I collected seeds of var. *Lyalliana* on October 20, 1906, from two trees, about 60 feet in height, which I found growing near New Burnaby, on the electric tram-line between Vancouver and New Westminster. The virgin forest had been cut down in this neighbourhood, and the few trees which I saw were young and thriving, and growing in open spaces amidst second-growth *Thuja* and *Douglas*. I had no time to descend to the alluvial flats of the Fraser River, where Sargent reports the existence of trees of large size. At the large lumber mills of Vancouver and New Westminster, where I made inquiries, the tree is unknown at the present time; but I was informed that some years ago a small quantity of furniture had been made from large trees cut down near New Westminster.

The seed which I collected has been distributed to various places in Great Britain, and has germinated well. Seedlings raised in a nursery bed at Casewick, Lincolnshire, by Lord Kesteven, are now (August 1908) 12 to 22 inches in height, and for so far have been healthy and vigorous in growth. Some of the seed did not germinate till the following year. At Brocklesby, Mr. Havelock has raised a few plants in a frame, which are 24 to 30 inches high, with fine, large foliage. At Pollokshaws, near Glasgow, Sir John Stirling Maxwell reports that they did better when sown in the open than when grown in a frame, and average 15 inches in height, the tallest being 29 inches. He adds that this variety shows every sign of being a thriving tree.

Elwes has also raised from seeds sent to him from Kaslo, on Lake Kootenay, British Columbia, in 1904, a few young trees which appear to belong to this variety, and others from seed given him by Professor Sargent, and said to be from the lower Fraser Valley. These are growing vigorously at Colesborne.

4. *Betula Andrewsii*, Nelson, in *Bot. Gazette*, xliii. 279, with figure of the tree (1907), is a peculiar form with many branching stems from the base, which has been found in Colorado.

¹ *Contrib. U.S. Nat. Herb.* xi. 218 (1906).

5. A hybrid between *B. papyrifera* and *B. populifolia*, found growing wild in New Hampshire and Massachusetts, is described by Sargent in *Garden and Forest*, viii. 356, fig. 50 (1895).

Several varieties and hybrids have originated in cultivation:—

6. Var. *grandis*, Schneider (*B. macrophylla*, Hort.). Leaves large, cordate, lobulate in margin. Similar leaves appear on coppice shoots and on lower branches of old trees belonging to the typical form of the species.

7. *B. Koehnei*, Schneider, *Laubholzkunde*, i. 114 (1907), a hybrid between *B. papyrifera* and *B. verrucosa*, is identical with *B. cuspidata* of Späth's nursery.

8. *B. excelsa*, Aiton, *Hort. Kew*, iii. 337 (1789), long supposed to be either a distinct species or a cultivated variety of *B. papyrifera*, is considered by Schneider (*op. cit.* 108) to be a hybrid between this species and *B. pumila*, and differs from the former mainly in the smaller size of the leaves.

DISTRIBUTION

The paper birch is the most widely distributed species of *Betula* in North America, the typical form extending northward to Labrador, the southern shores of Hudson's Bay and Great Shore Lake, and southward to Long Island, New York, northern Pennsylvania, central Michigan, central Ohio, northern Nebraska, the Black Hills of Dakota, and northern Montana. In various forms it also occurs west of the Rocky Mountains to the Pacific Coast, in Alaska, British Columbia, Washington, and Idaho.

It usually grows on rich wooded slopes and on the borders of streams, lakes, and swamps; and is common in Canada, New York, and northern New England, becoming rarer to the southward and in the Rocky Mountains. (A. H.)

CULTIVATION

Notwithstanding the rarity of this tree in cultivation, it seems to grow freely at Colesborne, where I have raised it from seed, and planted it out in situations where it is exposed to cold and damp. Here it does not suffer from spring frost, and has attained 15 feet in height in seven years. As an ornamental tree, however, it is not in England superior to the common birch, and has no special merit to justify its being planted except as a curiosity.

The paper birch was introduced into England in 1750, according to Loudon; but is rarely seen except in botanic gardens, as at Kew, where there are several fair-sized specimens, the largest, a tree with ascending branches, near the Victoria gate, being 45 feet high by 3½ feet in girth. Close to it is another nearly equal in size, with markedly drooping branches. In the Cambridge Botanic Garden, a tree, grafted at 1½ foot from the ground, was, in 1906, 47 feet by 4 feet 7 inches.

The largest tree we know of in cultivation is in Mr. Kaufman's garden at White Knights, near Reading, which Henry measured in 1904 as 82 feet by 4 feet 11 inches. Another tall white-barked tree with a clean stem, grafted on common

birch near the ground, grows at Bicton, and measured, in 1906, 75 feet by 7 feet 2 inches (Plate 259). A large tree is growing at Woburn, near the lake on the right of the main entrance from the village. It is on its own roots, and has bark of a brownish-grey colour, quite unlike the trees at White Knights and Bicton. At Arley,¹ a tree measured 41 feet by 4 feet in 1905. There is also an old and sickly tree at Boynton, in Yorkshire, and a young and healthy one on its own roots, about 40 feet high, at Tortworth.

In Scotland and Ireland we have failed to find a single specimen of any size.

The handsomest specimen that I have seen in Europe is at the nursery of Simon-Louis frères at Metz, where on a deep rich loam it has attained 70 feet high by 6 feet 4 inches in girth, and has a fine silvery bark, more beautiful than any that I know in England. (H. J. E.)

BETULA POPULIFOLIA, GREY BIRCH

Betula populifolia, Marshall, *Arbust. Am.* 19 (1785); Loudon, *Arb. et Frut. Brit.* iii. 1707 (1838); Sargent, *Silva N. Amer.* ix. 55, t. 450 (1896), and *Trees N. Amer.* 200 (1905); Winkler, *Betulaceæ*, 79 (1904).

Betula excelsa canadensis, Wangenheim, *Nordam. Holz.* 86 (1787).

Betula acuminata, Ehrhart, *Beit. Naturk.* vi. 98 (1791).

Betula cuspidata, Schrader, *ex Regel*, in DC. *Prod.* xvi. 2, p. 164 (1868).

Betula alba, Linnæus, var. *populifolia*, Spach, in *Ann. Sc. Nat. sér. 2*, xv. 187 (1841).

Betula alba, Linnæus, sub-species *populifolia*, Regel, in *Bull. Soc. Nat. Mosc.* xxxviii. 399 (1865).

A tree, attaining in America 30 or 40 feet in height and 18 inches in diameter. Bark similar to that of *B. verrucosa*, but greyish in colour. Young branchlets glabrous, covered with reddish-brown glands, which persist and roughen the shoot in the second year. Leaves (Plate 269, Fig. 4), 2½ to 3 inches long, 1½ to 2 inches wide, deltoid; broadly cuneate or truncate at the base; prolonged into a long caudate-acuminate apex; margin lobulate, irregularly serrate; nerves five or six pairs; both surfaces shining, glabrous, covered with minute brown glands; petiole reddish, long, slender, glandular, glabrous.

Fruiting-catkins (Plate 269, Fig. 4), cylindrical, ¾ inch long, ¼ inch in diameter, pendent or spreading on slender stalks; scales pubescent and ciliate, with short triangular middle lobe and recurved broad lateral lobes; wings broader than the narrow nutlet.

This species is closely allied² to *B. verrucosa*; but it is a smaller tree, strikingly different in the colour of the bark, and is readily distinguished by the shape of the leaf, the apex of which is very prolonged, and by the pubescent scales of the fruiting-catkins.

Varieties *laciniata* and *pendula* mentioned by Loudon are not known now in

¹ *Hortus Arleyensis*, 45 (1907).

² Sargent, in *Garden and Forest*, ii. 484 (1889), points out the differences between these two species.

cultivation.¹ Var. *purpurea*, with reddish leaves, was sent out in 1892 by Ellwanger and Barry, of Rochester, New York. *B. cærulea*, Blanchard, is apparently a form of this species, with dull bluish-green leaves, ovate rather than deltoid in outline, which is common on hills in northern New England and eastern Canada.

This is the smallest of the arborescent birches of America, and grows usually on dry, gravelly or sandy, barren soil, or on the edges of swamps and lakes. Its area of distribution extends from Nova Scotia and the valley of the St. Lawrence southward to Delaware, and westward through northern New England and New York to the southern shores of Lake Ontario. It is very abundant in the coast region of New England and the middle states, and springs up in abundance after forest fires or on abandoned farm lands.

It was first cultivated in England by Archibald, Duke of Argyll, at Whitton, near Hounslow, in 1750, and is rarely met with now except in botanical gardens. At Kew, the largest specimen, growing near the end of the rhododendron dell, is 35 feet high and about 6 inches in diameter. It produces fruit regularly. Loudon mentions a birch supposed to be of this species at Dodington Park in Gloucestershire, 60 feet high in 1838, but no such tree now survives there. (A. H.)

BETULA NIGRA, RED BIRCH

Betula nigra, Linnæus, *Sp. Pl.* 982 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1710 (1838); Sargent, *Silva N. Amer.* ix. 61, t. 452 (1896), and *Trees N. Amer.* 198 (1905); Winkler, *Betulaceæ*, 58 (1904).

Betula lanulosa, Michaux, *Fl. Bor. Am.* ii. 181 (1803).

Betula rubra, Michaux f., *Hist. Arb. Am.* ii. 142 (1812).

A tree, attaining in America 80 or 90 feet in height, with a trunk occasionally 5 feet in diameter, and usually divided into two or three diverging limbs at 15 or 20 feet above the ground. Bark at first smooth, reddish brown; with age, separating into successive layers, which curl up and persist on the trunk as thin papery scales of various tints of red and brown; ultimately turning black and becoming an inch thick and deeply furrowed at the base of old trunks. Young branchlets tomentose, with numerous glands; older branchlets glabrous and roughened with the remains of the glands. Leaves (Plate 270, Fig. 13), $1\frac{1}{2}$ to 3 inches long, 1 to 2 inches wide, deltoid-ovate, with cuneate base and acute apex; margin non-ciliate, coarsely and irregularly bi-serrate, and often lobulate; nerves seven or eight pairs; upper surface shining, with fine pubescence mainly on the nerves; lower surface greyish, with pubescence chiefly on the midrib and nerves, and with numerous white glands; petiole tomentose and glandular.

Fruiting-catkins (Plate 270, Fig. 13), cylindrical, 1 to $1\frac{1}{2}$ inch long, $\frac{1}{2}$ inch in diameter, erect, on stout tomentose peduncles, about $\frac{1}{2}$ inch long: scales pubescent

¹ There is a var. *laciniata*, and also a var. *purpurea* assigned to *B. verrucosa* in Späth's and Simon-Louis's nurseries, which may be what Loudon referred to.

and ciliate. The fruit ripens in May or June, and Sargent has called attention to the fact that the early ripening of the seeds of this and other trees, as the red and silver maples, growing beside rivers assures their germination, as they fall on the banks at the season of low water, immediately germinate, and grow speedily.

Betula nigra is readily distinguishable by its peculiar bark, the only other species in cultivation which at all resembles it in this respect being *B. dahurica*. It is also very distinct in the greyish colour of the leaves beneath, which are cuneate at the base, acute and not acuminate at the apex, and usually lobulate in margin with sharp double serrations.

In winter the twigs are brown, glandular, and almost glabrous; buds minute, $\frac{1}{8}$ inch long, appressed to the branchlet, with a sharp beak directed inwards; scales ciliate and pubescent.

This species, which is known as the red or water birch,¹ grows usually on the banks of streams and ponds or in swamps, in deep rich soil, liable to inundation. It occurs from Massachusetts, southwards to Florida, east of the Alleghany Mountains; through the Gulf States to Trinity River, Texas; and throughout the Mississippi valley to Indian territory, Kansas, Nebraska, Minnesota, Wisconsin, and Ohio. It attains its largest size in the damp lowlands of Florida, Louisiana, and Texas, being the only birch tree of these warm regions. (A. H.)

Sargent says² that its distribution is peculiar, as though it grows abundantly and luxuriantly on the banks of the Merrimac and Spicket rivers in north-east Massachusetts, it occurs nowhere else in New England, and only becomes common in the south of New Jersey, extending from thence to Iowa in the west, and to Florida and Texas in the south, growing in the south on the banks of almost every stream which has a gravelly bed, and of which the banks are not marshy, and attaining a height of 80 or 90 feet with a trunk 3 to 4 feet in diameter; but in North Carolina, according to Ashe, its average size is 40 to 60 feet high by 1 to 2 feet in diameter.

It was introduced into cultivation in England by Peter Collinson in 1736; but is rarely met with, though it ought to be more suitable for cultivation³ in the warmer parts of England than the more northern species. There are several good specimens in Kew Gardens, the largest, near the rhododendron dell, being 57 feet high and 5 feet in girth. This tree divides at 7 feet from the ground into two main stems; and one or two smaller trees in the collection of birches branch similarly near the ground into two or three stems. A tree near the Victoria gate has a single stem, 48 feet in height and $4\frac{1}{2}$ feet in girth. Some of these trees bore ripe fruit in June 1908.

Though Sargent says that large specimens may be seen in some of the older European parks, neither Pardé nor Correvon mention any trees of this species; but Bean⁴ saw one $7\frac{1}{2}$ feet in girth at Herrenhausen, Hanover. (H. J. E.)

¹ It is also known as the river birch, and though known to botanists as *B. nigra*, it is very seldom called in America black birch, the latter name being very commonly applied to *B. lenta*. ² *Garden and Forest*, ii. 591.

³ In an article on this tree, in *Gard. Chron.* xxv. 21 (1899), Mr. Bean recommends it for ornamental planting on low islands in lakes, and beside water-courses.

⁴ *Kew Bull.*, 1908, p. 392.

BETULA LUTEA, YELLOW BIRCH

Betula lutea, Michaux f., *Hist. Arb. Am.* ii. 152 (1812); Sargent, *Silva N. Amer.* ix. 53, t. 449 (1896), and *Trees N. Amer.* 197 (1905); Winkler, *Betulaceae*, 65 (1904).

Betula lenta, Linnæus, var. *lutea*, Regel, in DC. *Prod.* xvi. 2, p. 179 (1868).

Betula lenta, Linnæus, var. *genuina*, Regel, in *Mém. Soc. Nat. Mosc.* xiii. 126 (1861).

Betula excelsa, Pursh, *Fl. Am. Sept.* ii. 621 (1814) (not Aiton); Loudon, *Arb. et Frut. Brit.* iii. 1711 (1838).

A tree, attaining in America 100 feet in height and 3 or 4 feet in diameter. Bark smooth, shining, silvery or golden grey, breaking into ribbon-like strips and curls, which long remain attached; in old trees, $\frac{1}{2}$ inch thick, reddish brown, and fissured. Young branchlets covered with long pale hairs; in the second year smooth, brown, and usually glabrous.

Leaves (Plate 270, Fig. 11), 3 to $4\frac{1}{2}$ inches long, $1\frac{1}{2}$ to 2 inches wide, ovate-oblong, rounded at the base, acute or slightly acuminate at the apex; margin finely and sharply serrate, ciliate between the teeth; nerves nine to twelve pairs; both surfaces with long silky hairs mainly on the midrib and nerves; pale beneath; petiole pilose.

Fruiting-catkins (Plate 270, Fig. 11) erect, sessile or sub-sessile, ovoid-oblong, 1 to $1\frac{1}{2}$ inch long, $\frac{3}{4}$ inch in diameter; scale lobes nearly equal, ciliate, pubescent.

In winter the slender twigs are more or less pilose; buds fusiform, $\frac{1}{4}$ inch long, rather blunt at the apex, with minutely pubescent, ciliate scales.

This species occurs in Newfoundland and along the northern shores of the Gulf of St. Lawrence, to the valley of the Rainy River, extending southwards to Delaware and Minnesota, and along the Alleghany Mountains to the high peaks of North Carolina and Tennessee. It is one of the largest broad-leaved trees of the eastern provinces of Canada and New England, where it is abundant, usually growing in rich soil on moist uplands, in company with the beech, sugar and red maples, black and white ash, and white elm. The leaves turn a bright yellow in autumn. (A. H.)

The yellow birch was introduced into England, according to Loudon, about 1767, but has never become common.

The finest we know of in England grows in a shrubbery near the kitchen garden at Tortworth, and measured in 1907 about 50 feet by 4 feet. It has borne fruit, from which Lord Ducie has raised seedlings. There are small specimens in Kew Gardens.

At Auchendrane, Ayrshire, Mr. Renwick measured a tree in 1907, 57 feet high, with a bole of 15 feet girthing 5 feet 2 inches.

A very fine tree is growing at Oriel Temple, Co. Louth, the seat of Lord Masserene, which was mentioned by Loudon under the name *B. lenta*. When I saw it in July 1908, it was in perfect health, and measured 58 feet high by 7 feet 4 inches in girth (Plate 260). Loudon states that in his time it was about fifty years planted, and 50 feet high with a diameter of 1 foot 9 inches. (H. J. E.)

BETULA LENTA, CHERRY BIRCH, BLACK BIRCH

Betula lenta, Linnæus, *Sp. Pl.* 983 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1713 (1838); Sargent, *Silva N. Amer.* ix. 50, t. 448 (1896), and *Trees N. Amer.* 196 (1905); Winkler, *Betulaceae*, 64 (1904).

Betula nigra, Du Roi, *Obs.* 30 (1771) (not Linnæus).

Betula carpinifolia, Ehrhart, *Beit. Naturk.* vi. 99 (1791) (not Siebold and Zuccarini).

A tree, attaining in America 80 feet in height and 2 to 5 feet in diameter. Bark smooth, close, dark brown, with pale, elongated, horizontal lenticels, peeling off transversely in thin strips; on old trunks deeply fissured and broken into large, irregular scaly plates. Young branchlets glabrous, except for a few hairs above the leaf-insertions, slightly glandular.

Leaves (Plate 269, Fig. 3), $2\frac{1}{2}$ to 5 inches long, $1\frac{1}{2}$ to 3 inches wide, ovate-oblong, rounded or slightly cordate at the base, acuminate at the apex; margin non-ciliate, bi-serrate; nerves nine to thirteen pairs; upper surface dark green with a few long hairs confined to the midrib and nerves or scattered throughout; lower surface lighter in colour, with silky hairs on the midrib and nerves, forming axil-tufts; petiole pilose at first, ultimately glabrescent.

Fruiting-catkins (Plate 269, Fig. 3) erect, sessile, ovoid-oblong, 1 to $1\frac{1}{2}$ inch long, $\frac{1}{2}$ inch in diameter; scales glabrous, with nearly equal lobes, the lateral lobes being divergent.

This species is characterised by the pleasant aromatic flavour and fragrance of the leaves, twigs, and inner bark; and on that account is sometimes named sweet birch in America. It is, however, more often called, on account of the colour of the bark, cherry birch or black birch. In winter the twigs are shining and almost glabrous; buds fusiform, $\frac{5}{16}$ inch long, ending in a sharp beak, brownish, viscid, shining.

Var. *laciniata*, Rehder, in *Rhodora*, ix. 111 (1907). Leaves with six to nine pairs of sharply serrated lobes. A single tree of this variety, which resembles *B. verrucosa*, var. *dalecarlica*, in the form of the leaves, was found in 1901 at New Boston in New Hampshire.

A hybrid between this species and *B. pumila*, L., has been described by Sargent.¹ (A. H.)

This species is an inhabitant of Newfoundland and Canada from Nova Scotia to Lake Superior, growing in its greatest perfection in central Ontario, Algoma, and Parry Sound, where Macoun says it is often more than 4 feet in diameter. In the United States it extends west to Iowa, and along the Alleghany Mountains to Kentucky and Tennessee, attaining a large size in the valleys of North Carolina. Ashe figures on plate 12 of his work a splendid tree 80 feet in height, with a clean bole 5 feet in diameter. He says the bark is reddish brown and rough on old trees, while on young trees and branches it is smooth and dark, resembling that

¹ *Garden and Forest*, viii. 243, fig. 36 (1895).

of *Prunus serotina*. It produces seed once in three or four years, and does not bear shade well, though young trees will sprout from the stump. The timber is heavy, hard, and strong, dark brown in colour, and takes a good polish.

I saw a very fine tree of this species in a garden at Lancaster, Massachusetts, 62 feet by 10 feet, dividing at 3 feet into four stems, which were covered with a very pretty ragged yellow and grey bark.

Betula lenta was introduced into England in 1759, according to Loudon. We are not aware that it has anywhere attained a large size, except at Oakly Park, near Ludlow, the property of the Earl of Plymouth, where on a rich sheltered flat on the banks of the Teme, I found a tree of considerable age, which in August 1908 measured about 60 feet by 4 feet 9 inches. The trees in Kew Gardens are about 20 feet in height. A specimen at High Canons, Herts, measured 36 feet high by 4 feet 2 inches in girth, and bore fruit in 1907. Another at Bicton, 38 feet by 3 feet 5 inches, is growing in the Arboretum walk, near the Paper Birch.

Beer is sometimes obtained in America by fermenting the sugary sap of this tree. Oil of birch, which is made on a considerable scale in Pennsylvania, is a more important product. This is obtained by distilling the wood,¹ one ton of which yields about 4 lbs. of oil. This oil is nearly identical, both in chemical and physical properties, with oil of winter-green, which is manufactured in the same district; and commercial oil of winter-green is a mixture of the two oils in varying proportions. (H. J. E.)

BETULA FONTINALIS

Betula fontinalis, Sargent, in *Bot. Gazette*, xxxi. 239 (1901), and *Trees N. Amer.* 207 (1905).

Betula occidentalis, Sargent, *Silva N. Amer.* ix. 65, t. 453 (1896) (not Hooker); Winkler, *Betulaceae*, 86 (1904); Schneider, *Laubholzkunde*, i. 114 (1904).

A tree, occasionally attaining 40 feet in height and 3 or 4 feet in girth, more commonly shrubby, with many branching stems. Bark about $\frac{1}{4}$ inch thick, dark brown, shining, not separating into thin layers, marked by pale brown horizontal lenticels. Young branchlets viscid, densely covered with resinous glands, interspersed with long, pale hairs; older branchlets dark in colour and roughened with the persistent glands. Leaves about $1\frac{1}{2}$ inch long, and 1 to $1\frac{1}{2}$ inch broad, thin in texture, broadly or narrowly ovate; rounded, truncate or subcordate, and often unequal at the base; acute at the apex; margin ciliate, sharply and doubly serrate; nerves six to eight pairs; both surfaces glandular with scattered long hairs, at first paler beneath, becoming glabrescent; petiole, $\frac{1}{2}$ inch, glandular, glabrescent.

Fruiting-catkins, about 1 inch long, $\frac{1}{4}$ inch in diameter, cylindrical, on slender glandular stalks; scales pubescent, ciliate, with the three lobes triangular and nearly equal in size, the lateral lobes divergent; nutlets with broad wings.

This species is readily distinguished by its conspicuously glandular branchlets and its small, thin leaves, which are variable in width, and in the form of the base.

¹ Cf. article by H. Trimble in *Garden and Forest*, viii. 303 (1895), where the process is described. The oil of birch is contained in the inner bark only; and on this account the wood used in distillation is obtained from small trees, usually coppice shoots.

B. fontinalis × *B. papyrifera*. There are two small trees in Kew Gardens, with wide-spreading pendulous branches, which were obtained from Dieck in 1891, and were said to be *B. occidentalis* from Alaska. One of these trees has firm, dark-brown, shining bark like that of *B. fontinalis*; while the other has white bark, peeling off in shreds, indistinguishable from that of *B. papyrifera*. The branchlets are exactly similar to those of *B. fontinalis*. The leaves (Plate 269, Fig. 8) are very variable and not precisely the same on both trees; resembling those of *B. fontinalis* in colour, but much larger and much thicker in texture; 2 to 3 inches or more in length, broadly ovate; rounded, truncate, or cuneate at the base, acute at the apex, coarsely serrate or toothed in margin, pubescent and gland-dotted on both surfaces. The fruiting-catkins (Plate 269, Fig. 8) and the scales are as large as those of *B. papyrifera*; but the scales are more like those of *B. fontinalis* in shape, the three lobes being almost triangular, glabrous, and ciliate. In all probability these two trees, with such variable characters in the bark and foliage, are hybrid between *B. fontinalis* and *B. papyrifera*, which occur in the same region.

The small-leaved birch, described above under the name *B. fontinalis*, was identified by Nuttall¹ with *B. occidentalis*, W. J. Hooker, *Fl. Bor. Amer.* ii. 155 (1839); and most botanists, including Sargent² in 1896, Winkler, and Schneider, have followed Nuttall. Sargent,³ however, in 1901 advanced the opinion that the tall, large-leaved birch of the lower Fraser River, considered by us to be *B. papyrifera*, var. *Lyalliana*, is a distinct species, which he identified with Hooker's *B. occidentalis*; and he proposed the name *B. fontinalis* for the small-leaved birch.

The material⁴ in the Kew Herbarium, on which Hooker founded his species, includes no less than three distinct birches, none of which, however, is the large-leaved variety of *B. papyrifera*; and as his description is confused and not confined to a single species, the name *B. occidentalis*, Hooker, must be entirely abandoned; and, in consequence, *B. fontinalis* is rightly adopted for the small-leaved birch, as being the first valid name for this species.

B. fontinalis is a small tree or spreading shrub, widely distributed in western North America, where it usually grows on moist soil near the banks of streams in mountain valleys. It extends from the basin of the upper Fraser and Peace rivers in British Columbia, Alberta, and the valley of the Saskatchewan, southwards to Mount Shasta and the northern Sierra Nevada in California, and through the Rocky Mountains and the interior ranges to Nevada, Utah, and northern New Mexico; extending eastwards in the United States to the Black Hills of Dakota and north-western Nebraska. Mr. M'Innes, of the Canadian Geological Survey, has recently discovered this species in the district north of Lake Superior.⁵

¹ *N. Amer. Sylva*, i. 22 (1842).

² *Silva N. Amer.* ix. 65 (1896).

³ *Bot. Gazette*, xxxi. 237 (1901).

⁴ This material includes:—

I. One specimen collected by Dr. Scouler, labelled "De Fuca Straits"; another, collected by Dr. Tolmie, "N.-W. Coast"; and a third collected by Douglas "west of the Rocky Mountains." These three specimens are a small-leaved variety of *B. papyrifera*, identical with *B. kenaica*, Evans.

II. Two specimens, collected by Dr. Richardson, labelled "Arctic Sea-Coast," one of which is *B. fontinalis*, Sargent; and the other, *B. alaskana*, Sargent.

III. A specimen, with young foliage, collected by Drummond, near Edmonton, which is probably *B. fontinalis*.

⁵ *Canadian Forestry Journal*, 1905, 175.

It was introduced into cultivation in the Arnold Arboretum in 1874; but is rarely met with in Europe, except in Botanic Gardens. Four or five specimens, in the lower nursery at Kew, which were received from Sargent in 1903, are now 8 to 10 feet in height, and are vigorous in growth, promising to become trees of considerable size. Another specimen in the collection at Kew, raised from seed obtained from the Pinehurst Nursery in 1897, is about 10 feet in height and is more shrubby in appearance.

(A. H.)

TIMBER OF THE AMERICAN BIRCHES¹

All American authors agree in saying that the tree which supplies the best wood of commerce is that of the *Betula lenta*, known in New England as black birch, in Canada as cherry birch. Macoun says that the yellow birch is scarcely distinguished in commerce, and judging from the specimens in Hough's *American Woods*, it would be difficult for any one but an expert to do so. Michaux and Macoun both say that the timber of the white birch is less valuable than either of the above; and Sargent says that the wood of the red birch has lately been found suitable for furniture of the best quality. Mr. Weale tells me that large quantities of red and yellow birch are imported into Liverpool, chiefly in the form of hewn logs of 15 to 18 inches square, which are valued in proportion to their size at from 1s. 6d. to 2s. a foot and upwards for logs showing figure. The wood often shows a beautiful undulation called "roll figure," which, when cut into veneers, was a few years ago very fashionable for bedroom furniture, and is sometimes rather difficult to distinguish from satin wood, though its colour is rather pinkish than yellowish and the undulations larger and more open. Mr. C. L. Willey, of Chicago, tells me that this fine "curly birch" is principally found at altitudes of 3000 to 4000 feet in North Carolina, and is very light in colour, having a yellowish tint; whilst other trees produce wood of a reddish colour, resembling that of cherry (*Prunus serotina*).

A large quantity of American birch is also imported in the form of planks 2 inches to 5 inches thick, and averaging 8 inches wide, which are sold in Liverpool at about 1s. per cubic foot, and consumed for chair-making at High Wycombe and elsewhere. At this low price it is the most formidable competitor to the native beech, and in some of the factories which I visited, seemed to be the more popular wood of the two.

The bark of the Paper Birch, and to a less extent that of other species, is as important to the inhabitants of Canada as that of the common birch is to those of northern Europe. Canoes and lodges are covered with large sheets of bark; it is placed on shingled roofs under the shingles to prevent the water from coming through; and very ornamental boxes, baskets, and other articles are made from it by the Indians. It also serves as a writing material, and I have a clearly written letter from Prof. Elrod, sent me by him, when during an expedition in Montana he ran out of paper.

(H. J. E.)

¹ Emerson distinguishes the five common birches of New England as follows:—

1. *B. lenta*, black birch; bark dark coloured.
2. *B. lutea*, yellow birch; bark yellowish, with a silvery lustre.
3. *B. nigra*, red birch; bark reddish or chocolate coloured, very much broken and ragged.
4. *B. papyrifera*, canoe birch; bark white with a pearly lustre.
5. *B. populifolia*, grey or white birch; bark chalky-white, dotted with black.

DIOSPYROS

Diospyros, Linnæus, *Gen. Pl.* 143 (1737); Hiern in *Trans. Camb. Phil. Soc.* xii. 1, 144 (1873);
Bentham et Hooker, *Gen. Pl.* ii. 665 (1876); Gürke in Engler u. Prantl, *Pflanzenfam.* iv. 1,
161 (1890).

Cargillia, R. Brown, *Prod. Fl. Nov. Holl.* 526 (1810).

Leucoxyllum, Blume, *Bijdr. Fl. Ned. Ind.* 1169 (1825).

Noltia, Schumacher, *Dansk. Vidensk. Selsk. Skrift.* iii. 189 (1828).

Rospidius, A. de Candolle, *Prodr.* viii. 220 (1844).

TREES or shrubs, belonging to the order Ebenaceæ. Leaves alternate or rarely sub-opposite, deciduous or persistent, simple, entire, without stipules.

Flowers dioecious or rarely polygamous, monœcious or perfect,¹ in cymes or solitary from the axils of the leaves of the current year, or in a few species arising from the old wood. Calyx, three- to seven-, usually four-lobed, pubescent, and accrescent under the fruit. Corolla urn-shaped, campanulate, tubular, or salver-shaped, three- to seven-, usually four- to five-lobed, pubescent. Male flowers small, usually in cymes; stamens four to sixteen, inserted on the base of the corolla or hypogynous; filaments slender and often united by pairs, forming an outer and inner series; anthers opening longitudinally or by apical pores; ovary aborted or wanting. Female flowers often solitary; staminodes four to eight, sometimes wanting, occasionally with fertile anthers; ovary with four to sixteen cells, which are double the number of the styles and one-ovuled, or rarely of the same number as the styles and two-ovuled. Fruit a berry, with the enlarged and persistent calyx at its base, containing one to ten or more oblong seeds, which have a copious albumen.

The alternate, simple, stalked, entire leaves, without stipules, and the shoots without true terminal buds and with two persistent bud-scales at their base, are distinguishing marks of the genus.

About 180 species of *Diospyros* are known, mostly confined to the subtropical and tropical regions of both hemispheres. The wood is usually hard and close-grained, the heartwood black, the sapwood soft, thick and yellow.

Only three species are in cultivation in this country; and of these *Diospyros Kaki*, Linnæus f., the Chinese Persimmon, a shrub or small tree, usually only met with in England in greenhouses or trained against a wall, does not come within the scope of our work. It ripens its fruit in warm summers in England. (A. H.)

¹ In many species the sexes are unstable; cf. Wright, *Ann. R. Bot. Gard. Peradeniya*, ii. pt. i. 1, 133 (1904).

DIOSPYROS VIRGINIANA, AMERICAN PERSIMMON

Diospyros virginiana, Linnæus, *Sp. Pl.* 1057 (1753); Loudon, *Arb. et Frut. Brit.* ii. 1195 (1838)

Sargent, *Silva N. Amer.* vi. 7, tt. 252, 253 (1894), and *Trees N. Amer.* 749 (1905).

Diospyros guajacana, Romans, *Nat. Hist. Florida*, 20 (1775).

Diospyros concolor, Moench, *Meth.* 471 (1794).

Diospyros pubescens, Pursh, *Fl. Am. Sept.* i. 265 (1814); Loudon, *Arb. et Frut. Brit.* ii. 1196 (1838).

Diospyros caroliniana, Rafinesque, *Fl. Ludovic.* 139 (1817).

Diospyros Persimmon, Wikström, *Jahr. Schwed.* 1830, p. 92 (1834).

A deciduous tree, attaining occasionally in America 115 feet in height and 6 feet in girth, but usually smaller. Bark¹ deeply divided into square corky plates. Young shoots with a minute dense erect pubescence, persistent usually in the second year. Leaves (Plate 199, Fig. 3) oblong or elliptical; rounded and unequal or broadly cuneate at the base; shortly acuminate at the apex; margin entire and ciliate; upper surface dull, light green, and glabrous except for some pubescence on the midrib at the base; lower surface pale, glabrous; veins pinnate, arcuate, and looping near the margin; petiole pubescent, $\frac{1}{2}$ to 1 inch long.

Flowers appearing, when the leaves are more than half-grown, on the current year's shoot, diceious. Staminate flowers in two- to three-flowered pubescent pedunculate cymes; calyx with four broadly ovate acute ciliate lobes; corolla tubular, slightly contracted below the very short acute reflexed lobes; stamens sixteen, in two series, with pubescent filaments. Pistillate flowers, solitary, on short recurved peduncles; stamens eight, usually with aborted anthers; ovary pilose towards the apex, eight-celled; styles four, two-lobed at the apex, pubescent at the base.

Fruit solitary, on short woody peduncles, persistent on the branches during winter; depressed, globose; surrounded at the base by the persistent calyx, which has four broadly ovate pointed recurved lobes. The fruit is variable in size, from that of a small cherry to a large plum; and its flavour is very different in different localities and even on trees growing close together—sometimes sweet without the action of frost, or ripening after frost, or at other times acid and never edible. Seeds oblong, flattened, $\frac{1}{2}$ inch long. Seedless forms occur, and experiments are being made in America with these and other good varieties.

The leaves on trees, growing in the Southern States, are strongly pubescent beneath; and this variety, which we have not seen in cultivation in England, is scarcely to be distinguished by the foliage alone from *D. Lotus*, which has pubescent leaves, and differs in this respect from the ordinary form of *D. virginiana*, with

¹ The bark is well figured in *Gard. Chron.* iv. 504, fig. 71 (1888).

glabrous leaves. The buds and leaf-scars of the two species are very different, and constitute the best marks of distinction.

In winter, the American Persimmon (Plate 200, Fig. 4) shows the following characters:—Twigs slender, covered with a minute dense erect pubescence, with two broadly ovate scales (of the previous season's bud) persisting at the base of the shoot. Leaf-scars, oblique on prominent pulvini, small, semicircular, with a deep transverse lunate depression, showing indistinctly the coalesced cicatrices of the vascular bundles. True terminal bud not formed, the tip of the branchlet dying off in summer and leaving at the apex of the twig a short glabrous stump with a terminal scar, which subtends the uppermost axillary bud. Buds ovoid, slightly compressed, small, brown, shining, glabrous, usually with a minute curved beak tipped by a few hairs; outer scales two, imbricate, ovate, acute, non-ciliate, concave interiorly, pubescent at the tip, glabrous elsewhere.

This species is widely distributed in the United States, its most northerly point being at Newhaven in Connecticut. It is not uncommon in Long Island, and extends southwards to Alabama and Florida, and westwards through Ohio and Iowa to Missouri, Arkansas, Louisiana, eastern Kansas, Indian Territory, and the valley of the Colorado River in Texas. It usually grows on light, sandy, well-drained soil, but attains its largest size in the deep alluvial lands of the Mississippi basin, where it sometimes reaches a height of more than 100 feet, with a slender trunk free from branches for 70 or 80 feet. It is exceedingly common in the south Atlantic and Gulf States, often covering with its suckers abandoned fields, and springing up by the sides of roads and fences. Sargent¹ gives a figure of a tree with wide-spreading branches, not unlike the specimen at Kew in size and appearance, which is growing in an old corn-field near Auburn in Alabama.

Elwes saw a fine tree of this species in a damp river bottom near Mount Carmel, Illinois, in 1904, which measured 100 feet high by 6 feet in girth, with a clean, straight trunk 60 feet high; but the late Dr. Schneck, who showed it to him, measured one as much as 115 feet high, 80 feet to the first limb, and only $5\frac{1}{2}$ feet in girth at the base. When growing in open fields or along road-sides, where it is most frequently seen, it forms a more spreading tree, usually 30 to 40, and rarely more than 60 feet high. (A. H.)

CULTIVATION

This tree is easy to raise from seed, and perfectly hardy in England, but requires a warm, dry soil, and a much hotter summer than usual to make it thrive. The seedlings which I have raised grow very slowly and do not root freely in my soil. Judging from the extreme rarity of the tree in cultivation, it is hardly likely to be worth planting generally, and, so far as we know, has never borne fruit in England. Even in the climate of central France it fruits, according to Pardé,² very rarely, and grows slowly, having only attained about 20 feet in height at Les Barres. Neither

¹ *Garden and Forest*, viii. 262, fig. 38 (1895).

² *Arboretum Nat. des Barres*, 215 (1906).

Mouillefert nor Mayr mention this tree; and I have seen none in Europe worth mentioning, except a fine tree in the Botanic Garden at Padua, which appears to be the pubescent variety of this species, although it is labelled *D. Lotus*. According to Prof. Saccardo, it was planted in 1760, and measured 30 metres high by 2 metres in girth in 1887.

The American Persimmon was introduced into England some time before 1629, when an account of a cultivated tree appeared in Parkinson's *Paradisus* published in that year.

It is extremely rare in this country at the present day, and Loudon in 1838 only mentioned six trees, two of which still survive. One of these, which is a staminate tree, growing in Kew Gardens, now measures 64 feet in height by 5 feet 3 inches in girth, and, according to Sargent,¹ is apparently as thriving as if it were in its native habitat. It is one of the denizens of the original Kew Arboretum, which was laid out by W. Aiton, and in all probability was one of the numerous trees presented in 1762 to the mother of George III. by Archibald, Duke of Argyll, who was a great introducer and cultivator of rare trees at Whitton, near Hounslow.² (Plate 261.)

Another, mentioned by Loudon as being 24 years planted and 18 feet high in 1838, is growing at the Wilderness, White Knights, near Reading, and is now 45 feet high by 4 feet 1 inch in girth. At Barton, Suffolk, another is 40 feet high by 2 feet 1 inch in girth. At Bushey Lodge a tree with a broken top was, in 1904, 30 feet high by 5 feet 8 inches in girth. Suckers are growing from its roots as far away as 50 feet, and one of these, 10 feet high, is said to be about ten years old.

TIMBER

The wood is very hard and heavy, of a pale yellowish-white colour, with black heartwood, which, however, usually shows only in old trees. Hough states that he felled one 14 inches in diameter for the specimens in his work,³ but though there were over sixty rings of sapwood, only two or three in the heart were black. It is used in America for shoe-lasts and shuttles, for which latter purpose it is imported to a small extent to Liverpool. Michaux⁴ states that it was used at Charleston for shafts, and preferred for that purpose to ash or any wood except lancewood, but the quantity available is too small to give this timber much economic importance. The fruit is little valued as human food, though eaten by animals.

(H. J. E.)

¹ *Garden and Forest*, loc. cit.

² Cf. J. Smith, *Records of Kew Gardens*, 258; and Nicholson, in *Gard. Chron.* iv. 504 (1888), in which is given a good picture of the tree (fig. 72). Cf. also *Kew Bulletin*, 1891, p. 292.

³ *American Woods*, iii. No. 61.

⁴ *Mich. fil.*, *N. Am. Sytva*, ii. 222.

DIOSPYROS LOTUS, DATE-PLUM

Diospyros Lotus, Linnæus, *Sp. Pl.* 1057 (1753); Loudon, *Arb. et Frut. Brit.* ii. 1194 (1838); C. B. Clarke, in Hooker, *Fl. Brit. India*, iii. 555 (1882); Hemsley, in *Journ. Linn. Soc. (Bot.)* xxvi. 70 (1889); Shirasawa, *Icon. Ess. Forest. Japon.* 123, t. 79 (1900).
Diospyros microcarpa, Siebold, in *Ann. Soc. Hort. Pays.-Bas.* 1844, p. 28.
Diospyros japonica, Siebold et Zuccarini in *Abh. Bayer. Acad.* iv. 3, p. 136 (1846).

A tree attaining 60 feet in height and 6 feet in girth. Bark remaining a long time smooth, finally rough and with plate-like scales. Young shoots with a moderately long dense pubescence, often persistent in the second year. Leaves (Plate 199, Fig. 4) oblong or elliptical, base rounded or broadly cuneate, apex acuminate or acute; margin entire, ciliate; upper surface dark green, shining, usually becoming glabrous except at the base of the midrib, but often with scattered minute hairs on the veins and veinlets; lower surface pale and pubescent throughout; veins pinnate and looping towards the margin; petiole, $\frac{1}{4}$ to $\frac{1}{2}$ inch, pubescent.

Flowers diœcious. Staminate flowers, two to three together in subsessile cymes; calyx with four short ovate acute ciliate lobes; corolla urceolate, with four short obtuse lobes; stamens sixteen, in pairs in two series; filaments glabrous. Pistillate flowers, solitary, subsessile; staminodes, eight; ovary eight-celled, one ovule in each cell; styles, four. Fruit subsessile, almost globose, yellow or blackish, $\frac{1}{2}$ to $\frac{3}{4}$ inch in diameter; fruiting-calyx spreading, with a ring of short dense silky hairs on the inside beneath the fruit. The fruit varies considerably in size, and is astringent in flavour.

The leaves pubescent beneath, and the different buds and leaf-scars distinguish this species in summer from *D. virginiana*. In winter the following characters (Plate 200, Fig. 3) are available:—Twigs slender, usually with scattered long hairs, occasionally glabrous; two long acuminate scales of the previous season's bud persist at the base of the shoot. Leaf-scars small, nearly parallel to the twig on prominent pulvini, semicircular, marked with a raised transverse crescentic ridge, composed of the coalesced bundle cicatrices. True terminal bud absent, stump at the apex of the twig pubescent. Buds long, ovoid, acuminate, blackish, pubescent; outer scales two, imbricate, long, acuminate, pubescent, ciliate, concave interiorly.

This species has been long in cultivation, and its exact distribution in the wild state is difficult to define. It appears to be indigenous in Asia Minor; in the Caucasus,¹ where it occurs wild throughout the whole territory between sea-level and 3500 feet; in Afghanistan; in the north-west Himalaya² at 2000 to 6000 feet in Hazara and Kashmir; and in central and northern China.

It has been cultivated for centuries in the countries bordering on the Mediterranean, and has become naturalised in many places, as in the south of France and in Dalmatia. It is not wild in Japan, but is often planted there, either for its own

¹ Radde, *Pflanzenverb. Kaukasusländ.* 181 (1889).

² Gamble, *Indian Timbers*, 455 (1902).

1000 The Trees of Great Britain and Ireland

fruit or as a stock on which to graft the persimmon. In China it is largely cultivated, and the fruits, known as *hei-tsao* or "black dates," are an article of commerce. (A. H.)

The date-plum was early introduced into England, being cultivated by Gerard¹ in 1633 or earlier. It grows easily from seed, and, according to Loudon, at the rate of 12 to 18 inches annually, if planted in rich soil,² but requires a warmer climate than ours and never attains a large size, so far as we know, in England; though trees of 20 feet or so in height are sometimes seen in botanic gardens and in parks. It ripens fruit usually every year at Kew.

Mayr³ figures the wood, which is very remarkable on account of the contrast in colour between the black heart-wood and the pale sap-wood. Judging from this and the wood of the Japanese *kaki*, this wood if procurable would be valuable for cabinet-making; but, so far as I know, it is nowhere common enough to have acquired any recognised commercial value. (H. J. E.)

¹ *Herball*, Johnson's edition, 1495 (1633).

² The seedlings which I have raised from seed collected in France, seem liable to injury by frost, and do not ripen their shoots when young.

³ *Fremdländ. Wald- u. Parkbäume*, 464, t. xvii. fig. 29 (1906).

END OF VOL. IV



SILVER FIR AT COWDRAY

69-12135



SILVER FIRS AT LONGLEAT



SILVER FIR AT ROSENEATH

PLATE 210.



SILVER FIR AT TULLYMORE



SPANISH FIR IN ANDALUSIA

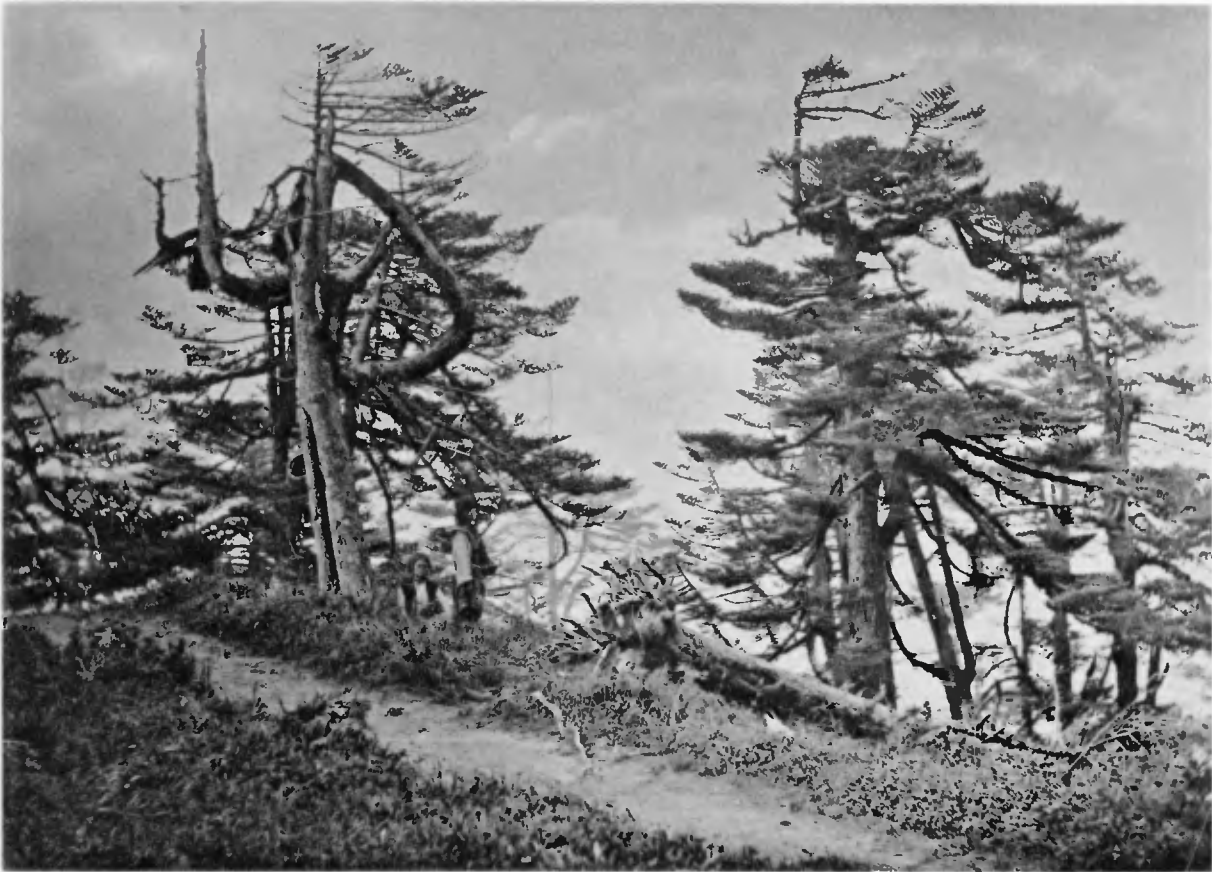


SPANISH FIR AT LONGLEAT



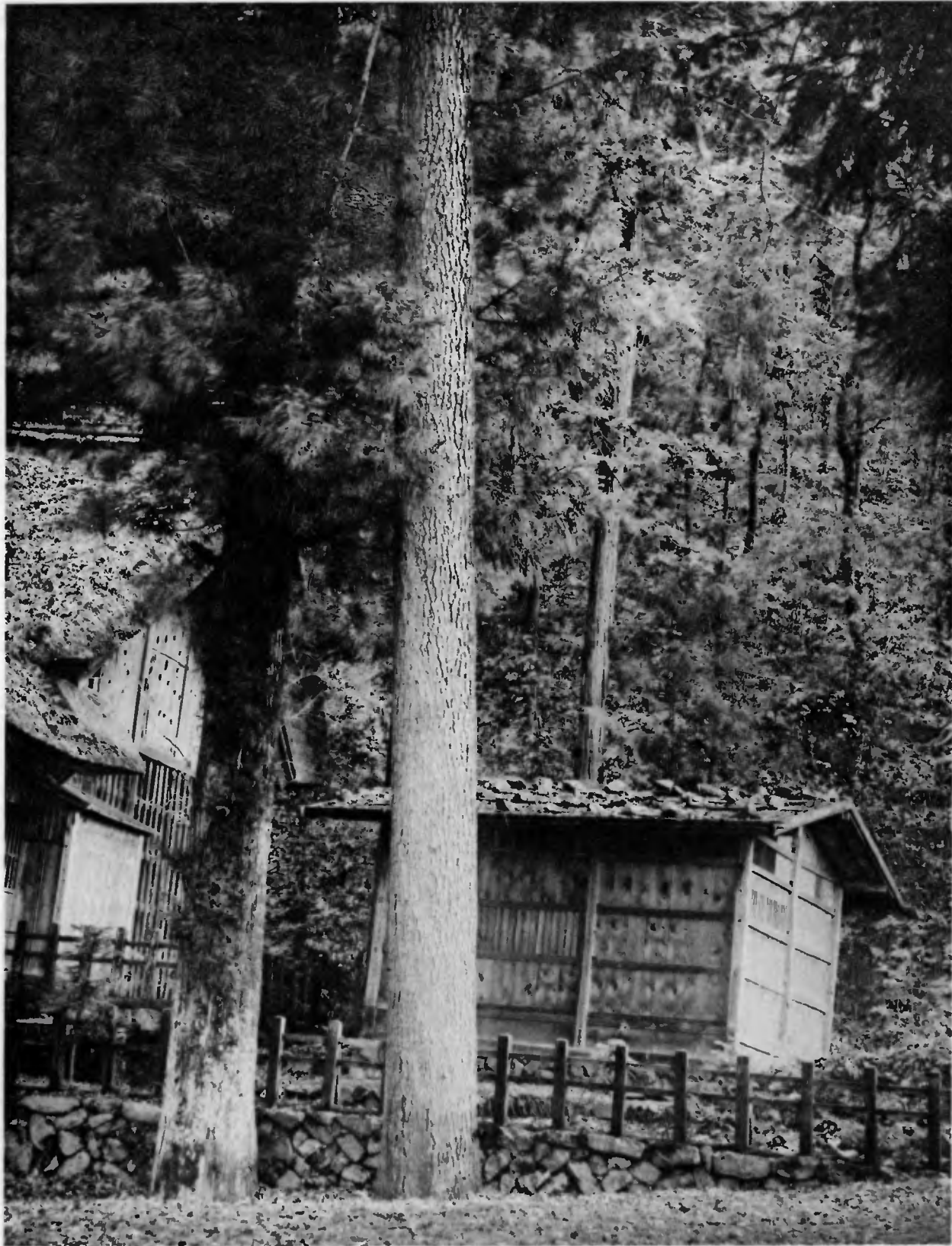
GREEK FIR AT BARTON

PLATE 214.



HIMALAYAN FIR IN SIKKIM

PLATE 215.



JAPANESE FIR IN JAPAN



GIANT FIR AT EASTNOR CASTLE

PLATE 217.



GIANT FIR IN VANCOUVER'S ISLAND

PLATE 218.



CALIFORNIAN FIR AT LINTON

PLATE 219.



LOVELY FIR IN BRITISH COLUMBIA

PLATE 220.



NOBLE FIR IN OREGON



RED OR SHASTA FIR AT BAYFORDBURY

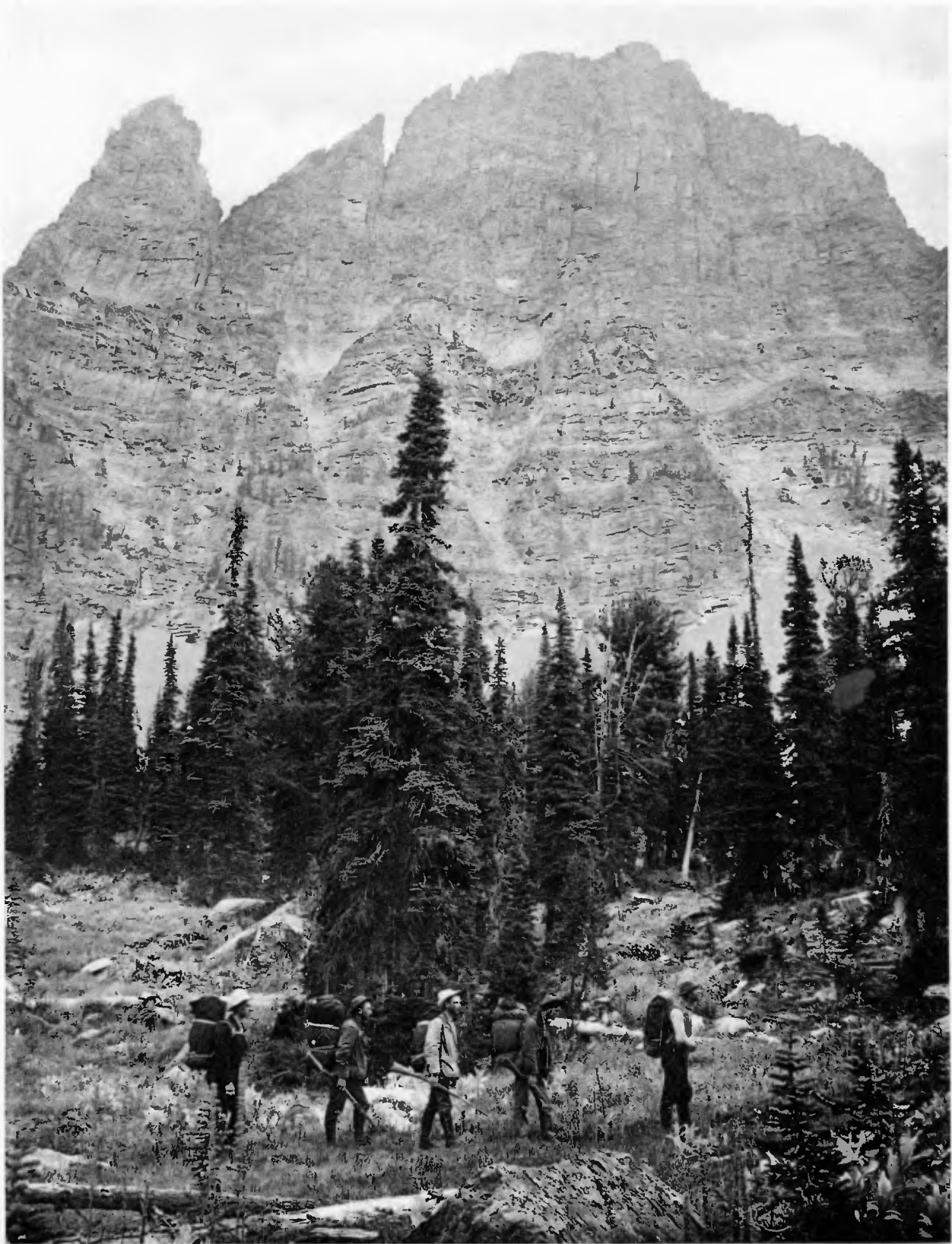


RED OR SHASTA FIR AT BONSKEID



BRISTLE-CONE FIR AT EASTNOR CASTLE

PLATE 224.



ROCKY MOUNTAIN FIR IN MONTANA

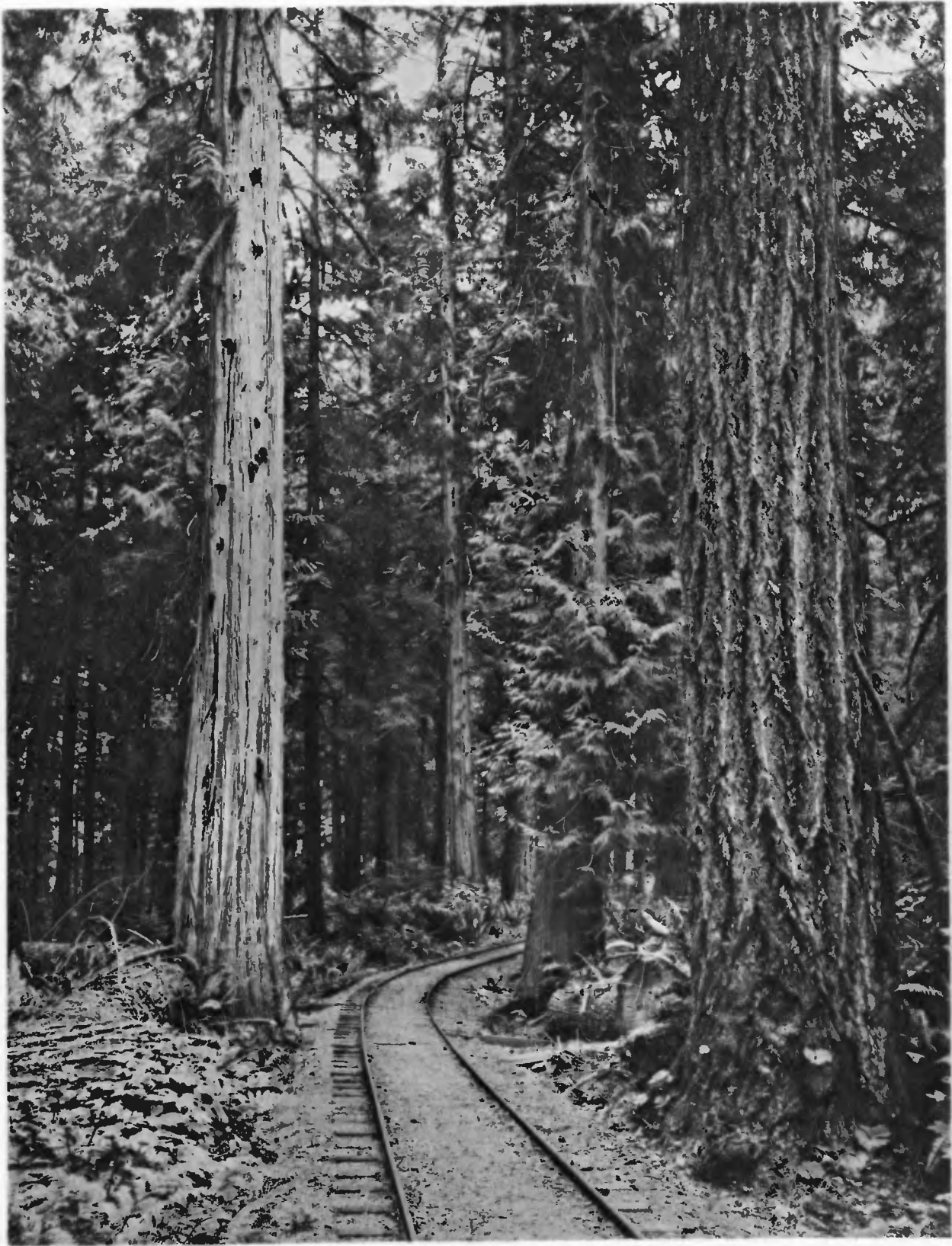


MEXICAN FIR AT FOTA



DOUGLAS FIR ON BARKLEY'S FARM

PLATE 227.



DOUGLAS FIR FOREST IN VANCOUVER'S ISLAND

PLATE 228.



DOUGLAS FIR AT EGGESFORD



DOUGLAS FIR AT LYNEDOCH

PLATE 230.



DOUGLAS FIR AT TORTWORTH

PLATE 231.



SPANISH CHESTNUT GROVE AT BICTON

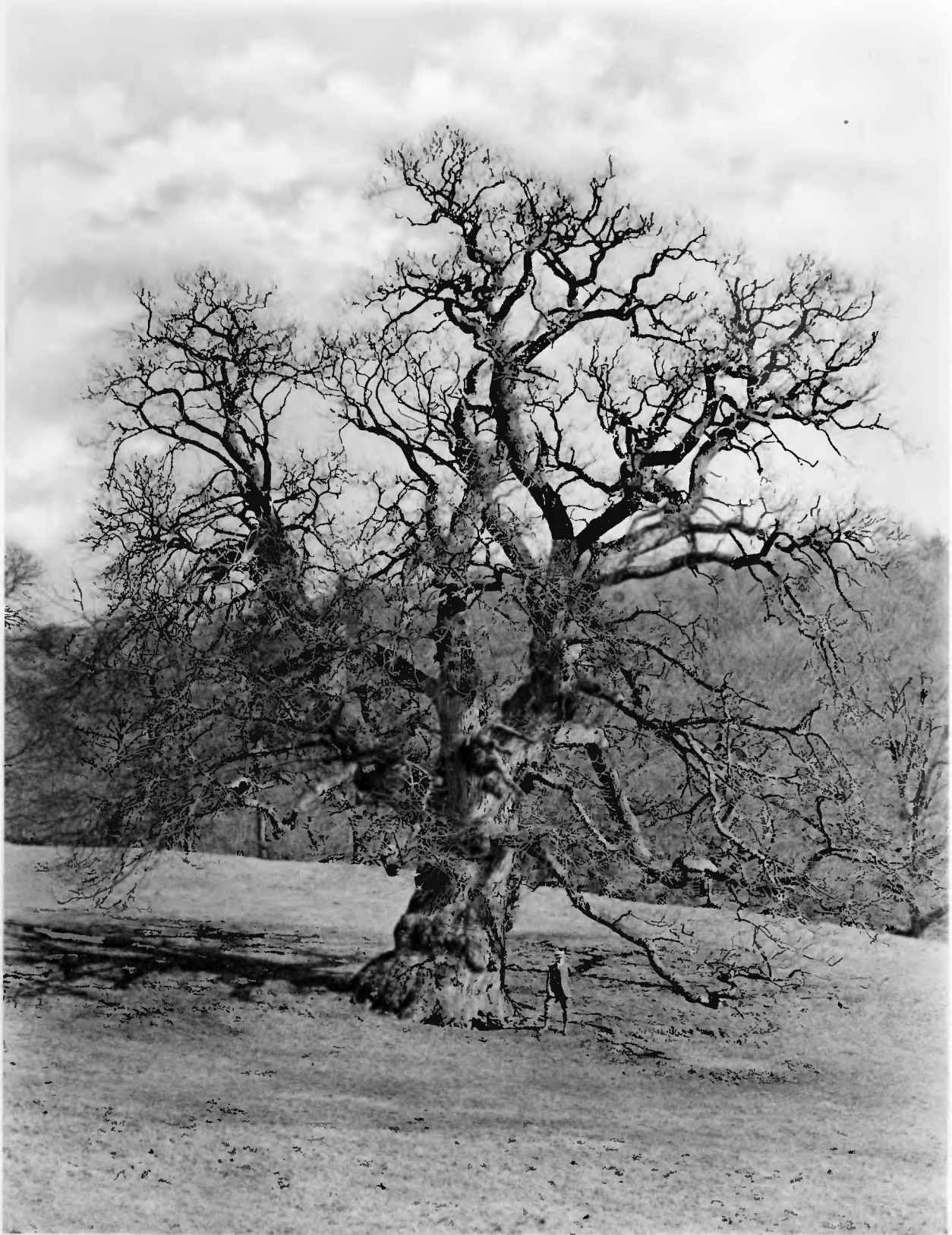


SPANISH CHESTNUT AT ALTHORP

PLATE 233.



SPANISH CHESTNUT AT THORESBY

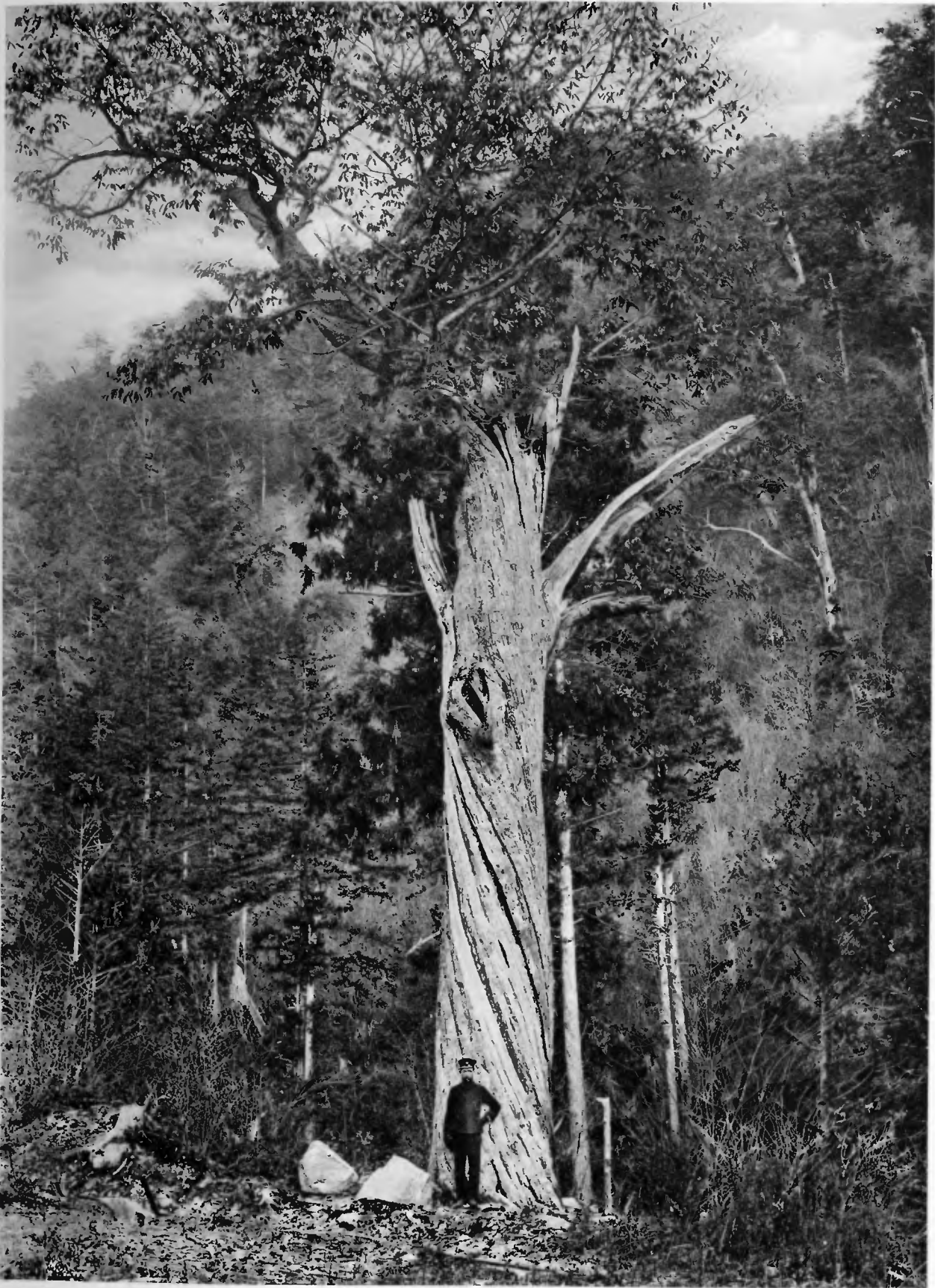


SPANISH CHESTNUT AT RYDAL

PLATE 235.



SPANISH CHESTNUT AT ROSSANAGH



JAPANESE CHESTNUT AT ATERA, JAPAN



WEeping ASH AT ELVASTON CASTLE

PLATE 238.



TAIL ASH AT COBHAM PARK

PLATE 239.



TWISTED ASH AT COBHAM PARK

PLATE 240.



TALL ASH AT ASHRIDGE

PLATE 241.



ASH AT WOODSTOCK, KILKENNY

PLATE 242.



ASH AT CASTLEWELLAN



DEFORMED ASH AT CIRENCESTER



DISEASED ASH AT COLESBORNE



PLATE 245.

NARROW-LEAVED ASH, ROUGHAM HALL



WHITE ASH AT KEW

PLATE 246.



PLATE 247.

BILTMORE ASH AT FAWLEY COURT



ZELKOVA CRENATA AT WARDOUR CASTLE

PLATE 248.



ZELKOVA CRENATA AT GLASNEVIN

PLATE 249.



PLATE 250.

ZELKOVA ACUMINATA AT CARLSRUHE



CELTIS OCCIDENTALIS AT WEST DEAN PARK

PLATE 251.



ALDERS AT LILFORD

PLATE 252.



ALDERS AT KILMACURRAGH

PLATE 253.



PLATE 254-

ITALIAN ALDER AT TOTTENHAM HOUSE, SAVERNAKE



BIRCH AT SAVERNAKE FOREST



BIRCH AT MERTON HALL

PLATE 256.



PLATE 257.

BIRCH IN SHERWOOD FOREST



GNARLED BIRCHES IN GLENMORE



PAPER BIRCH AT BICTON

PLATE 259.



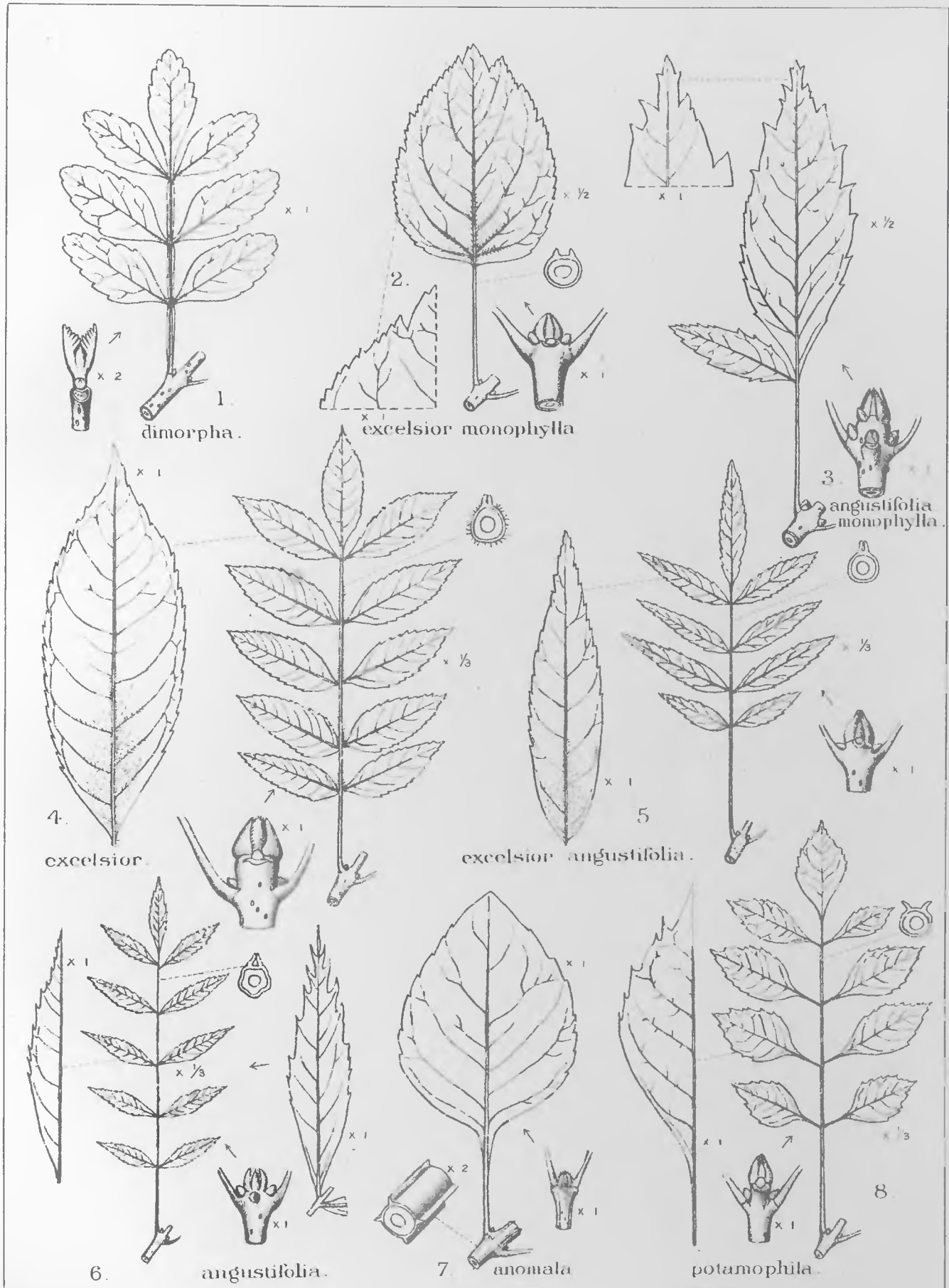
PLATE 260.

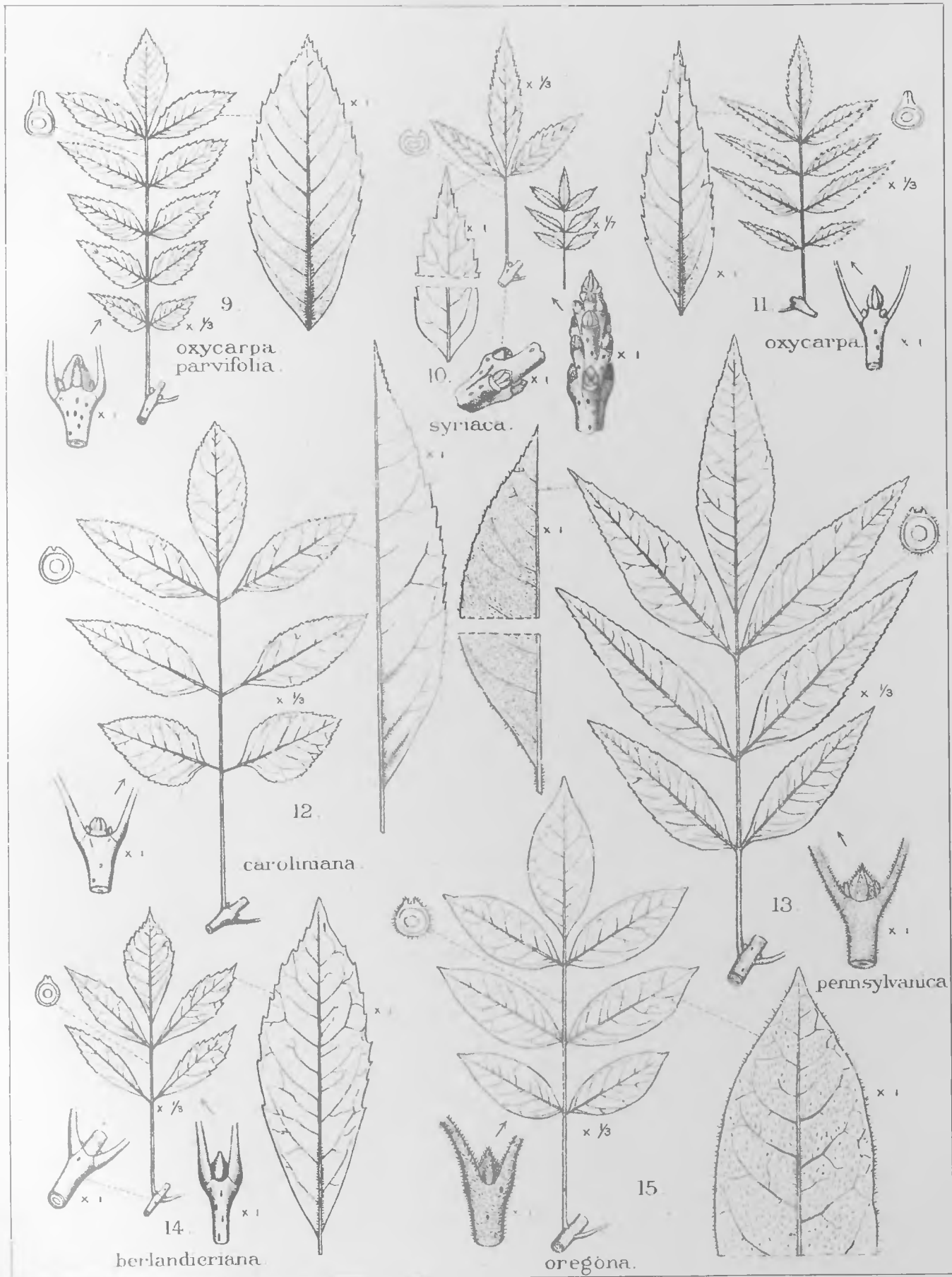
YELLOW BIRCH AT ORIEL TEMPLE

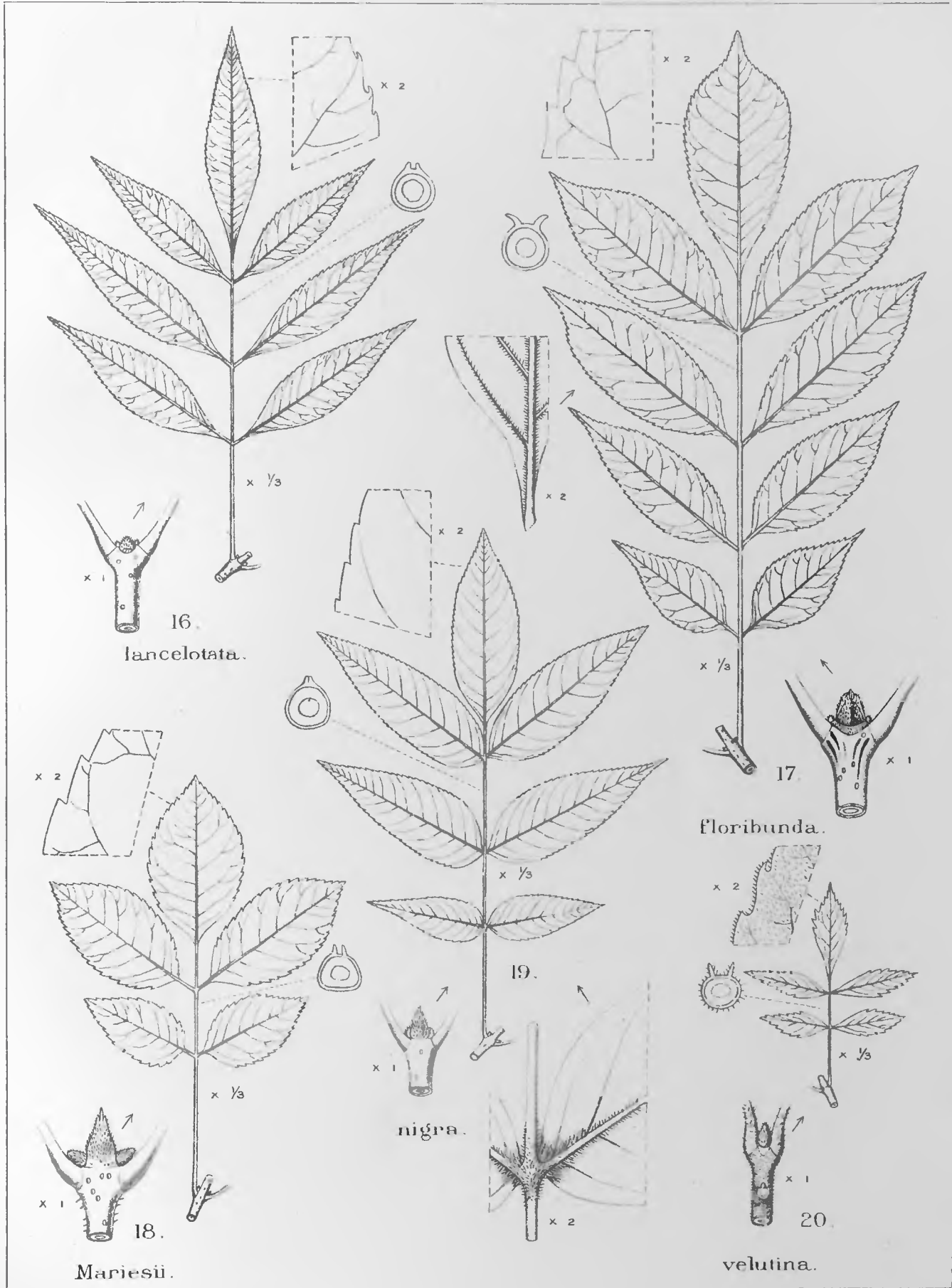


DIOSPYROS VIRGINIANA AT KEW

PLATE 261.



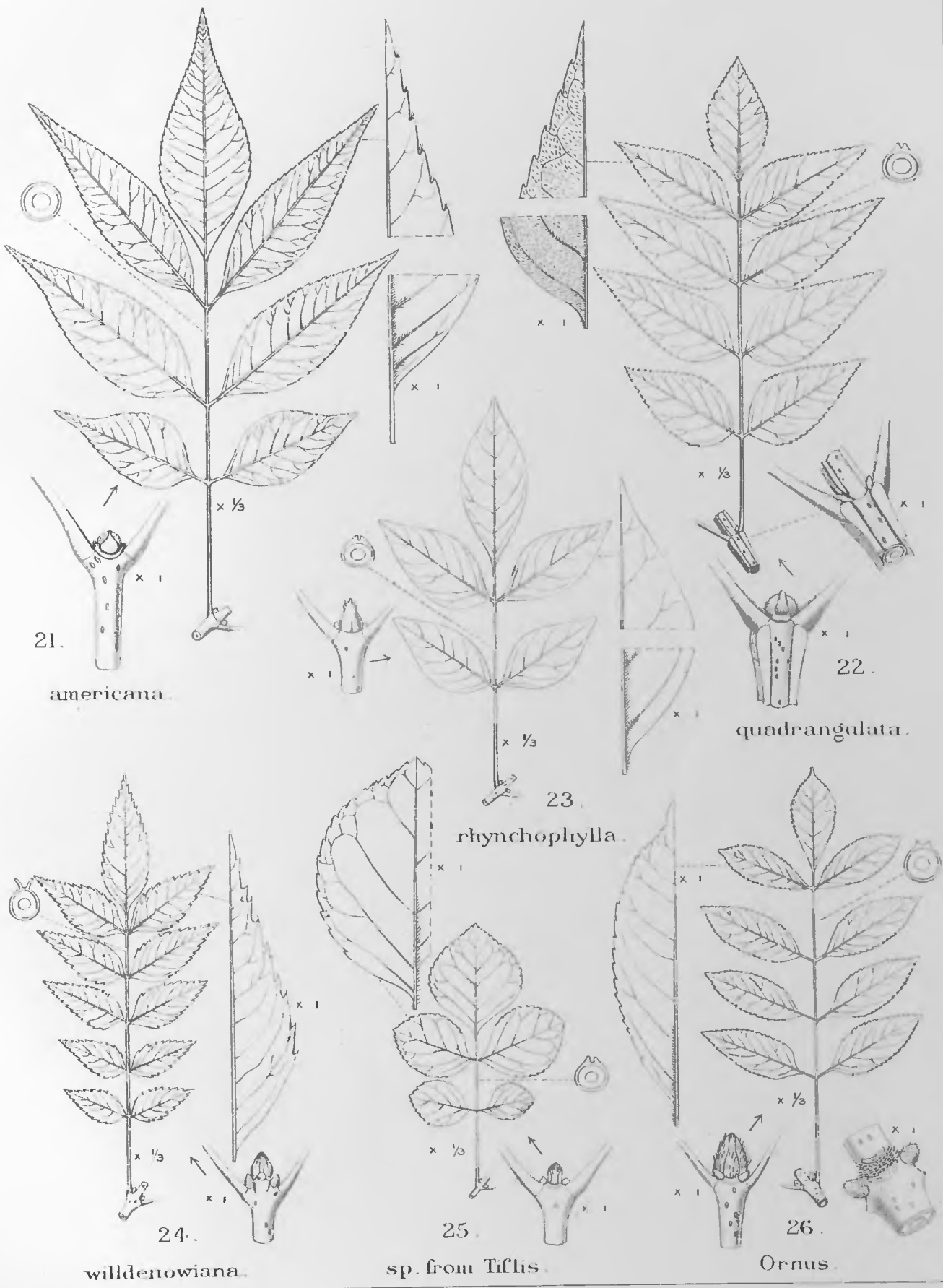




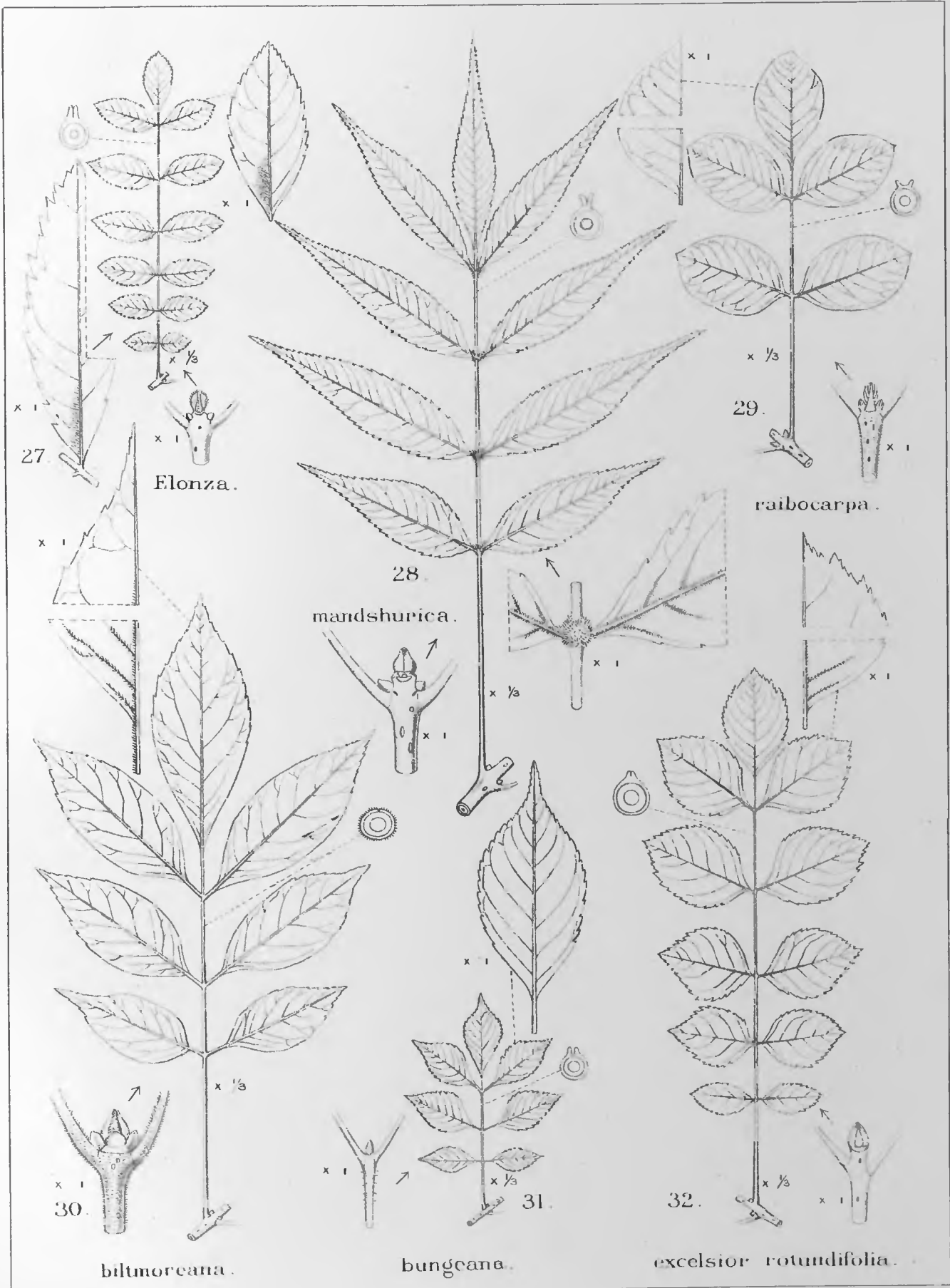
Huitt, del. Hutch, lith.

PLATE 264

FRAXINUS.



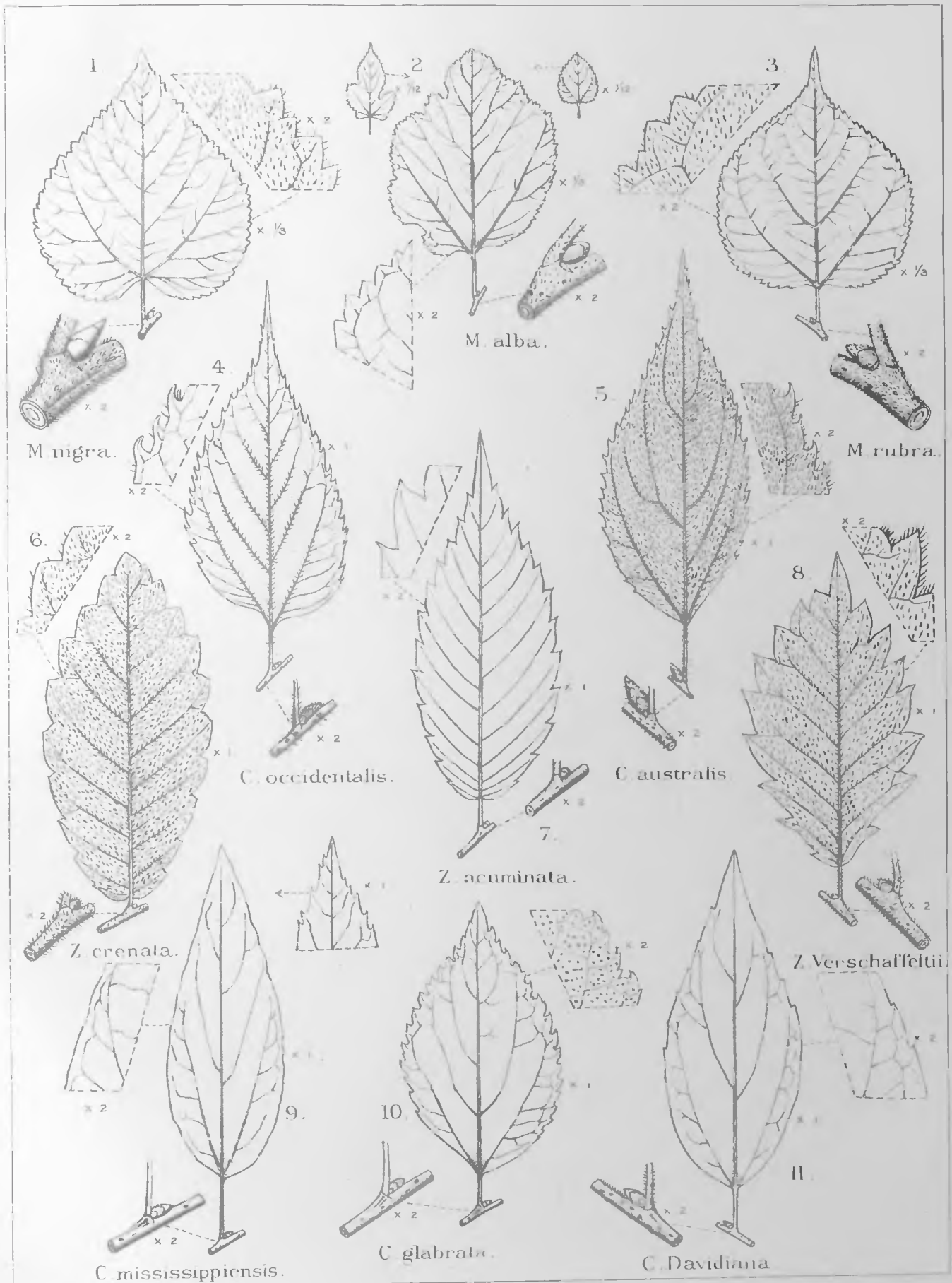
FRAXINUS.



Huitt, del. Hutch, lith.

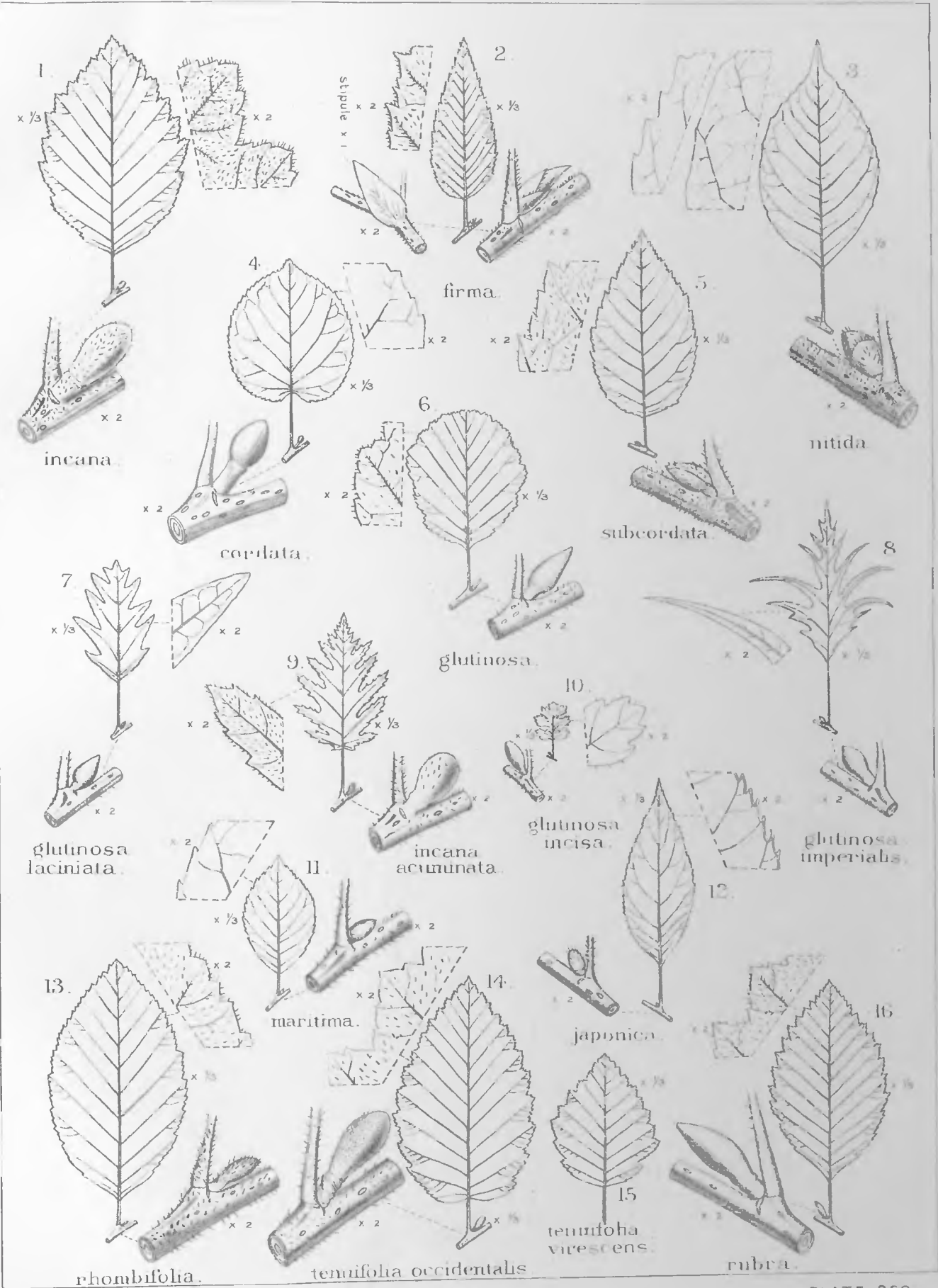
PLATE 266

FRAXINUS.



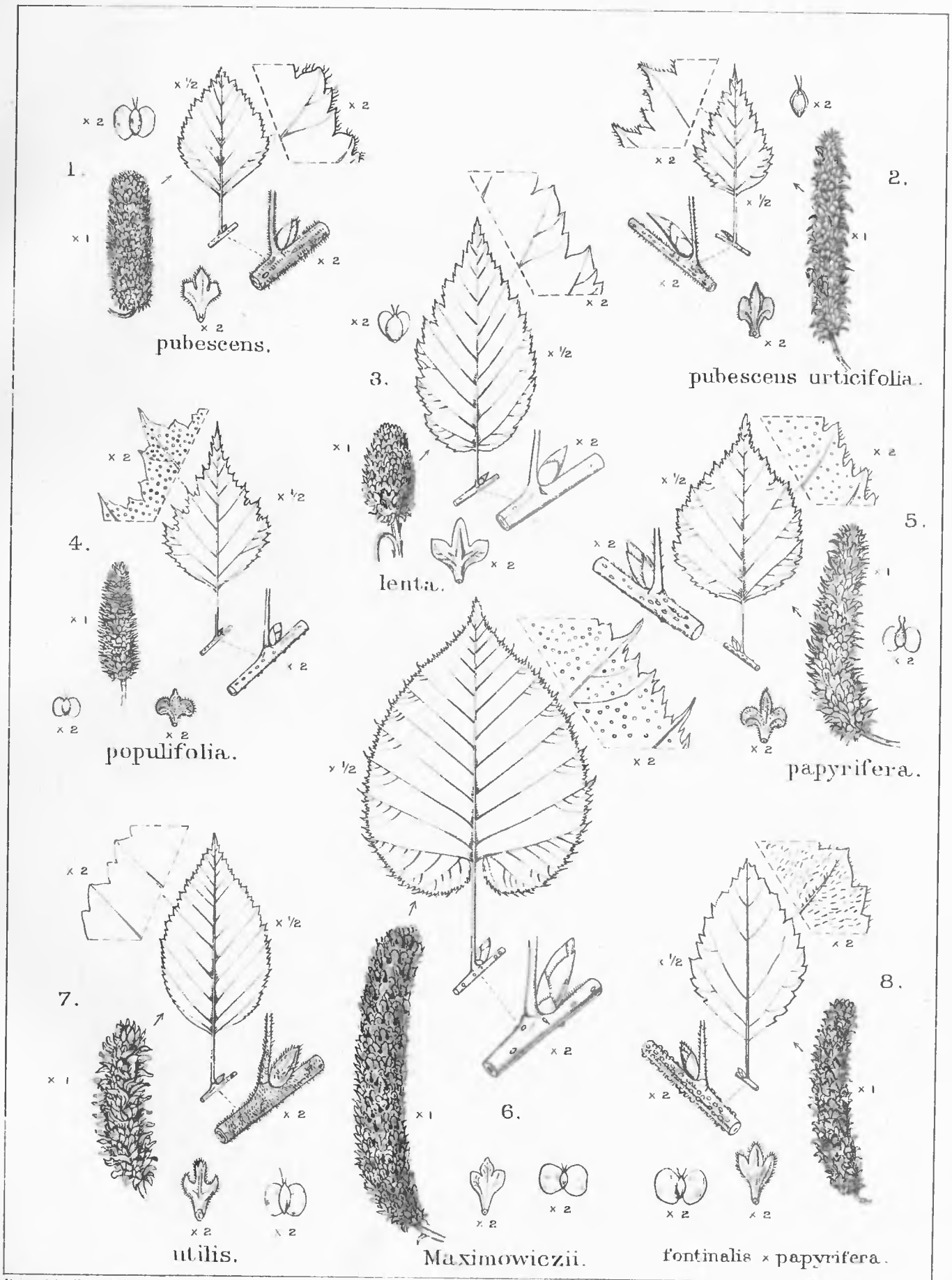
Drawn by H. B. Kuhn

MORUS, CELTIS, AND ZELKOVA



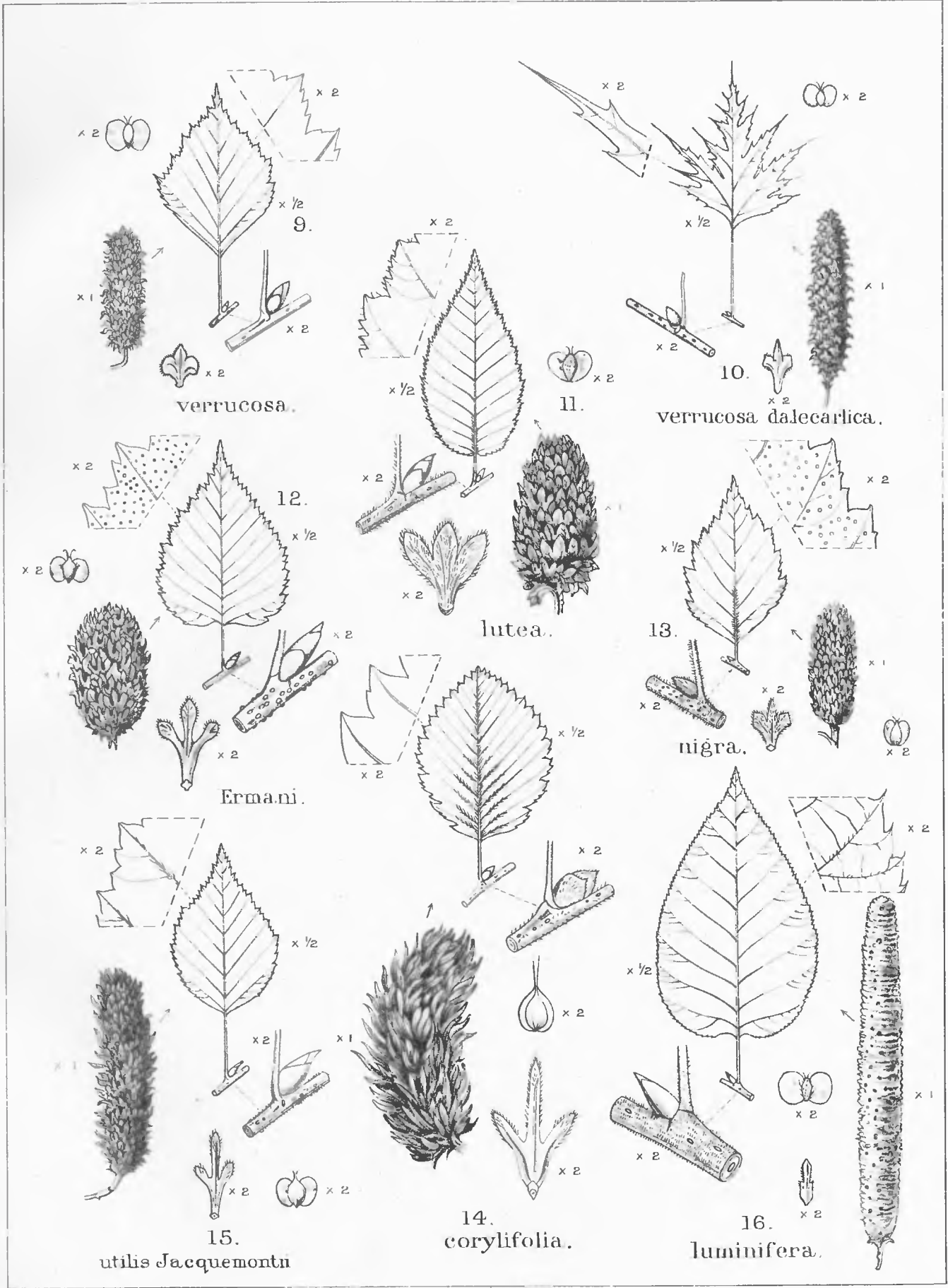
Horti del. Horti lith.

ALNUS



Hott, del. Nutt, lith

BETULA.



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VOLUME V



The Trees
of
Great Britain
& Ireland

BY
Henry John Elwes, F.R.S.
AND
Augustine Henry, M.A.

Edinburgh: Privately Printed

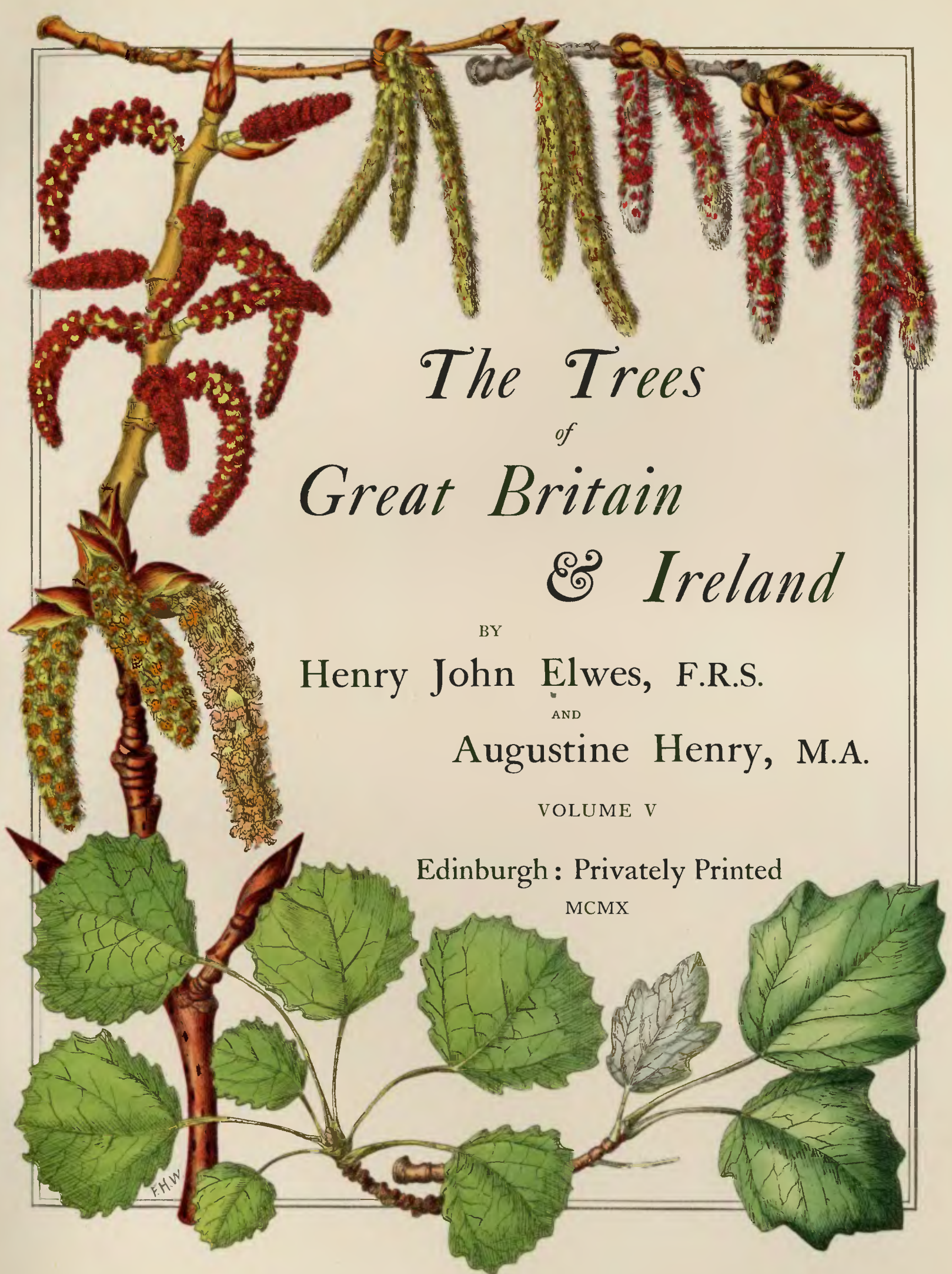
THE TREES OF GREAT BRITAIN AND IRELAND





HIMALAYAN SPRUCE ON THE ROAD NEAR NAGKUNDA

From a Drawing by the late Miss North



The Trees
of
Great Britain
& Ireland

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Henry John Elwes, F.R.S.
AND
Augustine Henry, M.A.

VOLUME V

Edinburgh: Privately Printed

MCMX

F.H.W.

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PINUS

Pinus, Linnæus, *Gen. Pl.* 293 (*ex parte*) (1737); Duhamel, *Traité des Arbres*, ii. 121 (1755); Bentham et Hooker, *Gen. Pl.* iii. 438 (1880); Engelmann, in *Trans. Acad. St. Louis*, iv. 161 (1886); Masters, in *Journ. Linn. Soc. (Bot.)*, xxvii. 236, 248, 258, 269, 309 (1891), xxx. 37 (1893), and xxxv. 560 (1904); Mayr, *Wald. Nordam.* 425 (1890), and *Fremdländ. Wald- u. Parkbäume*, 340 (1906); Shaw, in *Bot. Gaz.* xliii. 205 (1907).

EVERGREEN trees or shrubs, belonging to the division Abietinæ of the order Coniferæ. Bark usually thick, rough, and deeply fissured; but in some species thin and scaly, and in a few others peeling off in thin flakes like a plane tree. Branches arising from the stem in apparent whorls. Shoots of two kinds: short shoots, which are minute spurs of limited growth, bearing the adult leaves in clusters and deciduous with them; and long shoots, the ordinary branchlets, which continue growth.

In the majority¹ of pines, the long shoot produced in spring is a single internode, consisting of (*a*) a leafless base, which bears the staminate flowers, when these are developed; and (*b*) a longer upper portion bearing foliage, and ending in (*c*) a terminal bud, subtended by a whorl of smaller buds, one or more of which may be replaced by pistillate flowers (young cones). The buds and young cones being close to the apex of the shoot, are said to be subterminal. In the second year the mature cones and the branchlets, which have developed from the single whorl of buds of the first year, are situated beneath the base of the new shoot of the year, which has sprung from the terminal bud of the preceding season.

In another group² of pines, the long shoot produced in spring consists of two (rarely three or more) internodes, each with a leafless base, a leaf-bearing portion, and a whorl of buds (with or without young cones). The buds and young cones are in two or more whorls, and are both subterminal and lateral in position. Similarly, in the second year, the branchlets and mature cones are in two or more whorls.

In young or vigorous trees of any species of either group the subterminal whorl of buds and young cones, already formed in spring, is occasionally placed in a lateral position by the development above it of a summer shoot, which is distinguished from

¹ Termed uninodal pines by Shaw.

² Multinodal pines of Shaw, who points out that when the trees are old or diminishing in vigour, they often produce shoots with only one whorl of buds, but recognisable as having two internodes by the presence of two leafless bases; or they may, when very feeble, only develop one internode to each shoot.

the normal spring shoot with long leaves and brown withered scale-leaves, by bearing short leaves with green scale-leaves. In this exceptional case, which is, however, common in certain species, the buds and cones are said to be pseudo-lateral.

Buds, varying in the different species in shape and in the characters of their spirally imbricated scales, which are united together by their fringed margins or matted hairs, or are embedded in resin, their tips being erect, spreading, or reflexed. The buds are compound; their outer scales empty and persistent at the base of the shoot, when the bud unfolds; their inner scales enclosing minute buds, which develop into the short shoots and adult foliage (and when flower-bearing, into the staminate flowers as well). These inner scales persist on the developed branchlets as scale-leaves.

Leaves of three kinds: (a) Primordial leaves, borne on seedling plants, solitary, spirally arranged, spreading, linear-lanceolate, keeled on both surfaces, serrulate. (b) Scale-leaves, containing in their axils the short shoots and adult leaves, triangular-lanceolate, entire or fringed in margin, usually¹ quickly deciduous in part, their basal portion only persisting. (c) Adult leaves, needle-like, persistent two to twenty years, in clusters of one to five (rarely six or seven), at the apex of the short shoot, serrulate or entire in margin; section² plano-convex in two-leaved species, triangular in three- to five-leaved species; fibro-vascular bundle branched or simple; resin-canals, two to twelve, marginal or median. The sheath at the base of each cluster, formed by the scales of the minute buds, is either quickly and entirely deciduous or persistent; in the latter case usually becoming, with age, shortened, blackened, and lacerated, but in certain species dividing into segments, which become reflexed and surround the base of the leaf-bundle as a rosette.

Flowers monœcious. Staminate flowers,³ clustered in a head or spike at the base of the current year's shoot, ovoid or cylindrical, surrounded at the base by an involucre of scale-like bracts, composed of numerous imbricated sessile two-celled anthers; connective crest-like, nearly orbicular; pollen-grains with two lateral air-vesicles. Pistillate flowers or young cones, sub-terminal or lateral, solitary or in clusters, surrounded at the base by sterile bracts; composed of two series of scales, minute carpels becoming obsolete in the ripe cone, and large ovuliferous scales, each of the latter bearing two pendulous ovules. Pollination occurs in the first year, when the scales open to receive the pollen, closing immediately afterwards; but fertilisation, the arrival of the pollen-tube at the embryo-sac, does not occur till May or June in the second year; in consequence the cone remains small in the first year, and increases only in size in the second year.

Fruit a woody cone,⁴ ripening in nearly all the species⁵ at the end of the second

¹ In the species with leaves densely crowded on the branchlets, the scale-leaves persist during the first year.

² In *P. monophylla*, the section of the solitary leaf is terete.

³ Shaw, *Pines of Mexico*, 1 (1909), points out that in the Soft Pines the buds enclosing the staminate flowers are not sufficiently advanced at the end of the growing season to be distinguishable; but in the Hard Pines they are recognisable by their larger size. In the latter, the young staminate flowers are either (a) enclosed in the general outline of the bud, or (b) they form about the nodes of the bud characteristic enlargements, which are constant for each species.

⁴ The subterminal, lateral, or pseudo-lateral position of the cone referred to in descriptions of species is, as already defined above, that of the young cone in the first year.

⁵ In *P. Pinca*, *P. leiophylla*, and *P. chihuahuana* the cones take three years to ripen; and in these the umbo of the scale shows separate growths of the first and second years.

year; symmetrical, or oblique with the scales larger on the outer side of the cone. The exposed part of each scale in the unopened cone, known as the *apophysis*, is thickened and shows the apex of the growth of the first year as a terminal or dorsal protuberance or scar called the *umbo*, which is either unarmed or provided with a sharp prickle or stout spine. The cones in most species open their scales when ripe, allowing the seed to escape; but in *P. Cembra*, *P. pumila*, and *P. albicaulis* the scales are incapable of dehiscence, and the seeds are liberated by the attacks of squirrels and other animals. In other species a large proportion of the cones remain on the trees unopened for many years, the scales ultimately separating when scorched by forest fires. Usually the cones fall through decay at the insertion of their peduncle; but in *P. resinosa*, *P. ponderosa* and *P. palustris* separation occurs near the base of the cone, a few of the lower scales remaining attached by the stalk to the branch.

Seeds, two on each scale, obovate, triangular or cylindrical; wing embracing by its rim-like base the sides and part of the upper surface of the seed, and either separating freely from it as in the Hard Pines, or adhering closely and breaking off from it irregularly as in *P. Strobus* and its allies. In certain species, the seeds of which are edible and distributed by animals, the wing, no longer serving for flight, is either reduced to a mere vestige only visible on the upper surface of the seed, as in *P. Cembra* and its allies, or it is much shortened and reduced to a narrow lateral rim, which usually remains on the scale when the seed falls, as in *P. Pinca*, *P. cembroides*, *P. Bungeana*, and their allies.

In germination the shell of the seed, from which the wing has usually fallen, is raised as a hood on the top of the cotyledons,¹ which vary from three to eighteen in number and are usually triangular, flat, and green below, and keeled and marked with stomata above, entire in margin, acute or mucronate at the apex. The young stem elongating bears primordial leaves, in the axils of which the adult fasciated leaves are usually produced in the second year.

About eighty species of Pinus are known, distributed through the northern hemisphere from the Arctic circle to Central America, the West Indies, Canary Islands, Morocco, Algeria, Syria, Himalayas, Burmah, Philippine Islands, Sumatra, and Borneo. Of these about fifty-two species are in cultivation, which may be arranged as follows:—

I. HAPLOXYLON, Koehne, *Deutsche Dendrologie*, 28 (1893). Soft Pines.²

Leaves with a single fibro-vascular bundle. Scale-leaves subtending the leaf-clusters inserted on prominent bases, which are not decurrent on the branchlets. Cones symmetrical, opening when ripe. Seed-wing present or obsolete, not readily detachable from the seed. Cortex persistent on young trees for many years. Walls of tracheids of medullary rays of the wood not dentate. The wood is usually soft, close-grained, and light in colour; sap wood generally narrow.

¹ The number of cotyledons in each species is variable within narrow limits, and is stated by Dr. Masters in *Journ. Linn. Soc. (Bot.)* xxvii. 236 (1891). Cf. also Hill and de Fraine, in *Ann. Bot.* xxiii. 199 (1909).

² The shoots are always uninodal in the soft pines.

A. LEAF-SHEATH ENTIRELY DECIDUOUS. LEAVES IN FIVES.

§ 1. STROBUS, Spach. White Pines.

Leaves serrate in margin, with marginal resin-canals. Cones sub-terminal, elongated, pendulous, usually long-stalked; scales thin, each with a terminal unarmed umbo. Seeds with long wings, closely adherent and breaking off irregularly.

* *Branchlets glabrous.*

1. *Pinus excelsa*, Wallich. Himalayas. See p. 1011.

Branchlets glaucous, green. Buds conic, shortly acuminate. Leaves 5 to 8 in. long, spreading, slender; some sharply bent as if broken.

2. *Pinus Peuke*, Grisebach. Balkan Peninsula. See p. 1014.

Branchlets shining green. Buds ovoid, shortly acuminate. Leaves about 4 in. long, densely tufted towards the end of the shoot, and not spreading or broken as in *P. excelsa*.

** *Branchlets pubescent. Bud-scales free at their apices.*

3. *Pinus Ayacahuite*, Ehrenberg. Mexico. See p. 1017.

Branchlets covered with a short rusty-brown pubescence. Buds ovoid, acuminate, resinous. Leaves 4 to 6 in. long, spreading, occasionally bent as if broken, as in *P. excelsa*.

*** *Branchlets pubescent. Bud-scales closely appressed.*

4. *Pinus Lambertiana*, Douglas. Oregon, California. See p. 1020.

Branchlets with short brown, partly glandular pubescence. Buds cylindrical, rounded at the apex or sharp-pointed. Leaves about 4 in. long, twisted a complete turn, rigid, ending in a sharp cartilaginous point.

5. *Pinus monticola*, Don. Western North America. See p. 1022.

Branchlets with short brown, partly glandular pubescence. Buds ovoid, acuminate. Leaves 4 in. long, slightly twisted in their upper half, blunt at the apex.

6. *Pinus Strobus*, Linnæus. Eastern North America. See p. 1025.

Branchlets with pubescent tufts below the insertions of the leaf-clusters, elsewhere usually glabrous. Buds ovoid, acuminate. Leaves 3 in. long, very slender, not twisted.

7. *Pinus parviflora*,¹ Siebold et Zuccarini. Japan, Kurile Isles. See p. 1033.

Branchlets greyish, with a scattered minute pubescence. Buds ovoid, not acuminate. Leaves 2 in. long, white on the inner surfaces, blunt at the apex.

§ 2. CEMBRA, Spach. Stone Pines.

Leaves serrate or entire in margin, with median or marginal resin-canals. Cones sub-terminal, short-stalked; scales thickened, each with a terminal unarmed umbo. Seeds large, edible, with rudimentary or obsolete wings.

¹ This species, which is variable in the length of the seed-wing, is intermediate in character, and forms a connecting link between the first two sections.

* *Leaves serrate, with median resin-canals.*

8. *Pinus Cembra*, Linnæus. Alps, Carpathians, North-Eastern Russia, Siberia. See p. 1035.

Branchlets covered with a dense orange-brown shaggy tomentum. Buds ovoid, acuminate, resinous. Leaves 2½ to 3½ in. long, with few serrations at the tip.

9. *Pinus koraiensis*, Siebold et Zuccarini. Amurland, Manchuria, Korea, Japan. See p. 1041.

Branchlets and buds as in *P. Cembra*. Leaves with numerous sharp serrations at the tip, otherwise as in *P. Cembra*.

10. *Pinus Armandi*, Franchet. China. See p. 1043.

Branchlets olive green, glabrous or with minute scattered hairs. Buds with free or appressed scales. Leaves 4 to 6 in. long, spreading, and often bent, as in *P. excelsa*.

** *Leaves entire in margin, with marginal resin-canals.*

11. *Pinus pumila*, Regel. Kamtschatka, Eastern Siberia, Amurland, Saghalien, Kurile Isles, Japan. See p. 1045.

Buds and branchlets as in *P. Cembra*. Leaves¹ also similar, but usually shorter and differing in the position of the resin-canals.

12. *Pinus flexilis*, James. Western North America. See p. 1046.

Branchlets glabrous or covered with a minute brown soft pubescence. Buds ovoid, sharp-pointed, resinous. Leaves 2 to 3 in. long, stout, rigid, curved, sharp-pointed.

13. *Pinus albicaulis*, Engelmann. Western North America. See p. 1048.

Scarcely distinguishable from *P. flexilis* in the absence of cones, though the branchlets apparently differ in their scattered minute stiff pubescence.

B. LEAF-SHEATH ENTIRELY DECIDUOUS. LEAVES IN THREES.

§ 3. GERARDIANÆ, Engelmann. Plane-bark Pines.

Leaves serrulate, with marginal resin-canals. Cones sub-terminal; scales much thickened, each with a dorsal umbo. Seeds large, edible; wing reduced to a narrow deciduous rim, remaining on the scale when the seed falls.

14. *Pinus Bungeana*, Zuccarini. China. See p. 1050.

Branchlets glabrous, green, smooth. Buds spindle-shaped, with scales free at their tips. Leaves 3 in. long, shining green, rigid, with the basal sheaths deciduous in the first year.

15. *Pinus Gerardiana*, Wallich. Western Himalayas. See p. 1052.

Branchlets glabrous, green, smooth. Buds conic, acuminate, resinous. Leaves 3 to 4 in. long, duller in colour and less rigid than in *P. Bungeana*, with the basal sheaths deciduous in the second year.

¹ In the insular form of this species, the leaves are indistinctly serrulate in margin.

C. LEAF-SHEATHS PARTLY DECIDUOUS, THEIR INNER PART PERSISTING AS A ROSETTE OF REFLEXED SCALES AROUND THE BASE OF THE LEAF-BUNDLE. LEAVES ENTIRE IN MARGIN.

* *Leaves in fives.*

§ 4. BALFOURIANÆ, Engelmann. Fox-tail Pines.

Cones sub-terminal, short-stalked, cylindrical; scales each with a dorsal umbo, armed with a slender prickle. Seeds with long wings, easily separable.

16. *Pinus Balfouriana*, Balfour. California. See p. 1054.

Branchlets stout, pubescent. Buds ovoid, acuminate. Leaves $1\frac{1}{2}$ in. long, without stomata on the outer surface, rigid, curved.

17. *Pinus aristata*, Engelmann. Colorado, Utah, Nevada, Arizona, South-eastern California. See p. 1055.

Differs from the preceding species in the numerous resinous exudations on the leaves, and in the cones and seeds.

** *Leaves solitary or in twos, threes, or fours.*

§ 5. CEMBROIDES, Engelmann. Nut Pines.

Cones sub-terminal, sub-sessile, globose; scales few, much thickened, each with a dorsal umbo, unarmed or with a minute prickle. Seed large, edible, with wing reduced to a narrow rim, remaining on the scale.

18. *Pinus monophylla*, Torrey. Utah, Nevada, Arizona, California, Lower California. See p. 1056.

Leaves solitary, rigid, terete, sharp-pointed, $1\frac{1}{2}$ in. long, remotely placed on the branchlets.

19. *Pinus edulis*, Engelmann. Wyoming, Colorado, Utah, New Mexico, Texas, Arizona, Northern Mexico. See p. 1058.

Leaves in twos, rarely in threes, rigid, sharp-pointed, $\frac{3}{4}$ to $1\frac{1}{2}$ in. long, remotely placed on the branchlets.

20. *Pinus cembroides*, Zuccarini. Arizona, Lower California, Northern Mexico. See p. 1059.

Leaves in threes, rarely in twos, softer and more slender than in the other species of the section, and densely crowded on the branchlets.

21. *Pinus Parryana*, Engelmann. Southern California, Lower California. See p. 1060.

Leaves in fours, rarely in fives, $1\frac{1}{2}$ in. long, rigid, sharp-pointed, remotely placed on the branchlets.

II. DIPLOXYLON, Koehne, *Deutsche Dendrologie*, 30 (1893). Hard Pines.

Leaves with a divided fibro-vascular bundle. Bases of the scale-leaves subtending the leaf-clusters, decurrent on the branchlets. Cones sometimes asymmetrical, and often remaining closed for several years after ripening; scales always with dorsal umbos. Seed-wing present, occasionally reduced to a narrow rim; always readily detachable from the seed. Walls of tracheids of the medullary rays of the wood not dentate. The wood is usually heavy, coarse-

grained, and dark-coloured; sapwood thick, and paler in colour than the heart-wood.

D. LEAF-SHEAF PERSISTENT IN ALL THE CULTIVATED SPECIES. LEAVES ALWAYS SERRATE.

a. *Leaves in fives.*

§ 6. PSEUDOSTROBUS, Engelmann. Leaves with median resin-canals. Cones sub-terminal. Shoots uninodal.

22. *Pinus Montezumæ*, Lambert. Mexico, Guatemala. See p. 1061.

Branchlets stout, not glaucous, reddish brown. Buds ovoid, pointed, an inch long, reddish brown, scarcely resinous. Leaves about 9 in. long; basal sheaths $1\frac{1}{4}$ to 2 in. long. Scale-leaves persistent.

22A. *Pinus Montezumæ*, Lambert, var. *Hartwegii*, Engelmann. Cold regions and high altitudes of Mexico. See p. 1062.

Branchlets and buds, as in the type, but the latter smaller, $\frac{1}{2}$ to $\frac{3}{4}$ in. long, usually with resinous appressed scales. Leaves 5 to 6 in. long; basal sheaths 1 in. long. Scale-leaves persistent.

23. *Pinus pseudostrobus*, Lindley. Mexico. See p. 1064.

Branchlets slender, glaucous. Buds, leaves, and scale-leaves as in *P. Montezumæ*.

24. *Pinus Torreyana*, Parry. Coast of California near San Diego, and Santa Rosa island. See p. 1065.

Branchlets glaucous, dull grey in the second year. Buds cylindro-conic, $\frac{1}{2}$ in. long; scales pale brown with appressed points. Leaves 7 to 13 in. long, very stout; basal sheaths an inch long. Scale-leaves deciduous.

β. *Leaves in threes.*

§ 7. TAEDA, Mayr.

Leaves with median resin-canals. Cones variable in size and position. Shoots uninodal or multinodal.

* *Buds resinous; points of bud-scales appressed.*

† *Leaves more than 6 in. long.*

25. *Pinus Coulteri*, Don. California. See p. 1067.

Branchlets stout, glaucous, remaining green in the second year. Buds ovoid, stout, acuminate or cuspidate, 1 to $1\frac{1}{2}$ in. long. Leaves 10 to 14 in. long, dark green, spreading from the upper part of the branchlets of the first and second years.

26. *Pinus Sabiniana*, Douglas. California. See p. 1069.

Branchlets slender, glaucous, remaining green in the second year. Buds narrowly cylindrical, an inch long. Leaves 7 to 12 in. long, greyish green, spreading or drooping from the upper part of the branchlets of the first and second years.

27. *Pinus ponderosa*, Lawson. Western N. America. See p. 1071.

Branchlets stout, reddish, not glaucous, becoming nearly black in the second

and third years. Buds cylindro-conic, an inch long. Leaves 6 to 10 in. long, dark green, densely crowded on the greater part of the branchlets, directed outwards and forwards.

- 27A. *Pinus ponderosa*, Lawson, var. *Jeffreyi*, Vasey. California and Lower California. See p. 1072.

Branchlets stout, glaucous, becoming dark-coloured in the second and third years. Buds stout, cylindro-conic, reddish brown, an inch long, with scales less resinous and their points more free than in the type.

†† Leaves less than 6 in. long.

28. *Pinus tuberculata*, Gordon. Oregon, California. See p. 1077.

Branchlets reddish brown, not glaucous. Buds cylindrical, pointed, an inch long. Leaves 4 to 5 in. long, rigid, dark green; basal sheath $\frac{1}{2}$ in. long.

29. *Pinus radiata*, Don. Coast of California, near Monterey. Islands of Santa Cruz, Santa Rosa, and Guadalupe. See p. 1079.

Branchlets reddish brown, not glaucous. Buds cylindrical, pointed, $\frac{1}{2}$ to $\frac{3}{4}$ in. long. Leaves 4 to 5 in. long, slender, flexible and soft in texture, light green, densely crowded on the branchlets; basal sheath $\frac{1}{2}$ inch long.

** Points of the bud-scales free and slightly spreading, not reflexed.

30. *Pinus patula*, Schlechtendal et Chamisso. Mexico. See p. 1085.

Branchlets glaucous. Buds cylindro-conic, $\frac{1}{2}$ to $\frac{3}{4}$ in. long. Leaves 6 to 9 in. long, filiform, soft and very slender, drooping; basal sheath, 1 in. long.

31. *Pinus Teocote*, Schlechtendal et Chamisso. Mexico. See p. 1086.

Branchlets glaucous, the epidermis of the decurrent pulvini peeling off in the second and third years. Buds cylindro-conic, resinous, $\frac{3}{4}$ in. long. Leaves 4 to 8 in. long, rigid, spreading; basal sheath an inch long.

32. *Pinus rigida*,¹ Miller. Eastern Canada, and North-eastern United States. See p. 1087.

Branchlets not glaucous. Buds cylindro-conic, $\frac{1}{2}$ to $\frac{3}{4}$ in. long. Leaves $3\frac{1}{2}$ to 4 in. long, rigid; basal sheath $\frac{3}{8}$ to $\frac{1}{2}$ in. long.

33. *Pinus serotina*,¹ Michaux. South-eastern and Southern United States. See p. 1090.

Distinguishable from *P. rigida* by the different cones and longer leaves, 6 to 10 in. long; but in cultivated trees in England the leaves are as short as in that species.

*** Buds non-resinous; bud-scales with free, fimbriated, and recurved points. The apex of the second year's branchlet is marked with a conspicuous sheath of the persistent recurved bud-scales.

34. *Pinus palustris*, Miller. South-eastern and Southern United States. See p. 1091.

Branchlets stout, orange brown. Buds $1\frac{1}{2}$ to 2 in. long, with silvery white scales. Leaves 8 to 18 in. long, densely crowded on the branchlets; basal sheath $\frac{3}{4}$ to 1 in. long. Scale-leaves persistent.

¹ Adult trees of both these species are readily recognisable by the adventitious shoots on the old branches and stems. Occasionally the buds in *P. rigida* are very resinous, with closely appressed scales.

35. *Pinus Taeda*, Linnæus. South-eastern and Southern United States. See p. 1094.

Branchlets glaucous. Buds $\frac{1}{2}$ in. long, with brown scales. Leaves 6 to 9 in. long, spreading; basal sheath nearly 1 in. long. Scale-leaves persistent.

36. *Pinus canariensis*, Smith. Canary Islands. See p. 1096.

Branchlets yellow, not glaucous. Buds $\frac{3}{4}$ in. long, with reddish brown scales. Leaves 7 to 12 in. long, densely crowded on the branchlets, slender, flexible.

γ. Leaves in twos; in one species, clusters of three leaves also occur.

See § 8 and § 9.

- § 8. BANKSIA, Mayr.

Cones lateral. Shoots multinodal, a vigorous branch showing a whorl of buds, branchlets, or cones in the middle of each year's shoot, in addition to the subterminal whorl.

* Leaves in twos and in threes, on the same branch.

37. *Pinus echinata*, Miller. South-eastern United States. See p. 1098.

Branchlets slender, brittle, glaucous, with the bark in the third year exfoliating in large flakes. Buds $\frac{1}{4}$ in. long, brownish, shining, with resinous appressed scales. Leaves 3 in. long, resin-canals median; basal sheath $\frac{3}{8}$ in. long.

** Leaves always in pairs.

† Buds non-resinous, with free and recurved points to their scales.

38. *Pinus halepensis*, Miller. Mediterranean region, Caucasus. See p. 1099.

Branchlets glaucous. Leaves $2\frac{1}{2}$ to 4 in. long; resin-canals marginal; basal sheath $\frac{1}{3}$ in. long. In var. *Brutia* the leaves are 4 to 6 in. long.

†† Buds resinous, with appressed scales.

39. *Pinus muricata*, Don. California. See p. 1104.

Branchlets stout, reddish brown. Buds cylindrical, $\frac{3}{4}$ to 1 in. long; scales encrusted with white resin. Leaves 4 to 6 in. long, stout, rigid; resin-canals median; basal sheath $\frac{1}{2}$ in. long.

40. *Pinus pungens*, Michaux. Alleghany Mountains. See p. 1106.

Branchlets shining brown. Buds cylindrical, $\frac{3}{4}$ in. long. Leaves 2 to $2\frac{1}{2}$ in. long, stout, rigid, very sharp-pointed; resin-canals median; basal sheath $\frac{1}{4}$ in. long.

41. *Pinus virginiana*, Miller. Eastern United States. See p. 1107.

Branchlets slender, glaucous violet. Buds cylindrical, $\frac{3}{8}$ in. long. Leaves $1\frac{1}{2}$ to 3 in. long; resin-canals median; basal sheath $\frac{3}{16}$ in. long.

42. *Pinus Banksiana*, Lambert. Canada, east of the Rockies; United States, Minnesota to Maine. See p. 1109.

Branchlets slender, greenish. Buds ovoid, $\frac{1}{2}$ in. long. Leaves 1 in. long; resin-canals median; basal sheath $\frac{1}{8}$ to $\frac{1}{6}$ in. long.

- § 9. PINASTER, Mayr.

Cones subterminal. Shoots uninodal, a branch, even when vigorous, showing only one whorl of branchlets, buds, and cones, in each year's shoot, close to its apex. Leaves always in pairs.

* *Buds non-resinous; bud-scales with free and recurved points.*

43. *Pinus Pinaster*, Solander. Mediterranean region. See p. 1113.
Branchlets stout. Buds stout, spindle-shaped, pointed, $\frac{3}{4}$ to 1 in. long. Leaves 5 to 6 in. long, stout, rigid; resin-canals marginal; basal sheath 1 in. long.
44. *Pinus Pinea*, Linnæus. Mediterranean region. See p. 1119.
Branchlets slender. Buds ovoid, pointed, $\frac{3}{8}$ in. long. Leaves 4 to 5 in. long; resin-canals marginal; basal sheath $\frac{4}{10}$ in. long.
- ** *Buds resinous; bud-scales free at the apex. Bark of upper part of the stem reddish and peeling off in thin papery scales.*
45. *Pinus sylvestris*, Linnæus. Europe, Asia Minor, Caucasus, Siberia. See Vol. III. p. 571.
Branchlets shining, greenish. Leaves 2 to 3 in. long, glaucous blue, broad and flattened; resin-canals marginal; basal sheath $\frac{1}{3}$ in. long.
46. *Pinus densiflora*, Siebold et Zuccarini. Japan. See p. 1125.
Branchlets glaucous. Buds $\frac{1}{2}$ in. long. Leaves 3 to 4 in. long, dull green; resin-canals marginal; basal sheath $\frac{3}{8}$ in. long, often ending in two long narrow filaments.
- *** *Buds resinous; points of the bud-scales appressed.*
- † *Buds cylindric or spindle-shaped. Leaves $1\frac{1}{2}$ to 3 in. long.*
47. *Pinus montana*, Miller. Mountains of central and southern Europe. See p. 1127.
Branchlets brown. Buds $\frac{1}{4}$ to $\frac{1}{2}$ in. long, very resinous. Leaves persistent 5 to 10 years, $1\frac{1}{2}$ to $2\frac{1}{2}$ in. long; resin-canals marginal; basal sheath $\frac{1}{2}$ to $\frac{6}{10}$ in. long.
48. *Pinus contorta*, Loudon. Western North America. See p. 1134.
Branchlets brown. Buds $\frac{1}{2}$ in. long, very resinous. Leaves persistent 3 to 8 years, twisted, $1\frac{1}{2}$ to 3 in. long; resin canals median; basal sheath $\frac{1}{4}$ in. long.
†† *Buds ovoid. Leaves¹ 3 to 6 in. long.*
49. *Pinus resinosa*, Solander. Eastern Canada; United States, Minnesota to Massachussets. See p. 1140.
Branchlets orange-brown. Buds pale brown, $\frac{1}{2}$ to $\frac{3}{4}$ in. long. Leaves 5 to 6 in. long; resin-canals marginal; basal sheath $\frac{7}{8}$ in. long.
50. *Pinus Thunbergii*, Parlatores. Japan. See p. 1143.
Branchlets brown. Buds $\frac{1}{2}$ to $\frac{3}{4}$ in. long, whitish. Leaves 3 to 4 in. long, rigid, sharp-pointed; resin-canals median; basal sheath $\frac{1}{2}$ in. long, ending above in two long filaments.
51. *Pinus Laricio*, Poiret. Southern Europe, Caucasus, Asia Minor. See Vol. II. p. 407.
Branchlets brown. Buds $\frac{1}{2}$ to 1 in. long, light brown, tinged with white. Leaves 4 to 6 in. long; resin-canals median; basal sheath $\frac{1}{2}$ in. long.
52. *Pinus leucodermis*, Antoine. Bosnia, Herzegovina, Montenegro. See Vol. II. p. 424.
Branchlets glaucous. Buds $\frac{1}{2}$ to 1 in. long, dark brown. Leaves 2 to 3 in. long, rigid, sharp-pointed; resin-canals median; basal sheath $\frac{1}{2}$ in. long.

(A. H.)

¹ They are sometimes only 2 in. long in *P. leucodermis*, No. 52.

PINUS EXCELSA, HIMALAYAN BLUE PINE

Pinus excelsa, Wallich, *List* 6059 (1828), and *Pl. As. Rar.* iii. t. 201 (1832); Loudon, *Arb. et Frut. Brit.* iv. 2285 (1838); Forbes, *Pinet. Woburn.* 75, t. 29 (1839); Masters, *Gard. Chron.* xix. 244, figs. 32, 35 (1883), and *Journ. Linn. Soc. (Bot.)*, xxxv. 581 (1904); Lawson, *Pinet. Brit.* i. 27, t. 4 (1884); Hooker, *Fl. Brit. India*, v. 651 (1888); Kent, *Veitch's Man. Coniferae*, 328 (1900); Gamble, *Man. Indian Timbers*, 704 (1902); Brandis, *Indian Trees*, 689 (1906); Clinton-Baker, *Illust. Conif.* i. 20 (1909).

Pinus nepalensis, De Chambray, *Traité Prat. Arb. Rés. Conif.* 312 (1845).

Pinus pendula, Griffith, *Journals*, 211, 237, 239, 264, 265, 287, 293 (1847).

Pinus Griffithii, McClelland, in Griffith, *Notul.* iv. 17 (1854), and *Icon. Pl. Asiat.* iv. t. 365 (1854).

A tree, attaining in the Himalayas 150 ft. in height and 12 ft. in girth. Branches widely spreading; branchlets upturned at their tips. Bark greyish brown, smooth on young trees, ultimately fissuring into small regular plates. Buds conical, elongated, shortly acuminate; the long subulate points of the scales either free or appressed together with resin. Young branchlets glaucous, smooth, glabrous, turning olive green in winter, and dark grey in the second year.

Leaves in fives, persisting for three years, 5 to 8 in. long, spreading, often bent near the base, as if broken; slender, scarcely curved or twisted, serrulate, sharp-pointed, marked with stomatic lines on the three surfaces; resin-canals marginal; basal sheath $\frac{3}{4}$ in. long, early deciduous.

Cones solitary or two to three together, erect when young, pendulous in the second year on stalks $1\frac{1}{4}$ to 2 in. long; cylindrical, 6 to 10 in. long, light brown when mature. Scales elongated-cuneate, about $1\frac{1}{2}$ in. long, 1 in. broad at the widest part; apophysis longitudinally channelled, convex from side to side, and thickened in the centre, with rounded thin upper margin, and short pointed terminal dark coloured umbo. Seed ovoid, brown, $\frac{1}{4}$ to $\frac{5}{16}$ in. long; wing $\frac{7}{8}$ in. long, $\frac{3}{8}$ in. wide, very oblique on the outer side, light brown, streaked with darker brown wavy lines. Cotyledons 8 to 12.

This species is readily distinguishable from all the other pines with five leaves and a deciduous sheath, by its glabrous glaucous branchlets.

Striped¹ and one-leafed² sports, arising in cultivation, have been described; but appear to be unknown in England.

DISTRIBUTION

This species,³ known as the blue pine in India, is a native of the temperate Himalayas, at 6000 to 12,500 feet elevation, extending westward to Afghanistan and Kafirstan, and eastward to Nepal, but has not been seen in central and north-west Kumaon. It has not been found in Sikkim, but is common in Bhutan.⁴ According to

¹ Var. *zebrina*, Croux, in *Rev. Hort.*, 1889, p. 392, fig. 101. Leaves marked an inch below the apex with a cream-coloured band. Originated at Sceaux in France.

² Var. *monophylla*, Carrière, *Conif.* 398 (1867). Each sheath with apparently only one leaf, all the five leaves being welded together.

³ It was first collected by Buchanan-Hamilton near Narainhetty, in Nepal.

⁴ Hooker and Thomson, *Fl. Indica, Introductory Essay*, 178, 181 (1855), and Griffith, *Journ. Mission Bootan in 1837-1838*, p. 129.

Gamble it either forms pure woods or is mixed with other trees, such as the deodar, being accompanied at high levels by birch and silver fir, and at low elevations by *Pinus longifolia*. On the edges of the forest, scrub lands soon become covered with seedlings, which grow up into dense belts. These seedlings, on account of their rapid growth, soon suppress those of the deodar. Mayr¹ refers to the ease with which this pine naturally regenerates itself in the Himalayas, and gives a picture of the forest with numerous seedlings.

It commonly attains a height of 100 to 120 ft., with a girth of 6 to 10 ft., rarely reaching 150 ft. in height and 12 ft. in girth. On good soils at moderate elevations, it grows rapidly, making five rings per inch of radius; while at high elevations on rocky soil its rate sinks to 20 to 25 rings per inch. It prefers sandy or clayey soils, though occasionally met with on limestone. In India, while easy to rear in the nursery, it bears transplanting badly; and Gamble recommends that it should be grown in baskets, which should be used in planting out.

The timber is good, next in value to that of the deodar, and is largely used in construction throughout the western Himalayas, especially in Kashmir and the Punjab. For railway sleepers it is slightly inferior to the deodar; but for planking, doors, windows, and furniture, it is better than the timber of that tree, as it is not so brittle, and is free from the oil, which in the deodar so readily absorbs dirt. In Kangra and Kulu, it is said to be used for making tea-boxes, as it is free from strong scent.²

The wood is highly resinous, and produces turpentine and tar.² The trees are tapped for about three years, then allowed three years' rest, when tapping is recommenced on the other side. The more resinous parts of the wood are much employed for torches, known as *mashâl* in Hindustani.

In dry winter seasons, the leaves and twigs become covered with a copious sweet exudation, which is collected and eaten by the natives. The origin of this manna-like substance is not yet accurately determined.³ (A. H.)

CULTIVATION

P. excelsa was introduced into cultivation⁴ by Lambert, who raised many plants in 1823 at Boyton. Plants were also reared in the Chiswick Garden and in the Glasgow Botanic Garden in 1827 from seeds sent by Wallich.

It is perfectly hardy in all parts of Great Britain, Mr. Palmer's tables showing only five places out of ninety-five in which it was killed by the severe winter of 1860, and in three of these the thermometer fell below zero. Two-year seedlings raised at Colesborne from Himalayan seed were uninjured in my garden in 1908 by a temperature of about zero. But judging from its comparative rarity, and the smaller size of the trees we have seen in the north of England and in Scotland, it requires the full summer heat of our climate to do it justice, nearly all the largest specimens I

¹ *Fremdländ. Wald- u. Parkbäume*, 375, fig. 122 (1906).

² Cf. Watt, *Commercial Products of India*, 888 (1908), who refers to Thurston, *Resin and Turpentine from Indian Pines*, *Imp. Inst. Handbook*, 1893, pp. 7-19; Lawrence, *Valley of Kashmir*, 80 (1895); etc.

³ Cf. Madden, in *Journ. Agri-Hort. Soc. India*, reproduced in *Indian Forester*, i. 55 (1875).

⁴ *Genus Pinus*, ii. 6 (1824).

have seen being in the south and east, not attaining such large dimensions where the winters are very mild. It seems comparatively indifferent to soil, growing best on a good deep loam, and is one of the pines which may be planted on limestone successfully.

As a rule it seems to have a tendency to fork low down, and often develops into large spreading bushy trees with several leaders, and the lower branches resting on the ground. Its growth when young is rapid, but seems to fall off very much after forty or fifty years. It is liable to be injured by wind, and requires a sheltered situation, with full sun. I am not aware that it has anywhere been tried under forest conditions, and it has no special qualities that will justify its being looked on as other than an ornamental tree. It produces seed freely, which sheds early, and in favourable situations reproduces itself naturally.

REMARKABLE TREES

The best specimen as regards height and symmetry that I have seen is at Hewell Grange, near Bewdley, the seat of the Earl of Plymouth, which in 1909 measured 93 ft. by 8 ft. 4 in. There are two fine trees growing on low ground near the lake at Eastnor Castle, with tall oaks and elms near them. Mr. Mullins, the gardener, measured these in 1909, by sending a man up the stems to near the top, and found them to be 90 ft. by 7 ft. 11 in., and 80 ft. by 8½ ft.

A tree at the Hendre, Monmouthshire, is said by Sir H. Maxwell¹ to be 90 ft. high. A well-shaped tree near the mansion at Claremont was 81 ft. by 8 ft. in 1907. A tree at Nuneham Park was 74 ft. by 8 ft. 7 in. in 1907. A large tree forking close to the ground, where some of the branches have layered, about 60 ft. by 8 ft., is growing at Goodwood. At Ampney Crucis, near Cirencester, on the lawn of the house occupied by Mrs. Elwes, a tall slender tree was about 68 ft. by 4 ft. in 1909. At Highnam, Gloucester, a tree measured in 1906, 63 ft. by 8 ft. 5 in. At Wilton House, near Salisbury, a tree was 77 ft. by 8 ft. 3 in. in 1906.

At Merton, Norfolk, there is a tall tree, dividing near the base into four stems which reach a height of 86 ft. This was raised from seed in 1861. At Munden, Watford, a fine tree is 75 ft. high, girthing 9 ft. at two feet from the ground, and dividing above into two stems. There is a very remarkable specimen at The Frythe, Welwyn, which was planted in 1846. It is 60 ft. high and 7 ft. in girth, with extremely wide spreading branches, many layering and sending up erect stems. The total circumference of the branches was 246 ft. in 1906. Mr. H. Clinton-Baker measured a tree at High Canons, Herts, 75 ft. by 7 ft. in 1908.

Another is that at Barton, near Bury St. Edmunds, which measured in 1904, 87 ft. by 9 ft. 5 in. It was raised² from seed given to Lady Napier by Wallich, and was planted out in 1843. It bore the severe winter of 1860-1861 without injury. There is a large tree at Casewick, Stamford, from which Lord Kesteven

¹ Green, *Encycl. Agr.* iii. 280 (1908).

² Bunbury, *Arboretum Notes*, 131 (1889).

has raised numerous seedlings. At Wimpole, near Cambridge, a well-shaped tree measured 63 ft. by 7 ft. 3 in. in 1909.

In Wales the largest I have seen is an ill-grown tree, at Maesllwch Castle, forking at the ground, where it was 10 ft. 10 in. in girth in 1906.

In Scotland the finest tree¹ is probably one at Smeaton-Hepburn, planted in 1839, which was 76 ft. high in 1902, with a trunk 12 ft. in girth at two feet from the ground, dividing above into three stems. At Keir, Perthshire, a fine tree measured 67 ft. by 6 ft. 3 in. in 1903. At Galloway House, Wigtownshire, there is a healthy tree, about 40 ft. in height.

In Ireland, there is a fine wide-spreading tree at Kilruddery, near Bray, which in 1904 measured 65 ft. by 9 ft. 4 in. There are also good specimens at Castle-martyr. At Brockley Park, Queen's County, a tree, dividing into several stems near the base, was 64 ft. high in 1907. At Emo Park, Portarlinton, another measured, in the same year, 66 ft. by 6 ft. 9 in.

Sargent² says that in New England it is hardy though short-lived; but there are large, healthy cone-bearing trees in Central Park, New York, and near many cities of the middle states. (H. J. E.)

PINUS PEUKE, MACEDONIAN PINE

Pinus Peuke, Grisebach, *Spicileg. Flor. Rumel.* ii. 349 (1844); Christ, in *Flora*, xlviii. 257, t. 2 (1865); Boissier, *Flora Orientalis*, v. 698 (1884); Masters, in *Gard. Chron.* xix. 244, figs. 33, 34 (1883), and in *Journ. Linn. Soc. (Bot.)*, xxii. 205, figs. 30, 31 (1887), and xxxv. 581 (1904); Kent, Veitch's *Man. Conif.* 357 (1900); Beck von Mannagetta, *Vegetationsverhält. Illyrischen Ländern*, 363-365 (1901); Clinton-Baker, *Illust. Conif.* i. 42 (1909).

Pinus excelsa, J. D. Hooker, *Journ. Linn. Soc. (Bot.)*, viii. 145 (1864) (not Wallich).

Pinus excelsa, Wallich, var. *Peuce*, Beissner, *Nadelholzkunde*, 286 (1891).

A tree, attaining in Bulgaria 100 ft. in height and 7 ft. in girth, narrowly pyramidal in habit. Bark similar to that of *P. excelsa*. Buds ovoid, shortly acuminate, about $\frac{3}{8}$ in. long, brown, resinous; scales with long subulate free points. Young branchlets smooth, glabrous, shining green, becoming brownish grey in the second year.

Leaves in fives, persistent two or three years, about 4 inches long, directed forwards and slightly outwards, not widely spreading or bent as in *P. excelsa*, slender, straight, not twisted, serrulate, sharp-pointed, marked with stomatic lines on all three surfaces; resin-canals marginal; basal sheath $\frac{3}{4}$ in. long, early deciduous.

Cones on short (less than $\frac{1}{2}$ in.) stalks, subterminal, spreading or pendulous, green before ripening, brown when mature, cylindric, tapering to a blunt apex, 4 to 6 in. long, $1\frac{1}{2}$ to 2 in. in diameter. Scales broadly cuneate, thin, $1\frac{1}{4}$ to $1\frac{1}{2}$ in. long, $\frac{3}{4}$ in. broad; apophysis slightly rounded or almost straight in the thin bevelled upper margin, raised in the centre and marked exteriorly with longitudinal channels, convex from side to side, ending in a small dark-coloured depressed umbo. Seed

¹ Cf. *Hist. Berwickshire Nat. Club*, xviii. 211 (1904).

² *Garden and Forest*, x. 461 (1897).

similar to that of *P. excelsa*, but with a shorter broader wing, which has finer, closer, and straighter longitudinal veins.

Specimens from the Balkans, with shorter thinner leaves than those first described from Mt. Peristeri, were distinguished by Dr. Christ as var. *vermiculata*¹; but such trivial and inconstant differences scarcely deserve a varietal name.

This species is closely allied to *P. excelsa*, but differs remarkably in the narrow pyramidal habit seen both in cultivation and in Bulgaria, where, as Velenovsky states, natural woods look exactly like plantations of Weymouth pine. It has shorter stiffer leaves, more or less appressed to the branchlets, and not spreading or bent as in *P. excelsa*. The green glabrous branchlets distinguish *P. Peuke* from all other species of the *Strobos* and *Cembra* sections.

DISTRIBUTION

This pine has a limited distribution, being confined to three small areas, in Bulgaria, Macedonia, and Montenegro. The largest of these is on the confines of Bulgaria and Macedonia, where the tree is known as *Mura*, and occurs on the Rilo Mountains, on the Mussala Mountain in the Rhodope range, and in the Perim range in Macedonia. Here it forms woods of considerable extent, which extend low down into the valleys, where it is mixed with *Pinus sylvestris*, and ascend up to the alpine zone, where it is associated with *Pinus montana*, var. *mughus*. According to Velenovsky,² trees 100 years old are growing on the Rilo and Mussala Mountains, which are 100 ft. in height and 5 to 7 ft. in girth. There are specimens in the Kew herbarium, which were collected on the Rilo Mountains in June 1899 by Elwes.

The second area of distribution is confined to Mt. Peristeri, above Monastir (lat. 41°, long. 21°), where the species was first discovered in 1839 by Grisebach. The small forest on this mountain, situated on granite soil between 2400 and 5800 ft. altitude, consisted of pines growing rather scattered amongst a dense undergrowth of juniper, and of no great size, scarcely exceeding 40 ft. in height at the lower levels, and becoming mere bushes, 4 ft. in height, at the higher elevations. Orphanides rediscovered the tree on Mt. Peristeri in 1863, and records it as growing between 3000 and 6000 ft. altitude. Halacsy³ is of opinion that its occurrence on the mountains of northern Thessaly is probable, but as yet uncertain.

The third locality is in Montenegro, close to the Albanian frontier, where the tree is known as *Molika*, and occupies a narrow strip of territory, about 22 miles in length, extending from west to east through the mountains, in which the river Lim takes its origin. It is recorded from the high ridge between the valleys of the Perućica and Vermoša rivers in the Kom Mountains, and on the Zeletin, Zjekirica, and Šekular Mountains. According to Beck, the tree is not found on the north Albanian Alps, as these are composed of limestone, on which it never grows in the wild state. In Montenegro it is not much affected by the great differences in climate throughout its extensive range of elevation, 2600 to 6300 ft., in which three species of juniper are found, each confined to a distinct zone of altitude. It assumes a bushy

¹ *Ex* Beissner, *Nadelholzkunde*, 286 (1891).

² *Flora Bulgarica*, 518 (1891), and *ibid.*, *Suppl.* i. 333 (1898).

³ *Consp. Flora Græca*, iii. 451 (1904).

habit both at the lower levels and on the highest parts of the mountains, and never forms pure woods, growing scattered amidst other trees, and only attaining 30 to 45 ft. in height.

CULTIVATION

This species was introduced by Orphanides, who gathered ripe seeds on Mt. Peristeri in 1863, which were distributed by Messrs. Haage and Schmidt¹ of Erfurt.

Through the kind offices of Pierce O'Mahony, Esq., I received a large quantity of seed from King Ferdinand of Bulgaria in April 1908. This has been widely distributed to different friends throughout England, Ireland, and Scotland. Most of it was tardy in germination, and the seed came up irregularly, some not germinating until 1909.²

The finest tree known to us in England is one at Bicton, which, when measured by Elwes in 1906, was 42 ft. high by 3 ft. 8 in. in girth, and was bearing cones. There is also a good one at Grayswood, 36 ft. by 3½ ft., planted in 1881; and one at The Heath, Leighton Buzzard, 37 ft. by 2 ft. 10 in., both measured by Mr. A. B. Jackson in 1908.

A group of healthy trees are growing in Kew gardens, near the Isleworth Ferry gate, which were raised from seed of the original importation sown in 1864. These trees have a thriving appearance, and the largest one measured, in 1909, 42½ ft. by 3 ft. 10 in.

At Westonbirt there are several trees 30 to 35 ft. in height and a foot in diameter, growing beside a tree of *P. monticola*, about 50 ft. high and 15 in. in diameter, which was planted at the same time.

There are two trees at Galloway House, Wigtownshire, the larger of which measured, in 1908, 48 ft. by 4 ft. 9 in.; and a smaller tree is growing at Ochtertyre, Perthshire.

According to Mayr, *P. Peuke* is as fast in growth and as hardy in Germany as the Weymouth pine. It has withstood without injury the severe temperature of -22° Fahr. at Grafrath, near Munich, and for so far has not been attacked by *Agaricus melleus*. It may possibly also be immune to the pine blister (*Peridermium Strobi*), which is so destructive to the Weymouth pine in many places on the continent. For these reasons Mayr is inclined to recommend the immediate planting in Germany of *P. Peuke* in place of the Weymouth pine.

Elwes saw in the nursery of Regel and Kesselring at St. Petersburg in 1908 young trees of *P. Peuke* which on damp and sandy soil had attained 12 ft. high in twelve years, and had resisted 30 degrees centigrade of frost without injury. It seems, therefore, likely to become a valuable forest tree in central Europe.

In New England this species³ is quite hardy in the Arnold Arboretum, where, however, Sargent says that it is a slow-growing tree of no especial ornamental value.

¹ A letter of Haage and Schmidt to Lindley concerning the first seed of this pine, and dated 11th January 1864, is preserved in the Cambridge Herbarium.

² Mr. Storie reports from Highclere that about 300 plants came up in April 1909.

³ *Garden and Forest*, x. 461 (1897).

PINUS AYACAHUITE, MEXICAN WHITE PINE

Pinus Ayacahuite,¹ Ehrenberg, ex Schlechtendal, in *Linnaea*, xii. 492 (1838); Loudon, *Encycl. Trees*, 1023 (1842); Masters, in *Gard. Chron.* xviii. 492, f. 83 (1882), in Lawson, *Pinetum Brit.* i. 9, t. 2 (1884), and in *Journ. Linn. Soc. (Bot.)* xxxv. 579 (1904); Kent, Veitch's *Man. Conif.* 311 (1900); Clinton-Baker, *Illust. Conif.* i. 8 (1909); Shaw, *Pines of Mexico*, 9, t. iv. (1909).

A tree attaining in Mexico 100 ft. or more in height and 12 ft. in girth, and in cultivation resembling *P. excelsa* in habit. Bark rough and scaly on old trees. Buds reddish brown, resinous, ovoid, acuminate, about ½ in. long; scales with long acuminate tips, usually free and directed upwards. Young branchlets covered with a short brown pubescence, occasionally confined to the parts below the insertions of the leaves; older branchlets glabrescent, and bright brown or greyish in colour.

Leaves in fives, spreading, usually persistent for three years, very slender or filiform, 4 to 8 in. long, serrulate, sharp-pointed, straight, scarcely twisted; outer surface green, with two or three short stomatic lines near the top; inner flat surfaces, each with three or four continuous white stomatic lines; resin-canals marginal; basal sheath ¾ in. long, early deciduous.

Cones sub-terminal, pendent, solitary, or in pairs, on stalks about ½ in. long, ovoid-cylindrical, often curved, gradually narrowing towards the obtuse apex, 8 to 18 in. long, 2½ to 6 in. wide towards the base, pale brown and resinous when mature. Scales about 2 or 3 in. long, and 1 to 1½ in. wide; apophysis rhomboidal or triangular, reflexed, ending in a swollen, rounded, inflexed or reflexed resinous tip. Seed ovoid, compressed, ⅜ in. long, brownish, mottled with dark streaks or spots; wing oblong, narrow, oblique, about ¾ in. long, pale brown, with longitudinal darker streaks.

This species so closely resembles *P. excelsa* in habit and foliage that possibly some of the trees passing under the latter name in cultivation may belong to it, but it is readily distinguished by the more slender leaves and the pubescent branchlets, which have in cultivated trees a reddish brown colour. It is quite distinct in cones and seeds.

VARIETIES

This pine varies extremely in the size and shape of the cones, seeds, and seed-wings, and according to Shaw, comprises three distinct geographical races, which are however connected by numerous intermediate forms:—

1. Typical form, described above. Seed with a long narrow wing. Prevalent in Guatemala and the southern states of Mexico.

2. Var. *Veitchii*, Shaw, *Pines of Mexico*, 10, t. v. (1909).

Pinus Veitchii, Roehl,² *Cat. Gr. Conif. Mex.* 32 (1857).

Pinus Bonapartei, Roehl, in *Gard. Chron.* 1858, p. 358; Clinton-Baker, *Illust. Conif.* i. 12 (1909).

Pinus Loudoniana, Gordon, *Pinetum*, 230 (1858).

¹ Roehl's *P. durangensis* is probably typical *P. Ayacahuite*.

² *P. Don Pedri*, *P. hamata*, and *P. Popocatepetli*, names given to certain cones by Roehl, belong to this variety.

Cones larger, as a rule, than in the type. Seed larger, $\frac{1}{2}$ in. long, ovoid, compressed, dark brown or blackish; wing short and broad, about $\frac{1}{2}$ in. long and wide, dark brown in colour. Prevalent in the central states of Mexico.¹

3. Var. *brachyptera*, Shaw, *Pines of Mexico*, 11, t. vi. (1909).

Pinus strobiformis, Engelm., in Wislizenus, *Tour N. Mexico*, 102 (1848).

Differs from the type, according to Shaw, in the larger seeds, with extremely short wings. Occurs in the states of Durango and Chihuahua, in northern Mexico.

DISTRIBUTION

This pine, according to Shaw, is a native of cool temperate altitudes in Central America, and extends from Guatemala throughout Mexico to the borders of the United States.

The typical form of the species was discovered² by Ehrenberg in 1836 in Mexico, who found trees 100 feet high at Omitlan, near Hacienda de Guerrero, and appears to be common in Oaxaca, particularly on the higher points of the Cumbre Mountains and on Mount Pelado. Hartweg found it in Guatemala, where he observed dead trees on the volcano Xetul, near Quezaltenango, at 10,000 ft. elevation.

Var. *Veitchii* was discovered³ by Roehl on the Sierra Madre range at 8600 ft. and at Tenango, and also on the eastern side of Mt. Popocatepetl at 11,000 to 12,000 ft., where it grows abundantly on the borders of deep ravines, never descending into the depths of the gorges, or ascending much above them. Here the winters are dry, the temperature descending to 10° to 14° Fahr., but the summers are long and warm. It is known to the Mexicans as *Ayacahuite colorado*, or red pine, on account of the excellence of its timber.

Var. *brachyptera* was discovered on the mountains of Cosihuiriac in the province of Chihuahua, at about 8000 ft. elevation, where, according to Engelm., it is a large tree, 100 to 130 ft. in height, with short leaves $2\frac{1}{2}$ to 3 inches long, and very resinous cones about 10 in. in length. This northern form does not appear to have been introduced into cultivation. (A. H.)

CULTIVATION

The typical form of the species was introduced into the Chiswick garden of the Horticultural Society by Hartweg in 1840, and seeds were again sent to this country by Roehl in 1857. It is comparatively rare in cultivation, and appears to succeed best in the south-west and west of England, Palmer's frost tables⁴ showing that it was killed in 1860 at Thorpe Perrow in Yorkshire, and at Highnam Court in Gloucestershire.

At Westonbirt a tree, which produces cones freely, from the seed of which numerous seedlings have been raised at Kew and Glasnevin, measured in 1909, 62 ft.

¹ Engelm., in *Trans. St. Louis Acad. Sci.* iv. 178 (1886), considered this variety to be a distinct species (*P. Bonaparteana*), with stout leaves, showing on section seven resin-canals; while *P. Ayacahuite* has more slender leaves with only two resin-canals. The number of resin-canals, however, is variable, two to eight being found by Shaw in wild specimens; and this character alone cannot be relied on for the discrimination of the type and var. *Veitchii*.

² Cf. Loudon, *Gard. Mag.* xv. 129 (1839).

³ Cf. *Gard. Chron.* xxi. 769 (1884).

⁴ Masters, in Lawson, *Pinetum Brit.* loc. cit.

by 6 ft. 8 in. It is pyramidal in habit, with slightly ascending branches. I have raised seedlings from this tree which appeared to me to be hardy, as they endured very severe frosts in early autumn and late spring. Planted, however, on rather heavy soil in a low situation, they succumbed to a frost certainly below zero in the winter of 1908-1909. The tree seems to endure lime in the soil without injury, and may be planted in a dry sunny position in most parts of England.

Another large tree is growing at Beauport, Sussex, and was 55 ft. high and 8 ft. in girth in 1904. At a distance this tree is indistinguishable from *P. excelsa*, having the wide-spreading branches and upturned branchlets which are usual in that species. It bears cones freely, but had increased little in size when seen in 1909.

There is a fine specimen at Bicton, which Mr. H. Clinton-Baker measured in 1908 as 65 ft. by 7 ft. 8 in. At Batsford Park, Gloucestershire, the seat of Lord Redesdale, there are two trees, the larger measuring 42 ft. by 3 ft. The other, more dense in habit and with less spreading branches, is scarcely so tall, and is 2 ft. 10 in. in girth. In Shroner wood, near Winchester, at 450 feet elevation, there is a narrow pyramidal tree, 51 ft. by 3 ft. 8 in., which was bearing ripe cones in February 1910. Mr. E. L. Hillier, who has sent us specimens, stated that this tree was planted in 1889, and is making very rapid growth.

Another in Messrs. Paul and Son's nursery at High Beech, Essex, which was planted probably in 1850-55, is only 30 ft. by 2 ft. 8 in. It survived the severe winter of 1860, which killed a deodar standing beside it; but subsequent hard winters have much damaged the stem on the north side. It bore cones¹ 9 in. long in 1882, and in subsequent years up to 1903, but the seeds proved unfertile when sown.

At Grayswood, Haslemere, trees of this species, growing on light sandy soil, succumbed to the attack of a fungus which affects Weymouth pine in that neighbourhood.

Var. *Veitchii* was introduced in 1857 by Roehl, who gave it many specific names. It is extremely rare in cultivation in England, where, however, it thrives in the mild humid climate of the west and south-west. The largest tree² known to us is growing at Heligan, near St. Austell, Cornwall, in the grounds of John Tremayne, Esq., who informed us in 1906 that it was then 60 ft. in height and 8 ft. 6 in. in girth. It measured in 1909, 66 ft. by 9 ft. 8 in. at 3 ft. above the ground, dividing above into several main stems. Another tree,³ cones of which are preserved in the museum at Kew, is growing at Ballamoar, in the Isle of Man. According to Dr. Tellet, of Ramsey, who sent a specimen branch, it was about 40 ft. high and 4 ft. 8 in. in girth in 1906. At Eastnor Castle a thriving specimen, about 35 feet high, produced cones with apparently fertile seeds in 1908; and the gardener, Mr. Mullins, believes that it was planted about twenty-five years ago. (H. J. E.)

¹ Figured in *Gard. Chron.* xviii. 492, fig. 83 (1882).

² Described and figured as *P. Ayacahuite* in *Gard. Chron.* xx. 748, figs. 131, 132 (1896), when it was said to be 49 ft. high and 7 ft. in girth.

³ Cf. *Gard. Chron.* vi. 599 (1889), and *Garden*, xxxii. 47 (1887). Dr. Tellet's letter was kindly forwarded to me by the owner, Mrs. Farrant. The soil is sandy—glacial drift containing clay. The tree is supposed to have been planted between 1857 and 1860.

PINUS LAMBERTIANA, SUGAR PINE

Pinus Lambertiana, Douglas, in *Trans. Linn. Soc.* xv. 500 (1827); Loudon, *Arb. et Frut. Brit.* iv. 2288 (1838); Lawson, *Pinet. Brit.* i. 47, t. 7 (1884); Masters, in *Gard. Chron.* i. 772, f. 144 (1887), and in *Journ. Linn. Soc. (Bot.)* xxxv. 578 (1904); Sargent, *Silva N. Amer.* xi. 27, tt. 542, 543 (1897), and *Trees N. Amer.* 5 (1905); Kent, Veitch's *Man. Coniferae*, 336 (1900); Clinton-Baker, *Illust. Conif.* i. 29 (1909); Shaw, *Pines of Mexico*, 12 (1909).

A tree, attaining in America¹ about 250 ft. in height, and 40 ft. in girth. Bark of young stems and branches smooth, thin, dark green; becoming on old trunks 2 or 3 in. thick and deeply divided into long irregular scaly ridges. Buds cylindrical, rounded at the apex or short-pointed, $\frac{1}{4}$ in. long, brownish, resinous, with closely, partly glandular appressed scales. Young branchlets smooth, covered with a minute brown, partly glandular pubescence.

Leaves in fives, deciduous in the second and third year, $3\frac{1}{2}$ to 4 in. long, rigid, sharp-pointed, twisted, making a complete turn, serrulate, with two or three stomatic lines on each of the three surfaces; resin-canals marginal; basal sheath $\frac{3}{4}$ in. long, early deciduous.

Cones sub-terminal, cylindrical, 11 to 21 in. long, 3 to 4 in. in diameter when closed; scales woody, 2 to $2\frac{1}{2}$ in. long, $1\frac{1}{2}$ to $1\frac{3}{4}$ in. wide, thickened towards the middle line, thin in margin, flat or slightly convex from side to side; apophysis smooth, orange-brown, slightly reflexed at the apex, which is marked with a small thickened resinous umbo. Seed $\frac{1}{2}$ in. or more in length, ovoid, compressed, dark-brown or nearly black; wing 1 to 2 in. long, $\frac{1}{2}$ in. broad, dark-brown, oblique and broadest below the middle. Cotyledons twelve to fifteen.

This species is very variable in the size of the cones, and of the seeds, which often have very long wings.² It is readily distinguished from all the other pines of the *Strobus* section by the rigid leaves, which are sharp-pointed and twisted, the twist making a complete turn.

DISTRIBUTION

The sugar pine is the largest species of the genus, and derives its name from the sugar³ which exudes from wounds that have been made in the heartwood. It is found in Oregon, from the valley of the Santiam river southward along the Cascade and Coast ranges, at elevations of 3000 to 4000 ft.; and extends in California through the Siskiyou and Coast mountains to Napa county,⁴ and along the western side of

¹ Dr. W. P. Gibbons, in *Erythea*, i. 161 (1893), says that he has seen a sugar pine 12 ft. in diameter, the height of which was 300 ft.; and another 8 ft. thick, the measurement of which when felled was something over 300 ft.

² Sargent, *Trees N. Amer.* 5 (1905), says that the seeds are $1\frac{1}{2}$ to 5 in. long, but this is evidently a misprint for $1\frac{1}{4}$ to 2 in.

³ This sugar exudation is often found on the surface of the heartwood where a forest fire has scarred the tree. It is white in colour and delicious to the taste, but can only be eaten in small quantity as it is laxative, and bears are said never to touch it. Cf. Muir, in *Harper's Magazine*, xxii. 717.

⁴ Jepson, *Flora W. Mid. California*, 20 (1901), says that it forms considerable forests in the high Coast ranges north of Clear Lake, where there are magnificent specimens, 150 to 175 ft. high and 22 ft. in girth. The record in Sonoma County, given in *Erythea*, iv. 152, needs confirmation. Jepson reports it in the Santa Lucia mountains.

the Sierra Nevada at least 200 miles farther south, where it attains its maximum size at 3000 to 7000 ft. high. It also grows in the southern part of the state in the San Bernardino and Cuyamaca mountains; and was discovered by Brandegee¹ on Mount San Pedro Martir in Lower California. It is seldom found growing pure, occurring usually in open woods in company with *P. ponderosa*, and is most common on mountain slopes and on the sides of ravines and cañons. Douglas fir, *Libocedrus*, *Sequoia gigantea*, and *Abies Lowiana* are also often associated with the sugar pine.

This pine is remarkable in its appearance in the forests on account of the long outward and downward sweep of the branches, the first of which often arise at 100 ft. above the ground. Sir Joseph Hooker, who gives a picture of a tree growing near the hotel at Calaveras, not far from the Wellingtonia grove, says² that the drooping attitude of the leaves towards the under side of the branches near their tips is very characteristic. The largest tree recorded seems to have been one near the Umpqua river in Oregon found by Douglas,³ which was 245 ft. in length, as it lay on the ground, girthing at 3 ft. from the ground 57 ft. 9 in. and at 134 ft. up no less than 17 ft. 5 in. Mr. F. R. S. Balfour photographed a fine tree, 27 ft. in girth at 5 ft. from the ground, which was growing near the bend on the M'Cloud river in Shasta County, California. (Plate 271.) Like all travellers, he was much impressed by the size and number of the cones which hung from the ends of the tapering branches. He says that the tree matures at 300 to 400 years old, though trees have been felled with as many as 700 rings. (A. H.)

CULTIVATION

This noble pine was discovered⁴ by Douglas in 1825 on the headwaters of the Multnomah river in Oregon; and was introduced by him in 1827, when plants were raised in the garden of the Horticultural Society at Chiswick, most of which, however, according to Loudon, died before they had attained 5 ft. in height. Lobb⁵ collected a further supply of seed in 1851.

Though rather slow in growth, this pine appears to be hardy, and is represented by single specimens in a few collections, more especially in the south of England.

A tree at Dropmore raised from seed given to Lady Grenville by the Duke of Buccleuch in 1843, bore cones for the first time⁶ in 1872; and occasionally in subsequent years, thrice in the last eight years. Mr. Page measured it in 1908 as 85 ft. by 10 ft., and says that occasionally the cones are as much as 18 in. in length. There are two younger trees at Dropmore which have not as yet borne cones.

A fine tree at Arley Castle, also raised from the seed sent by Douglas, measured⁶ 91 ft. by 10 ft. 8 in. in 1903; and so far as Mr. Woodward can ascertain has never borne cones. There is a well-shaped tree at Eastnor Castle (Plate 272), which occasionally bears cones, 83 ft. by 10 ft. in 1909.

¹ Cf. *Zoe*, iv. 201 (1893).

² In *Gard. Chron.* xxiii. 11, fig. 1 (1885).

³ *Comp. Bot. Mag.* ii. 92, 130 (1836).

⁴ *Hortus Veitchii*, 39 (1906). According to Loudon, *Gard. Mag.* xvii. 429 (1841), Dr. M'Laughlin sent home a parcel of cones in 1841 from Fort Vancouver, on the Columbia river; but it is unknown whether any trees were raised from these.

⁵ *Gard. Chron.* 1872, p. 1166.

⁶ *Hortus Arleyensis*, 14 (1907).

A splendid tree at Danesbury, near Welwyn, Herts, measured 90 ft. by 10 ft. 4 in. in 1907, and produced cones for the first time in 1897. There are several other good specimens in the same county; two trees at Brickendon Grange, the larger of which was 49 ft. by 4 ft. 10 in. in 1906, when it bore cones; another at Bayfordbury which measured 64 ft. by 7 ft. 3 in. in 1905, and has borne cones of late years.

At Nuneham Park, Oxford, a fine tree measured 75 ft. high and 10 ft. 9 in. in girth in 1906. Mr. H. Clinton-Baker in 1907 saw a tree at Flitwick Manor, Bedford, 72 ft. by 7 ft. 6 in., which was bearing numerous young cones.

Sir Hugh Beevor reports a tree at Fulmodestone, Norfolk, said to have been planted about 1851, which was 60 ft. by 6 ft. 5 in. in 1903. A tree¹ at Barton, Suffolk, measured 65 ft. by 10 ft. in 1905.

The best specimen in Kew Gardens measured 63 ft. by 4 ft. 7 in. in 1903.

A fine tree, measuring 74 ft. by 7½ ft. in 1908 when it produced cones, grows in the grounds of Bowood Park, Wilts, the seat of the Marquess of Lansdowne. It is said to have been planted about the year 1838.

The following were the only trees of the species mentioned in the reports² sent to the Conifer Conference in 1891:—Revesby Abbey, Lincolnshire, forty-three years old, 50 ft. high, 6 ft. 8 in. in girth; Poltalloch, Argyllshire, 45 ft. high, 9 ft. in girth, said to be growing vigorously.

Murray reported³ in 1860 that a fine tree, now no longer living, in the Keillour Pinetum, had produced cones for several years past. This is remarkable, if true, as this species, rare in Scotland, appears to bear fruit only in the south of England.

In Ireland it is not common, the best I know of being a tree at Woodstock, which in 1909 was 62 ft. by 6 ft.

A tree in the Wellesley Pinetum,⁴ Massachusetts, U.S.A., was 27 ft. high in 1905; but Sargent says that although hardy as far north as Boston, it is not worth growing in New England except as a curiosity. (H. J. E.)

PINUS MONTICOLA, WESTERN WHITE PINE

Pinus monticola, Don, in Lambert, *Genus Pinus*, ii. t. 81 (1832), and iii. t. 87 (1837); Loudon, *Arb. et Frut. Brit.* iv. 2291 (1838); Sargent, *Silva N. Amer.* xi. 23, tt. 540, 541 (1897), and *Trees N. Amer.* 5 (1905); Kent, Veitch's *Man. Coniferae*, 349 (1900); Masters, *Journ. Linn. Soc. (Bot.)* xxxv. 580 (1904); Clinton-Baker, *Illust. Conif.* i. 36 (1909).

Pinus Strobus, Linnæus, var. *monticola*, Nuttall, *Sylva*, iii. 118 (1849).

Pinus porphyrocarpa, Murray, in Lawson, *Pinetum Brit.* i. 83, ff. 1-8 (1884).

Pinus Grozelieri, Carrière in *Rev. Hort.* 1869, p. 126, f. 31.

A tree, usually attaining in America 100 ft. in height and 15 ft. in girth, rarely as high as 150 ft., with a trunk 25 ft. in girth. Bark of young stems and branches thin, smooth, and light grey, becoming on old trees 1½ in. in thickness and divided

¹ There is no record of this tree in Bunbury, *Arboretum Notes*.

² *Journ. Roy. Hort. Soc.* xiv. 492, 503 (1892). A tree at Keir, Perthshire, incorrectly reported (*ibid.* 531) to be *P. Lambertiana*, turns out to be *P. Strobus*.

³ In *Trans. Bot. Soc. Edin.* vi. 370 (1860).

⁴ Sargent, *Pin. Wellesley*, 10 (1905).

by fissures into small square scaly plates. Buds, as in *P. Strobus*, but larger. Branchlets, covered with short, brown, partly glandular¹ pubescence, retained in part in the second year.

Leaves, in fives, slightly spreading, dense upon the branchlets, persistent for three or four years, about 4 in. long, often only 2 to 3 in. long in native specimens, rigid, broader and thicker than in *P. Strobus*, serrulate, narrowed but blunt at the apex, with several stomatic lines on the inner surfaces, and two to three broken lines of stomata on the outer surface near the tip; resin-canals marginal; basal sheath about ¾ in. long, early deciduous.

Cones spreading, on short stout incurved stalks, cylindrical; very variable in length in wild specimens, averaging 5 to 8 in., occasionally 12 and rarely 18 in.; in cultivated specimens usually about 5 in. Scales thin, oblong-cuneate, averaging 1½ in. long and ¾ in. broad; apophysis rounded and thin in upper margin, slightly convex from side to side, and tipped with a small dark-coloured resinous umbo. Seed narrowed at the end, ½ in. long, reddish brown, mottled with black; wing about 1 in. long, narrow, pointed, dark brown. Cotyledons 6 to 9.

The cones are usually green in colour before ripening, but a tree at Glenalmond in Scotland produced purple cones and has been named var. *porphyrocarpa*, (A. H.) Masters.²

DISTRIBUTION

This tree represents *P. Strobus* in the Pacific coast region of North America, where it occurs in the north in Vancouver Island, in the Columbia river valley, and on the Selkirk range in British Columbia; and extends southwards to Idaho, where it attains its maximum size in the Bitter Root Mountains, and to the western slopes of the Rocky Mountains in northern Montana; and is found throughout the coast ranges of Washington and Oregon, and on the Cascade and Sierra Nevada ranges as far as the Kern river valley in California. It descends³ to sea-level in Vancouver Island, ascends in the Selkirks to 2500 ft., and reaches 10,000 ft. altitude in the Californian Sierras, where trees with enormous stems and short twisted branches withstand for centuries the fiercest mountain gales.⁴

It does not often grow as pure forest, but wherever I have seen it, is mixed with other conifers, and most abundant in regions where there is a heavy rainfall, though usually not a large tree in comparison with others in the same region, and commonly about 100 ft. high. Sargent gives 150 as its extreme height, and Sheldon says 100 to 200 ft. I measured at 1650 ft. elevation near Camp 6 of the Victoria Lumber Company at Chemainus in Vancouver Island, a tree which was at least 200 ft. high by 13½ ft. in girth, with a stem clear of branches to 80 or 90 ft. It is not abundant

¹ Some of the hairs are tipped with a globose gland.

² In *Journ. R. Hort. Soc.* xiv. 235 (1892). This is *P. porphyrocarpa*, Murray, in Lawson, *Pin. Brit.* i. 83 (1884).

³ Throughout the greater part of its range, it occurs at considerable altitudes, and though in south-western Vancouver Island it grows sparingly through the coast forest, it is more abundant at 500 ft. where the fogs are less and the summer days are warmer. Close to the sea, trees are usually somewhat stunted. Cf. Butters, in *Postelsia, Year Book of the Minnesota Seaside Station*, 1906, p. 160.

⁴ *Garden and Forest*, x. 460 (1897). In this journal, v. 1, figs. 1 and 2 (1892), there are two excellent illustrations of trees of great age, growing in an exposed situation in the Yosemite valley.

here, and though occasionally cut up in the sawmills, does not form an important item in the timber resources of British Columbia.

According to Macoun and Anderson¹ the wood is used for the same purposes as eastern white pine. It is useful for window-sashes, doors, powder barrels, and similar work, but being a white and very light wood it is unfit for outside work and decays rapidly in contact with the ground.

In north-western Montana, this species does not ascend above 4000 ft. and never crosses the continental divide. It is of rather rare occurrence in the Flathead region where scattered trees grow in the mixed forest, which is mainly composed of western larch and Douglas fir. It thrives best on moist soil, but on swampy ground has shallow roots and is often blown down. Seedlings² germinate in the open, where the soil is not too dry; but they bear a certain amount of shade, though they are never seen under the dense cover of *Thuja plicata* or *Tsuga Albertiana*.

CULTIVATION

Though discovered by David Douglas in 1831 and introduced by him soon afterwards, the tree did not become common in England until Lobb and others sent seeds in quantity between 1851 and 1855. It seems to be perfectly hardy as regards cold everywhere, but does not succeed as well in England generally as in Scotland, and even there it seems very subject to the attacks of a rust which was identified by Mr. W. G. Smith as *Peridermium pini*,³ and which is described by Mr. J. Laurie, gardener at Murthly Castle, as spreading over all the trees there, but not attacking *P. Strobus* which grows close by. From what I have seen elsewhere this or a similar rust has destroyed other trees in different parts of the country. It seems to succeed best in the wetter parts of Scotland, and to dislike lime, as the seedlings I have raised will not grow at Colesborne. It cannot be recommended on our present knowledge as a forest tree in this country.

Among the finest I have measured in England are those at Adhurst St. Mary near Petersfield, the seat of Miss Bonham Carter, where in 1908 I measured a tree growing on the lower greensand which was 78 ft. by 5½ ft. At Barton, in 1904, a tree with three leaders was 79 ft. by 8 ft. It was planted in 1848⁴ and bore cones in 1864. At Beauport, two trees, 81 ft. by 7 ft. and 68 ft. by 7½ ft., were healthy and covered with cones in 1905. At Enville Hall, Staffordshire, Henry saw a beautiful glaucous tree which in 1904 was 77 ft. by 6 ft. At Kew, a tree on the lawn north-west of the Water Lily house, planted in 1843, measured in 1903, 63 ft. by 5 ft. 1 in.⁵ At Highnam, Major Gambier Parry in 1906 measured a tree 64 ft.

¹ *Brit. Columbia, Bureau Inform., Bull. No. 15*, p. 239 (1903).

² Cf. Whitford, in *Bot. Gaz.* xxxix. 201 (1905). Henry in 1906 saw numerous seedlings near Nyack on the Great Northern railway. The tree is of no economic importance in Montana, and is estimated by Ayres to yield about one per cent of the total timber in the Lewis and Clarke Forest Reserve. Elrod gives 10 ft. as the maximum girth.

³ *Gard. Chron.* xxiii. 244 (1898). Smith says that the rust is *Peridermium pini* and not *P. Strobi*. The two fungi are distinct. Cf. Smith, *ibid.* 202. According to Ulmer, in *Naturw. Zeitsch. forst. Landwirtschaft*, 1908, pt. 12, of all the five-leaved pines in the forest garden at Tharandt in Saxony, only *P. monticola*, of which there are several trees eighteen years old, is attacked by *Peridermium Strobi*. Experiments in that place have shown that the only species of *Ribes* infected by the spores is *R. sanguineum*.

⁴ Bunbury, *Arboretum Notes*, 133 (1889).

⁵ *Kew Hand-List Conifera*, xiv, xxii (1903).

by 6 ft. 8 in. At High Leigh, Hoddesdon, Mr. Clinton-Baker in 1908 measured a tree 66 ft. by 4 ft. 10 in.

In Scotland the largest known to us is a tree at Murthly (Plate 273), which, when I saw it in 1906, was 85 ft. by 6½ ft. and covered at the top with cones. The next is at Scone, in Perthshire, the seat of the Earl of Mansfield. This, when measured in 1891 for the Conifer Conference, was 71½ ft. high, by 5 ft. 11 in. in girth at about forty years of age; and when measured by Henry in 1904 had increased to 82 ft. by 7 ft. 9 in., and was quite healthy. Another at Keillour, which is probably one of Douglas's original introduction, as it was planted in 1834, was in 1904 80 ft. by 6 ft. 9 in.; and there are many others in Scotland which are from 60 ft. to 70 ft. high. One at Monreith, Wigtownshire, planted in 1876, measured in 1908 56 ft. by 4 ft. 11 in., whilst *P. Cembra*, planted with it at the same time, is only 16 ft. high. Another at Poltalloch, raised from the seed of a tree at Lamb Abbey, measured 50 ft. by 5¼ ft. in 1906, and has itself produced fertile seed.

In Ireland it also grows well. At Hamwood, Co. Meath, the seat of C. R. Hamilton, Esq., there is a splendid tree planted in 1847 which Henry measured in 1904 and found to be 76 ft. by 7 ft. At Fota, another measured 69 ft. by 6 ft. 8 in. in 1907. (H. J. E.)

PINUS STROBUS, WEYMOUTH PINE, WHITE PINE

Pinus Strobus, Linnæus, *Sp. Pl.* 1001 (1753); Loudon, *Arb. et Frut. Brit.* iv. 2280 (1838); Sargent, *Silva N. Amer.* xi. 17, tt. 538, 539 (1897), and *Trees N. Amer.* 4 (1905); Kent, *Veitch's Man. Conifera*, 377 (1900); Masters, in *Journ. Linn. Soc. (Bot.)*, xxxv. 579 (1904); Clinton-Baker, *Illust. Conif.* i. 52 (1909).

Pinus tenuifolia, Salisbury, *Prod.* 399 (1796).

Pinus alba canadensis, Provancher, *Fl. Canadienne*, ii. 554 (1862).

A tree, attaining in America at the present time 150 to 175 ft. in height and 10 to 15 ft. in girth, but stated to have been much larger formerly. Bark on young stems, thin, smooth, and greenish; on old trunks 1 to 3 in. in thickness, and divided by shallow fissures into broad connected scaly ridges. Buds ovoid, sharp-pointed, ¼ in. long, brown, resinous, with some of the scales free at the tips. Young branchlets with short tufts of pubescence below the insertions of the leaf-clusters on the slightly raised pulvini, being glabrous elsewhere.¹

Leaves in fives, persistent two or three years, spreading, 3 to 4 in. long, very slender, straight, serrulate, whitened with stomatic lines on the two inner surfaces; resin-canals marginal; basal sheath ⅝ in. long, early deciduous.

Cones sub-terminal, pendulous on stalks (usually less than 1 in. long), cylindrical, often curved, pointed at the apex, 4 to 6 in. long, 1 in. in diameter. Scales 1 to 1¼ in. long, ½ to ⅝ in. wide, usually very convex from side to side; apophysis smooth, rounded, and thin in upper margin, slightly thickened in the centre, terminating in a

¹ Occasionally the pubescence is diffused over the whole surface of the branchlet, but remains densest on the pulvini.

small resinous flat umbo. Seed ovoid, $\frac{1}{4}$ in. long, reddish brown, mottled with black; wing narrow, 1 in. long. Cotyledons 7 to 14.

VARIETIES

Several forms with variously coloured foliage or of peculiar habit have arisen in European nurseries.¹

1. Var. *nana*, Knight, *Syn. Conif.* 34 (1850). A compact round-headed shrub rarely exceeding 6 ft. in height, with short slender branches, and crowded branchlets; leaves short, $\frac{3}{4}$ to $1\frac{1}{2}$ in. in length. A specimen of this variety planted at Bayfordbury in 1849 is about 15 ft. high. Sargent says that this is perhaps one of the most distinct and beautiful of all the dwarf conifers in cultivation; and those which Elwes saw at Underley Hall, Westmoreland, the seat of Lord H. Cavendish-Bentinck, confirmed this opinion.

2. Var. *nivea*, Booth, *ex Knight, loc. cit.* Leaves short, and silvery white beneath.

3. Var. *aurea*. Leaves yellowish when young.

4. Var. *variegata*. Leaves variegated with yellow.

5. Var. *zebrina*. Leaves striped with yellow.

6. Var. *monophylla*, Tubeuf, *Forst. naturw. Zeitschr.* vii. 34 (1897). A variety with the needles more or less cohering throughout their length, and forming a single needle.

7. Beissner also mentions fastigiate and prostrate varieties, which do not seem to be in cultivation in England.

DISTRIBUTION

P. Strobus is the largest of all the conifers indigenous in North America eastward of the Rocky Mountains; and its original area of distribution comprises a vast territory in Canada and the northern United States, roughly bounded on the north by the parallel of 50° from south-eastern Manitoba to Newfoundland, and on the south by the parallel of 42° from Iowa to Connecticut; while it spreads southwards in the Alleghany mountain region from Pennsylvania and New Jersey, through Maryland, West Virginia, Virginia, Kentucky, North and South Carolina, Tennessee, to the northern parts of Alabama and Georgia, becoming rarer and confined to high altitudes towards the south. It grows up to about 3500 ft. on the Blue Ridge, but does not there attain anything like the size it does farther north, 60 to 70 ft. high being about the size of the trees which Elwes saw in North Carolina.

Although still met with throughout this vast region, the original forest has in many parts been cut away, and in some districts, as in New England and eastern Canada, the species only remains in small areas. The great forests, where the pine occurs in commercial quantity, are now confined to Michigan, Minnesota, and Wisconsin in the United States, and to the Ottawa valley, and to the districts bordering Lake Huron and Lake Michigan in Canada.

¹ Sargent, in *Garden and Forest*, x. 460 (1897), mentions two varieties of American origin growing in the Arnold Arboretum; one, dwarf with pendulous, nearly prostrate branches; the other, with short, slender, nearly erect branches, in whorls of three, growing a dense, low, round-topped head.

The white pine is less gregarious than many other pines, and originally formed an important component of the mixed deciduous forest of New England, New York, and Pennsylvania, attaining its best development along water-courses, and reaching its greatest size when growing in mixture with beech, maples, and birches, often towering in such woods high above the general level of the other trees. It is often, however, in the same regions associated with hemlock; and in eastern Canada is frequent in company with hemlock, spruce, and *Thuja occidentalis*.

The pine forests, which cover large tracts of sandy soil in the Lake States, are composed of varying mixtures of *P. Strobus*, *P. resinosa*, and *P. Banksiana*.¹ On poor dry sand the two latter species outgrow and supplant the former, while on moist deep sand *P. Strobus* is the more vigorous. Its growth is much aided by the presence of organic matter and loam in the sand, and on soil of this kind, pure woods of white pine, sometimes several square miles in extent, occur. With an increase of loam in the soil, deciduous trees make their appearance, and the forest becomes a varied mixture of these trees and *P. Strobus*. On heavy clay soil, the white pine tends to disappear, and a forest of only hardwoods results.

On sandy soil in the eastern states, *P. rigida* is the companion of the white pine, and in the southern states, *P. echinata*.

This tree prefers a climate with considerable moisture in the air, as is shown by its abundance in the region of the Great Lakes and towards the sea-board. It withstands windy and cold exposures, but suffers from strong sea-breezes. It excels all pines in its capacity for bearing shade in the early stage of its growth, and reproduces itself naturally under oak, but not under beech or maples. It is long in cleaning its stem, even where the young growth, as is often the case, forms dense thickets. (A. H.)

Though it is improbable that any such trees now exist, Sargent quotes various old writers to show that in former times trees rivalling the giant pines of California were found in New England. A tree, 7 ft. 8 in. in diameter at the butt, on the Merrimac river; and another, 6 ft. in diameter and 260 ft. high, in Lincoln,² N.H., are mentioned as instances. But trees of 150 ft. high, 24 in. in diameter, are now quite uncommon, and the largest actually measured in Pennsylvania by Pinchot was 155 ft. high, $3\frac{1}{2}$ ft. in diameter at $4\frac{1}{2}$ ft. from the ground, and 357 years old.

Emerson tells us³ that fifty years ago several trees at Blanford, which grew

¹ In the Cass Lake Forest Reserve, in Minnesota, which I visited in 1906, these three pines occur; and *P. Strobus* invariably occupied the better soil where the sand contained a percentage of blackish mould.

² With regard to the gigantic heights given by early writers I am very sceptical, and Prof. W. A. Buckhout, of the Pennsylvania State College, to whom I wrote for information, shares my doubts. The most authoritative statement is by Fox, in *U.S. Forestry Bull.* No. 34, p. 8 (1902), who says: "there is a record of a white pine cut in Meredith, Delaware County, New York, that measured 247 ft. in length as it lay on the ground." He adds: "Many New York lumbermen still living recall giant white pines 7 ft. or more across the stump, and over 220 ft. in height." Fox does not state where the record exists or its authority; and Springer, in *Forest Life and Forest Trees*, 40 (New York, 1851), says: "In Dr. Dwight's *Travels*, there is an account of a tree in Lancaster, New Hampshire, which measured 264 ft. in length. I have worked in the forests among the timber several years, have cut many hundreds of trees and seen many thousands, but have never found one larger than the one I felled on a little stream which emptied into Jackson Lake in the eastern part of Maine. Its trunk was 6 ft. in diameter at 4 ft. from the ground. It was about 9 rods in length or 144 ft., about 65 ft. of which were free of limbs, and retained its diameter remarkably well." The tree mentioned in *Garden and Forest*, 1894, p. 188, which grew in Wisconsin, and was said to be 200 ft. high and 45 in. in diameter, is also exaggerated, I believe, as regards its height.—(A. H.)

³ *Woody Plants Massachusetts*, i. 74 (1875).

on rather dry land, measured after they were felled over 223 ft., and speaks of a mast cut on the Penobscot river in 1841, which, after being hewn to an octagonal shape, measured 90 ft. long, 36 in. in diameter at the butt, and 28 in. at the top.

The tree lives to a very great age, remaining sound up to 350 or 400 years, and it is said in New England that no one has lived long enough to see the stump of a white pine decay. Fences made from the stumps after they have been torn up by the roots, show after 100 years few signs of decay.

The white pine grows naturally on all kinds of soil, and varies very much in its habit according to the soil and surroundings, but flourishes best in a deep, moist sandy loam, and in land which, being covered with a thick growth of moss, never dries in summer.

The trees now commonly seen by the traveller in New England, which have been left when the original forest was felled, or which have sprung up from seed on abandoned farms, or as second growth in forest which has been logged, give no idea of what the tree is in a virgin forest. These are now only found in remote localities from which the logs cannot be profitably extracted; and the ingenuity of the lumberman is so great, and the present value of large clean logs so high, that it is not easy to find any which have not been cleared of their finest timber.

The reproductive power of the tree is very good, whenever fire is kept out of the forest, and large areas of land which have been abandoned by the descendants of the original settlers as unprofitable to cultivate, are now becoming¹ re-covered with white pine, from which second growth in New Hampshire and Vermont alone, Sargent tells us that no less than 100,000,000 ft. of lumber were manufactured in the year 1880.

A remarkable instance of the rapid growth and branching habit of the white pine on land which has been burnt over is described by Mary Robbins in *Garden and Forest*, viii. p. 333. These trees are in a large cemetery at St. Stephen, New Brunswick, on land which was devastated by fire in 1821. The largest of them in 1895 were 75 ft. high and 11 ft. or more in girth, with high horizontal or perpendicular branches coming off close to the ground, some of which are as much as 7 ft. in circumference and spread 40 to 60 ft. from the trunk.

HISTORY AND CULTIVATION

The white pine was first described by Plukenet² in 1696, and according to Aiton³ was first cultivated⁴ at Badminton in Gloucestershire by the Duchess of Beaufort in 1705. Its common English name was given it because Lord Weymouth planted it⁵ largely in the beginning of the 18th century at Longleat, Wilts;

¹ In *U.S. Forest Service, Circular 67* (1907), a leaflet on the planting of this species, it is said that in many situations, if the land is protected from fire, white pine will extend itself rapidly by natural seeding; and planting is recommended only when natural regeneration is impracticable.

² Plukenet, *Amalth. Bot.* 171 (1705).

³ *Hort. Kew.* iii. 369 (1789).

⁴ It was introduced earlier into France, as a plant was growing in the Royal Nurseries at Fontainebleau in 1553. Cf. Belon, *De Arboribus Coniferis*, published in that year, and quoted by Bolle, in *Gartenflora*, 1890, p. 434.

⁵ The date of first planting at Longleat is uncertain, and possibly preceded that at Badminton. In *London Catalogue of Trees by Society of Gardeners*, 57 (1730), it is said that "Lord Weymouth's pine was raised from seed in Badminton Gardens several years since, and has been growing many years in the gardens of Lord Weymouth, where it hath produced ripe seed for several years."

and Miller says that at Mersham le Hatch, near Ashford, Kent, then the property of Sir Wyndham Knatchbull, and still held by his descendant of the same name, it produced, as early as 1726, good seed from which many of the trees in England were raised. I have been unable to find any trees either at Badminton or at Longleat which can be certainly looked on as the original trees;¹ but there are many places in England where trees dating from at least the middle of the 18th century still survive, and some of these, as will be shown later, are of great size.

The tree is apparently at home on all good deep sandy soils, and when not too dry, grows vigorously for 100 years or more in all the southern half of England; ripening seed in most seasons and often reproducing itself naturally; but in Scotland it does not seem to thrive so well, probably on account of insufficient heat in summer. I do not, however, think that it is likely in any part of Great Britain to prove a profitable forest tree in comparison with Scots or Corsican pine, as the value of its timber depends on climatic and soil conditions rarely found in this country.

The Weymouth pine has been extensively planted in Germany, there being, for example, 3,000,000 trees in the state forests of Bavaria. In central Europe, it is remarkably hardy, as it is not injured by the severe winter climate, never suffers from spring or autumn frosts, and is not easily broken by heavy snow. It is considered, on account of the abundant fall of its soft needles, which speedily decay, to be a better soil-improver than any European pine. Slow in growth during the first five years, it attains about the same height as the Scots pine in the twentieth year, and exceeds the latter species considerably in height and diameter growth after this period. Dr. L. Wappes,² a Bavarian forester, states that it seeds early and heavily, is readily reproduced naturally,³ withstands crowding and shading, and produces even on poor soils a large amount of timber. On very inferior soil in the Palatinate, pure plantations, 104 years old, yielded per acre, 13,000 cubic ft. of timber, exclusive of branches and stumps. In spite of such results, much exceeded on loamy sands at other stations in Prussia and Thuringia, it is doubtful if this tree will be planted extensively in the future. It is much subject to the attacks of fungi, many plantations being ruined by *Agaricus melleus* and *Peridermium Strobi*, while deer bite the shoots and gnaw the bark, injuring many trees in the German forests.

The timber produced in central Europe appears to be as good as that of America, and Wappes states that though little valued at first, it is now readily saleable, the price in 1899 being double that of 1882. Mayr⁴ gives an instructive comparison of the wood of two trees, one 87 years old, grown in Bavaria; the other, 138 years old, grown in Wisconsin. The specific gravity of both was identical; and the Bavarian

¹ Forbes, in *Pin. Woburn.* 83 (1839), says: "The original tree, first brought to England by Viscount Weymouth, is now standing, though perfectly decayed, in a timber grove at Longleat." According to *Museum Rusticanum*, iv. 381 (1765), gold and silver medals were offered by the Society for the Encouragement of Arts, in 1765 and succeeding years, for plantations of Weymouth Pine. According to Dillwyn, *Hortus Collinsonianus*, 40 (1843), Bartram sent a small tree to Collinson in 1737, which was growing at Mill Hill in 1756, when it was 40 ft. high.

² The articles on the cultivation of this pine in Germany, which Dr. Wappes published in Lorey's *Allgemeine Forst- und Jagdzeitung* for 1899, are abstracted by Spalding, in *U.S. Forestry Bulletin*, No. 22, *The White Pine*, p. 68 (1899).

³ Unwin, *Future Forest Trees*, 90, fig. 1 (1905), gives a good picture of natural reproduction of the Weymouth pine in the Rhine Palatinate.

⁴ *Fremdländ. Wald- und Parkbäume*, 378 (1906). Mayr's article on "White Pine in Europe," published in *Garden and Forest*, 1888, p. 10, should also be consulted.

tree excelled in having a less proportion of sapwood. These two trees contained nearly the same percentage of resin; and Mayr's researches have shown that the wood of the Weymouth pine contains more resin than that of Scots pine, larch, spruce, or silver fir. He considers that its qualities of lightness and softness, for which it is esteemed in America, render it useful for many purposes, for which it is better fitted than any European species.

In Belgium the finest specimens of the Weymouth pine are a group of seven trees standing close together in good soil beside a pond on the farm of St. Michel, in the western Ardennes, not far from St. Hubert. These are growing at an altitude of 1000 ft., and the largest measured in 1909, when they were seen and photographed by Henry, 110 ft. high and 8 ft. 8 in. in girth. They have produced seed freely from an early period, and there are many seedlings of different ages in the vicinity, some, believed to have been of this source, being as far away as two miles to the westward. The dry easterly winds open the cones, and distribute the seeds to a great distance. To the eastward of the tree the seedlings, though numerous, only extend about 200 yards. The older trees are not attacked by the "rouge" (*Peridermium Strobi*¹), but many of the younger trees are affected. This pine succeeds well at considerable elevations in the Ardennes, and would be a desirable acquisition were it not for its liability to disease.

This tree grows well as far north as Christiania, where I have seen in the grounds of Baron Wedel Jarlsberg at Bogstad a healthy specimen about 90 ft. high, with a clean trunk of about 12 ft. in girth. According to Schübeler, it has been planted at many places on the coast as far north as Trondhjem, and in Sweden as far as 64° N.

On the Isola Bella, in Lago Maggiore, I saw in 1906 a fine tree, 98 ft. by 10½ ft. and covered with cones, which is said to have been brought from Paris in 1815.

REMARKABLE TREES

By far the largest tree of which we have an exact record, grew in a sheltered valley at Ironmill Wood not far from Tortworth, Gloucestershire, and, as I learn from the Earl of Ducie, was measured² in 1864 by Sir Joseph Hooker and Professor Balfour, who made it about 114 ft. high by 10½ ft. in girth. It was blown down in 1875 when it was believed to be about 105 years old, and measured 122 ft. high and 46 ft. to the first branch, containing no less than 324 cubic feet of good timber, which was cut up and used on the estate.

The next largest is a tree at Stowe, probably at least 150 years old, which in 1905 when I measured it, was 104 ft. high by 13 ft. 2 in. in girth at 3 ft., where the stem divides into several massive ascending limbs.

At Pains Hill, Surrey, there is a remarkable old tree with very spreading branches, not mentioned by Loudon, which in 1904 was about 90 ft. high by 12 ft. 8 in. in girth.

¹ This fungus was first noticed in England, in 1892, at King's Lynn. Cf. Plowright, in *Gard. Chron.* xii. 133, figs. 22, 23 (1892); xiii. 425 (1893); xxvi. 72, 94 (1899). Dr. Somerville, in *Quart. Journ. Forestry*, iii. 232 (1909), gives an account of its ravages in late years.

² In *Gard. Chron.* 1853, p. 725, this pine was reported to have been planted in 1772; and it measured in 1853, 114 ft. by 9 ft. 10 in.

At The Grove, Herts, there are two large rough and branching old trees, one of which Henry in 1904 found to be 96 ft. by 12 ft. 2 in. Another at Cassiobury Park measured 102 ft. by 8½ ft. in the same year.

In the Belvedere plantation, Windsor, there are a number of fine Weymouth and Scots pines planted about 1760, according to Menzies, though Mr. Simmonds, who showed them to me, thought that they may be older. The best of the former measure about 100 ft. by 9 ft., are clean for half their length, and are little if anything less in size than the Scots pine presumably of the same age.

At Hollycombe, Sussex, the seat of J. C. Hawkshaw, Esq., there are some of the cleanest and best grown trees of their age in England growing among larch near the entrance to the lodge. The best I measured was over 100 ft. high by 8½ ft. in girth, and contained 120 to 150 ft. of timber. Mr. Hawkshaw informs me that these trees are about 100 years old.

At Woburn Abbey this tree has been planted to some extent on sandy soil, which suits Scots pine very well, but which is apparently too dry for *P. Strobus*. On the Green Drive there are some large old trees left, of which the best measured in 1908 about 90 ft. by 7½ ft., but the majority have died or been felled; and the self-sown seedlings which are numerous in the plantation are mostly suffering from the attacks of a species of Chermes.¹

At Arley Castle there is a tree 95 ft. by 11 ft. 4 in. in 1905, which is perhaps not over 80 years old. At Ombersleigh Court, the seat of Lord Sandys, a tree, with large branches forking low down, in 1906 was 90 ft. by 16½ ft. near the ground.

At Nuneham Park, Oxford, a tree with a clean stem, was 95 ft. by 7 ft. 9 in. in 1908. At Burwood House, near Cobham, Surrey, Mr. R. Woodward in 1903 measured a tree 92 ft. by 8 ft. 3 in. A tree in a field near Coombe Bank, Sevenoaks, was 80 ft. by 9 ft. 8 in. in 1904.

At Black Park, near Slough, the property of Sir R. Harvey, Bart., in a dense wood of Scots pine near the upper end of the lake, there is a very fine Weymouth pine growing on moist sandy soil, which, when I measured it in 1908, was about 110 ft. high by 9 ft. in girth; the stem forking at 58 ft. from the ground contains about 200 ft. of timber.

At Gwydyr Castle, N. Wales, the property of Earl Carrington, there are several large clean trees growing in a wood, with stems clean to a considerable height, which I saw in 1906 and found to be from 100 to 110 ft. high and 9 to 10 ft. in girth.

The largest in Scotland of which I have certain knowledge is one of nine trees on the banks of the Almond, at Logiealmond, the property of the Earl of Mansfield. Mr. A. Kinnear has recently measured these, and informs me that the largest is 94 ft. high and 7 ft. 9 in. in girth, with a cubic content of 119 ft. over bark. The remaining eight are from 60 to 80 ft. high, growing on a steep bank of light, dry soil, facing west.

¹ Gillanders, *Forest Entomology*, 331, 336, fig. 307 (1908), says that *Chermes corticalis*, Kalt., is common in the south of England, and is said to do great injury to the trees. The stems attacked resemble in appearance those of beech trees, affected by *Cryptococcus Fagi*; but the two insects have no connection whatever, although on one occasion the absurd proposal was made to cut down Weymouth pines to prevent the extension of the beech disease on a certain property. This aphid is also harmful to the Weymouth pine in Germany.

Sir Herbert Maxwell reports¹ a very large tree at Dunkeld, 13 ft. 3 in. in girth. At Keir, Perthshire, there is a tree 59 ft. by 6 ft. 11 in., which was reported² at the Conifer Conference in 1891 to be 40 years old, and 46 ft. by 6 ft.

In Ireland, there are two fine old trees, both about 80 ft. by 7½ ft., at Woodstock; and a tree at Muckross, Kerry, was in 1908 about 65 ft. high, and 8 ft. in girth. Another at Coolattin, Wicklow, was 73 ft. by 7 ft. 7 in. in 1906; but the forester here reported that larger trees were to be found on this property, where this species thrives, and produces valuable timber.

TIMBER

The wood of the white pine is, in Sargent's words,³ "light, soft, not strong, close, straight-grained, very resinous, easily worked, light brown, often tinged with red, with thin, nearly white sapwood, weighing only 24 pounds to the cubic foot when quite dry."

For a century or more it has played a conspicuous part in the material development of the United States and Canada. "Great fleets of ships and long railroads have been built to transport the lumber sawn from its mighty trunks, men have grown rich by destroying it, building cities to supply the needs of their traffic, and seeing them languish as the forests disappear." Fifty years ago the supply seemed inexhaustible, and for a long period the price of white pine lumber governed that of most other woods, whilst it formed a basis of comparison for the quality of other kinds of trees.

Now the best sources of supply are so much depleted that though, in Michaux's time, three-quarters of the houses, except in the great cities, were built mainly of white pine, it has become so scarce and risen so much in price that Canadian forests are largely purchased by American lumbermen to supply their own needs, and the export to Europe has very much diminished.

Much of what still comes is moreover cut from smaller and younger trees, often of second growth, and is inferior in quality to that which gave its reputation, and which was preferred to all others on account of the facility with which it worked up for all domestic purposes.⁴

Laslett, as timber inspector to the British navy at a time when ships were still built of wood, gives numerous details⁵ of the experiments which were made on its strength, elasticity, and durability, and states that it was used for masts, yards, bowsprits, and in the form of deals, but says it was not strong enough for light spars subject to great and sudden strains, for which it was inferior in strength and durability to Oregon fir.

Mr. Weale of Liverpool writes to me as follows:—"It is the most generally useful of all the pines, and is largely exported to Europe. As a building timber it is

¹ *Memories of the Months*, 3rd series.

² Erroneously named *P. Lambertiana*, in *Journ. Roy. Hort. Soc.* xiv. 531 (1892).

³ *Silva*, xi. 19 (1897).

⁴ *Popular Science Monthly*, xxviii. 682.

⁵ *Timber and Timber Trees*, 356-66 (1894).

durable for such purposes as windows and doors, but deteriorates if exposed to alternate heat and damp. It is in favour for the inside linings of furniture, but for this purpose is rapidly giving place to the American whitewood, *Liriodendron tulipifera*, the latter having a lower price to recommend it. For pattern-making, the yellow pine¹ is preferred to all other woods, being soft, easily worked, straight-grained, and of a mellow texture. Its value has been steadily advancing for some years, the fine trees producing the best timber becoming scarce in the more accessible districts, and a great and growing demand from the United States, being the chief reasons. The first quality wood in 1905 was 20 per cent greater in price than ten years previous. It is generally imported into Europe in the form of sawn deals, and the disposal in England is practically in the hands of two firms." (H. J. E.)

PINUS PARVIFLORA, JAPANESE WHITE PINE

Pinus parviflora, Siebold et Zuccarini, *Fl. Jap.* ii. 27, t. 115 (1844); Syme, in *Gard. Chron.* x. 624, f. 103 (1878); Engelmann, *Revision Genus Pinus*, 178 (1880); Masters, in *Journ. Linn. Soc. (Bot.)* xviii. 504 (1881), and xxxv. 578 (1904); Mayr, *Abiet. jap. Reiches*, 76, t. v. f. 19 (1890), and *Fremdländ. Park- u. Waldbäume*, 386 (1906); Kent, *Veitch's Man. Conifera*, 353 (1900); Clinton-Baker, *Illust. Conif.* i. 40 (1909).

A tree attaining in Japan in favourable situations 100 ft. in height, but usually smaller. Bark smooth and greyish for many years, ultimately becoming on old trunks darker in colour and fissuring into small scales. Buds ovoid, less than ¼ in. long, not acuminate at the apex, light brown, slightly resinous, with some of the scales free at the tips. Young branchlets smooth, greyish, with a scattered minute pubescence.

Leaves in fives, persistent for three years, spreading, about 2 in. long, curved, usually blunt at the apex, serrulate, with the inner flat surfaces marked by three or four white stomatic lines; resin-canals two, marginal; basal sheath ½ in. long, early deciduous.

Cones sub-terminal, sessile, spreading, in clusters of three or four, ovoid-conic, 2 to 2½ in. long; scales spreading widely when open, woody, about ¾ to 1 in. long and ½ to ¾ in. wide, convex from side to side, thin in margin; apophysis thickened, incurved in the centre of the rounded broad upper margin, with a minute dark-coloured or resinous umbo. Seed obovoid, ⅜ in. long, ⅓ in. wide, compressed, brown; wing short and broad, scarcely exceeding ¼ in. long, usually left in part on the scale when the seed falls. Cotyledons 8 to 10. Seedlings very slow in growth for several years.

Var. *pentaphylla*.

Pinus pentaphylla, Mayr, *Abiet. jap. Reiches*, 78, t. vi. f. 20 (1890), and *Fremdländ. Park- u. Waldbäume*, 377 (1906); Kent, *Veitch's Man. Conifera*, 356 (1900); Masters, in *Journ. Linn. Soc. (Bot.)* xxxv. 577 (1904).

In the northern part of Hondo, Yezo, and the Kurile Isles the tree bears more

¹ The timber when imported is known as *yellow pine*, a name used in America for other species, and liable to be confused with yellow deal, a London trade name for the timber of Scots pine from the Baltic.

pendulous larger cones,¹ up to $3\frac{1}{2}$ in. in length, and seeds with a longer wing, up to $\frac{1}{2}$ in. in length. Mayr considers this variety to be a distinct species; but there is great variation in the size of the cones and in the length of the seed-wing; and we have found no constant characters by which the wild and cultivated specimens that we have examined could be clearly separated into two distinct groups. There is no difference in the foliage or the branchlets.²

This species³ is a native of Japan and the Kurile Islands; the typical form, according to Mayr, being restricted to southern Hondo, Shikoku, and Kiusiu, where it either grows scattered in the beech and chestnut forests, or forms large woods in company with Tsuga. In Kiso he found single trees in woods mainly composed of *Cupressus obtusa*. Sargent⁴ says it is a common inhabitant of mountain forests above 5000 ft. elevation, usually occurring singly or in small groves, occasionally reaching a height of 60 or 70 ft., and overtopping the deciduous trees by its handsome head of long, graceful, somewhat pendulous branches. Mayr, however, says that it attains 100 ft. in favourable situations.

The large-coned variety is the prevalent, if not the only form found north of lat. 35° , where it is met with in the great central chain of Hondo, being very common in Kotzuke. Mayr states that it is always found in the broad-leaved forest, never ascending into the fir region, and becoming in deep valleys a tree of the first magnitude, but in elevated regions scarcely higher than 50 or 60 ft. Faurie⁵ collected it on the precipitous mountains of Aomori, and Sargent⁴ states that it is a rare inhabitant of the mountain forests of southern Yezo.

This species is known in Japan both as *himeko-matsu* and *goyo-matsu*, the former name being restricted in books to the type, and the latter being assigned to var. *pentaphylla*; yet, as is acknowledged by Mayr, in the mountains of the interior the colloquial usage varies, showing that there is little or no difference between the two forms, which only vary in the size of their cones. This pine is cultivated in pots everywhere in Japan, being dwarfed and distorted in many ways. The timber is little used.

(A. H.)

I saw this tree in the forest above Agematsu in Kisogawa, at an elevation of about 3000 ft.; and, as I noted at the time, it looked so peculiar in habit and bark, that until I got the leaves and cones I could not believe that it was a pine. The illustration which I give of this tree (Plate 274) was taken for me by Mr. Masuhara of Tokio, and would, I think, be generally taken for a cypress. It was growing alone in a grassy valley, and though not of very large size seemed to be an old tree. In this part of Japan it is scattered here and there among deciduous trees and is not gregarious.

¹ Cones collected in Yezo by Maries in 1879 and by J. H. Veitch in 1892 are preserved in the Kew Museum, and though larger than those from other localities, differ in no essential character.

² Mayr says that in *P. pentaphylla* the branchlets are glabrous, but in the Yezo specimens which we have seen they are distinctly pubescent. In the northern tree, according to Mayr, the bark separates into larger scales.

³ This species is represented in Formosa by a closely allied species, *P. formosana*, Hayata, in *Journ. Coll. Sc. Tokyo*, xxv. 217 (1908), referred to in *Gard. Chron.* xliii. 194 (1908) as *P. morrisonicola*, Hayata. The Formosan tree has longer leaves (3 to 4 in.) and larger cones, with strongly reflexed scales.

⁴ In *Garden and Forest*, viii. 306 (1895) and x. 461 (1897).

⁵ Cf. Masters in *Bull. Herb. Boissier*, vi. 270 (1898).

CULTIVATION

*P. parviflora*¹ was introduced into cultivation in England by John Gould Veitch in 1861. In England, as is the case in Japan, it bears cones at an early age, which render it rather unsightly as an ornamental tree. The seeds ripen early in the season, and are eaten by finches with great avidity. Seedlings have been raised from home-grown seed. The largest tree that I have seen is one at Wilton House which in 1906 was 36 ft. by $3\frac{1}{2}$ ft. At Eggesford, in Devonshire, it forms a large spreading bush. At Blackmoor, at Westonbirt, and many other places I have seen very similar specimens, of from 20 to 30 ft. high, on lawns, and except as a purely ornamental tree it has no value whatever.

At Grafrath, near Munich, the tree is rather fast in growth, and perfectly hardy; but it suffers much from attacks of *Agaricus melleus*.

In New England,² *Pinus parviflora* grows rapidly, and resists the most severe cold. There are specimens 20 to 25 ft. in height, which produce cones in profusion.

(H. J. E.)

PINUS CEMBRA, ALPINE PINE

Pinus Cembra, Linnæus, *Sp. Pl.* 1000 (1753); Loudon, *Arb. et Frut. Brit.* iv. 2274 (1838); Murray, in Lawson, *Pinet. Brit.* i. 17, t. 3 (1884); Willkomm, *Forstliche Flora*, 169 (1887); Mathieu, *Flore Forestière*, 622 (1897); Kent, Veitch's *Man. Coniferae*, 317 (1900); Masters, in *Journ. Lin. Soc. (Bot.)* xxxv. 583 (1904); Kirchner, Loew u. Schröter, *Lebensgeschichte Blütenpfl. Mitteleuropas*, i. 241 (1905); Clinton-Baker, *Illust. Conif.* i. 14 (1909).
Pinus sibirica, Mayr, in *Allgem. Forst- u. Jagdzeitung*, 1900, ex *Fremdländ. Wald- u. Parkbäume*, 388 (1906).

A tree attaining about 130 ft. high in Siberia and 70 ft. in central Europe. Bark of young trees greenish grey, smooth or warty, with resin blisters; on old stems reddish grey, and dividing into thin scaly plates. Buds ovoid, resinous, about $\frac{1}{2}$ in. long, acuminate at the apex, the long subulate free points of the scales being usually appressed together and not spreading as in *P. koraiensis*. Young branchlets with prominent pulvini, and densely covered with an orange-brown shaggy tomentum. Older branchlets roughened by scars and dark in colour.

Leaves³ in fives, persistent three to five years, densely crowded, more or less spreading or appressed and nearly parallel to the branchlets, $2\frac{1}{2}$ to $3\frac{1}{2}$ in. long, slender, curved, acute or acuminate at the apex; margin with fine and not very close serrulations, which are not continued to the extreme tip; dark green, with inconspicuous whitish stomatic lines on the two inner surfaces; resin-canals three, median.

Staminate flowers sessile, about $\frac{1}{2}$ in. long, yellow; connective violet, serrulate. Young cones, violet, nearly $\frac{1}{2}$ in. long, erect, solitary, or in whorls of two to six.

¹ Cf. *Gard. Chron.* 1861, p. 265. The cones collected by J. Gould Veitch in 1860, figured by Murray in *Proc. Hort. Soc.* ii. 272, fig. 13 (1862), as well as those collected by Maries in 1879 and by J. H. Veitch in 1892, came from Yezo, and are those ascribed to var. *pentaphylla*. From the seeds of these cones some of the trees in cultivation in this country are derived, yet these invariably bear short cones, like those of the typical form described by Siebold. Similarly, in the Arnold Arboretum, a small tree of *P. pentaphylla*, raised from Yezo seed, has borne short cones.—(A. H.)

² *Garden and Forest*, viii. 306 (1895) and x. 461 (1897).

³ The leaves emit, especially in summer, a very agreeable peculiar odour. Cf. *Gard. Chron.* xx. 301, 309 (1883).

Cones subterminal, short-stalked, never opening, spreading, ovoid, obtuse at the apex, 2 to 3 in. long, $1\frac{1}{2}$ to 2 in. wide, greenish with a violet tinge before ripening, brown when mature. Scales numerous, scarcely woody, brittle, about 1 in. long and $\frac{3}{4}$ in. broad; apophysis, bent at nearly a right angle to the concealed part of the scale, with semicircular, sharp, and bevelled margin, and minutely tomentose outer surface; umbo terminal, thickened, triangular or rounded.

Seed obovoid, about $\frac{1}{2}$ in. long, dull brown, convex on the lower, flattened on the upper surface, with rounded and scarcely sharp angled sides, wingless,¹ edible. These are distributed by nutcrackers, squirrels, and dormice, who break the scales of the cone, which never open, and carry away the seeds to their larders or holes; and as some are often dropped by the way, seedlings are observed in the Alps and elsewhere at a considerable distance from the parent tree.

VARIETIES²

1. Var. *sibirica*, Loudon (*Pinus sibirica*, Mayr³). The tree occurring in Siberia is scarcely to be distinguished by any definite morphological characters from the typical form of central Europe (var. *helvetica*, Loudon), though Willkomm and others state that it has longer cones and larger seeds. The physiological differences are, however, considerable, as the Siberian tree attains a much greater height, forming a narrow pyramidal tree, like *P. Strobus* in habit; and is faster in growth in the young stage, with longer shoots, and more branchlets developed in each whorl. These differences are preserved in trees growing in severe climates, like Scandinavia and Germany; but in this country the Siberian variety is very slow in growth, and does not appear to be long-lived.

2. Several varieties of horticultural origin have been described, as var. *aurea*, *Kew Handlist of Conifera*, 127 (1903), and a dwarf form and a single-leaved form, mentioned by Carrière in *Conif.* 389 (1867).

DISTRIBUTION

This species occurs in two distinct regions, one embracing a vast area in Russia and Siberia, and the other confined to narrow limits in the Alps and Carpathians. In Europe it is widely spread in isolated tracts throughout nearly the whole of the Alps, scarcely ever descending⁴ below 5000 ft., and reaching timber line in different places at 6200 to 8000 ft. elevation. In France it is called *arole* or *auvier*, and is confined to the northern part of the Maritime Alps, the high peaks of Dauphiné, the Graian Alps, and Mont Blanc. In the Maurienne, close to Modane, it is well seen in the wild forest of Villarodin Bourget, where it begins at about

¹ Kirchner, *op. cit.* 270, fig. 136, describes and figures the vestiges of the rudimentary wing, which remains attached to the scale.

² Var. *pumila* is now considered to be a distinct species, *P. pumila*, Regel. (See p. 1045.)

³ Mayr relies on trifling differences in the colour of the leaves, and in the shape and colour of the buds, characters which I have not been able to verify. The two trees, one of Swiss, and the other of Siberian origin, in the Christiania Botanic Garden, though strikingly different in habit, show no differences in leaves, buds, or branchlets.

⁴ The lowest altitude, according to Dr. Rikli, is 4000 ft., near Raron, in the upper Rhone valley.

5000 ft., where *Pinus sylvestris* and *Abies pectinata* cease to grow, and is common mixed with larch and spruce at about 6000 ft., assuming in this dense part of the forest a narrow pyramidal form. Higher up, at about 7000 ft., it grows nearly pure in groups, scattered amidst rhododendrons, where seedlings are numerous, and is of a much more branching and picturesque habit, while far above on the rocky crests up to 8000 ft. isolated and broken trees are visible on the sky line. The largest specimens, which are at about 7000 ft., are of great girth, one tree which I saw in 1904 measuring 5 ft. in diameter, and dividing at 8 ft. from the ground into two stems. It is about 60 ft. high. Taller trees, up to 70 or even 80 ft., but of lesser girth, occur at the lower levels. Still larger specimens are said to exist in the forest of Arvieux in the same district.

In Switzerland¹ the tree is usually called *Zürbel*, *Zirbe*, or *Arve*; but is named *Schember* in the Engadine, which corresponds to the Italian name *zembra* or *zimbro*. The most extensive woods occur in the great central chain, as in the Pennine Alps and in the Engadine, though the tree is nearly extinct in Tessin; whilst smaller woods and scattered trees are met with in the limestone Alps from Vaud and Freiburg to Chürfürsten in St. Gall. From here the distribution extends through the Bavarian Alps to Salzkammergut, whilst it is continued through the Tyrol in the main chain to Gamstein, on the Styrian frontier, its most northern and eastern station in the Alps. In the southern Alps the tree grows here and there from Mt. Adamello in the Tyrol to Bleiberg in Carinthia and the Steiner Alps in Carniola. Throughout the Alps *P. Cembra* is seen on all formations—granite, slate, limestone, dolomite, etc.—but it thrives best and forms the largest woods on moist soils containing a considerable amount of clay, and remains stunted on dry limestone.

(A. H.)

In the Swiss Alps it is becoming in most places a scarce tree,² as the wood is in great request for carving, and the seeds are mostly eaten by mice and birds. But in the high Alps on the south side of the Valais many fine old trees may yet be seen.

A very beautiful one is shown in Plate 275, which is reproduced from a negative lent me by M. Coaz, Chief Inspector of the Swiss Government Forests, and forms plate xvi. of *Les Arbres de la Suisse*. It grows at Muotta da Celerina, near Pontresina, on a formation of mica schist and syenite rocks, at an elevation of 2120 metres, and measures 15 to 16 metres high, with a girth of 4.20 metres. It is divided into three principal stems, with many great branches, which extend to a diameter of $16\frac{1}{2}$ metres, and is surrounded by numerous seedlings, which often grow from seeds dropped by the nutcracker (*Nucifraga caryocatactes*).

By far the best illustrations that I have seen of this tree in its native Alps are a series of twelve plates (27 B to 36 B) in *Vegetationsbilder* 11 (1905), by Dr. L. Klein. Of these the most remarkable is a tree broken off at a few feet up, where it measures $4\frac{1}{4}$ metres in girth, with eight ascending candelabra-like branches. This grows at

¹ A very complete account of this pine in Switzerland has lately been published by Dr. M. Rikli, *Die Arve in der Schweiz*, pp. xi + 455, with 21 maps and 60 illustrations (Georg et Cie, Basel, 1909). A review of this important work is given in *Nature*, lxxxii. 399, figs. 1, 2 (1910).

² This species, according to Kirchner, *op. cit.* 250, was formerly much more widely spread in the Alps and Carpathians than it is at the present time.

2300 metres behind the Findelen Hotel, on the Riffel Alp. Another decayed tree grows near it, measuring, close to the ground, no less than 7.67 metres (about 25 ft.) in girth, which Dr. Klein computes, from a careful counting of the rings in other trees, to be from 1000 to 1100 years old, and considers to be the oldest recorded tree of the species in Switzerland.¹

In the Carpathians² the woods of *P. Cembra* are smaller in extent and less frequent than in the Alps, occurring from the Tatra mountains in the north to Baiku in Banat, and ranging from 4200 to 7500 ft. altitude.

In north-eastern Russia *P. Cembra* occurs in the plains of Vologda, Viatka, and Perm, to the eastward of a line drawn from the source of the river Vaga to the middle reach of the Petchora in lat. 65°, and often forms extensive forests of tall trees, without a branch to 70 or 80 ft., which are seldom, however, cut for their timber. In the Ural mountains its range is from lat. 64° to lat. 55°.

In Siberia this species occupies a wide territory, its northern limit crossing the Obi at lat. 66°, the Yenisei at 68°, the Lena at 60°, and the Aldan at 55°, and it does not appear to extend farther east than long. 130°, being replaced by *P. pumila* in north-eastern Siberia and Kamtschatka, and by *P. koraiensis* in Amurland, Manchuria, and Korea. The southern limit, beginning in the Ural at lat. 55°, crosses the plain to reach the Alatau, Altai, and Sayan mountains, and, passing south of Lake Baikal, ends in north-eastern Mongolia.³

In the Ural Mountains this tree is abundant, though I did not see it myself so far south as the line of the Siberian railway. It occurs in the neighbourhood of Ekaterinburg, where Pallas first described it.⁴ He called it the Siberian cedar or pine of Liban, probably confusing it with the true *Cedrus Libani*. He says that it grows so slowly that in a tree only 5 in. 4 lines in diameter he counted sixty-two rings, whilst a larch of fifty-nine years old was only 5 in. 9 lines in diameter. He further states that in the Ural it only produces much seed when two wet seasons occur in succession, and that in marshy places it grows to a much greater size than on the mountains.

Ledebour⁵ says that in the south-western Altai this tree ascends from about 4500 ft. to the timber line, which is here about 6500 ft., but this is not the case in the more eastern district of the Altai which I visited, and where, probably on account of the much drier soil, I saw few or no *Pinus Cembra* in the Katuna and Tchuja mountains. But on my return journey it formed a considerable part of the forest on the steep mountains forming the southern shore of the north end of Lake Teletskoi, mixed with *Abies sibirica*, and was frequented by flocks of nutcrackers, which were feeding on its seeds. These seeds are a favourite article of food in Siberia, as well as in the Ural, and were sold in the market at Barnaoul in September.

¹ Cf. Correvon in *Gard. Chron.* xvii. 80, fig. 12 (1882), who figures an old tree in the Tyrol, about 7 ft. in diameter.

² Cf. Pax, *Pflanzenverh. Karpathen*, i. 126 (1898), and ii. 247 (1908). Heuffel saw, just below the alpine pasture of Baiku, the only grove of *P. Cembra* in the whole territory of the Banat Alps. According to Golesco, in *Bull. Soc. Dend. France*, 1907, p. 178, it occurs as a scattered tree in the *P. montana* belt of the mountains of the Muscel district in Roumania.

³ Radde, *Reisen im Süden von Ost-Sibirien*, 117 (1861), gives the limit of elevation in the East Sayan as 7095 ft. On the mountains of N.W. Mongolia at Sochondo it only attains 6500 ft.

⁴ Pallas, *Voyages*, ii. 252 (1789).

⁵ *Reise Altai Gebirge*, i. 345-9 (1829). Ledebour, *op. cit.* 144, mentions a tree in the south-west Altai at 5700 ft. altitude, which measured 13 ft. 8 in. in girth at a foot from the ground.

CULTIVATION

According to Hempel¹ the ripe seeds of the Cembra pine fall with the cones in the early spring, and as a rule lie a year before germinating; but a small proportion of the seeds that I have sown have germinated in England in the first season, and some will remain two or even three years before coming up.

The seedling has nine to twelve, usually ten cotyledons, and makes but a short shoot in the first year. As mice and birds will probably devour the seeds unless protected, it is best to sow them in boxes filled with rich light sandy soil, and covered with fine wire netting. The seedlings should remain two or three years in the boxes, and will require three to five years or more in the nursery before they are large enough to plant out.² They are not often injured by spring frosts, but appear to dislike lime in the soil, and the seedlings which I raised from seed brought from Siberia all died at Colesborne, though one which I planted on sand in Norfolk grew much better.

Though a native of climates where the summer is extremely short, and growing naturally on dry rocky situations, the tree seems to want good and fairly deep soil to develop into a fine tree in England, and is usually a very slow grower,³ though when established it will make growths of 9 to 15 in. annually until it reaches 40 to 50 ft. in height. It does not seem so difficult to transplant as some pines.

REMARKABLE TREES

This tree is said by Loudon to have been introduced by Archibald Duke of Argyll in 1746; and one of the original seedlings mentioned as being at Whitton in 1838 still survives; and though somewhat crowded by other trees which have prevented it from branching in a natural manner, it is still fairly healthy and the tallest known to us in England, being 80 ft. by 5 ft. when measured by Henry in 1903.

At Walcot in Shropshire, the seat of the Earl of Powis, a large number of this species were planted, according to Lambert, about 1820, having been raised from Swiss seed some years previously; but when I visited this place in 1906 I could not find many survivors, though five or six handsome specimens remain in the grounds, the largest of which were 59 ft. by 8 ft. 11 in., 59 ft. by 8 ft. 10 in., and 65 ft. by 7 ft. 5 in. respectively.

At Oakly Park near Ludlow there is a very well-shaped tree, probably of the same age as those at Walcot, on a steep bank below the house, which, though difficult to measure accurately, is about 70 ft. by 8 ft. 4 in. The trunk of this is much cleaner than usual, and contains about 80 ft. of timber.

¹ Hempel u. Wilhelm, *Bäume und Sträucher des Waldes*, i. 175 (1889).

² In his garden at Stratton Strawless, Mr. W. J. Birkbeek showed me in 1907 some seedlings which he had raised from seeds gathered by him at Tolga Monastery in Russia, which were only about 3 in. high four years after sowing.

³ Correvon, in *Gard. Chron.* xvii. 80 (1882), states that seeds sown at Vevey, at 300 ft. elevation above Lake Geneva, and at a high altitude in the mountains, produced seedlings markedly different in their rate of growth. Those at the high elevation attained 8 ft. high, while those at Vevey were scarcely 3 ft. high at the same age.

At Barton, Bury St. Edmunds, there is a tree planted in 1825, which is 57 ft. by 5 ft. 1 in. At Linton Park, Kent, a tree which was the largest reported to the Conifer Conference in 1891, when it measured 68 ft., when I saw it in 1903 was only 70 ft. by 4 ft. 6 in., and did not look at all healthy.

At Woburn there is a very healthy specimen, branched to the ground, which in 1903 measured 53 ft. by 8 ft. 6 in. At Dropmore a tree said by Loudon to have been about 40 ft. high is now about 60 ft. At Osberton Hall, Notts, there is an old tree 50 ft. by 6 ft. 2 in.

At Essendon Place, Herts, Mr. Clinton-Baker in 1907 measured a specimen 60 ft. by 5 ft. 4 in. At Bayfordbury a tree planted in 1840, is now 41 ft. by 5½ ft.

In Scotland this tree does not seem to have been much planted at an early date, and I have heard of no trees of great age; but it seems to have been a great favourite with the late Queen Victoria and the Prince Consort, and a great number of thriving specimens are growing at Balmoral, where the soil and climate seem to suit it remarkably well, and where it ripens good seed. There is an avenue 12 yards wide from the stables to the back door of the castle, which Mr. Michie believes to be fifty years old, and the trees, planted 6 yards apart, averaged in 1904, 38 to 40 ft. high by 3 to 4 ft. in girth. A much larger tree grows on the north side of the castle, and a number of the trees planted by royal and distinguished visitors in memory of their visits are of this species. This seems to show what I have not noticed in England, that a cold climate and dry sandy soil are, as might be expected, favourable to the health of this tree.

At Abercairney, in Perthshire, Henry measured a tree 55 ft. high by 5 ft. 7 in. in girth; and Hunter records one at Cultoquhey near Crieff, planted out from a pot in 1826, which in 1883 was 40 ft. by 6¼ ft.

In Ireland the damper climate does not seem to suit it, as we have not seen any trees of considerable size.

A tree planted in the Park of Bogstad near Christiania, which Schübeler thought to be about 100 years old, and which he says was in 1885, 60 ft. high, was, when I measured it in 1903, about 85 ft. high with a trunk 10 ft. in girth, and divided at about 30 ft. into four stems. It is the largest cultivated tree that I have seen anywhere, and shows that it might prove a valuable forest tree in Norway.

There is in the Botanical Garden at Christiania a tree believed to be of the Siberian variety which looks healthier, and is growing faster, than the European form. When I saw it in 1903 it was growing at the rate of about a foot per annum, and according to Schübeler is now about forty-one years old. This variety was growing healthily but slowly at the forest nursery at Storgaard in the upper part of Saltdalen, latitude 67°.

TIMBER

The wood of this tree is almost unknown in England except in the form of carvings and toys, for which it is preferred in its native country to that of any other conifer, on account of its softness, density, and the absence of hard rings. It is, however, difficult to procure in large sizes without knots; and among a large

quantity of this timber which I saw at Innsbruck, I could not find a log that would cut into clean boards over a foot wide.

It is used in the Tyrol for wainscoting and domestic furniture on account of its durability and fragrance, which is said to endure for a very long period.

Seeböhm,¹ who found this tree growing on the Yenesei as far north as latitude 67½°, says that the timber has a much higher market value than that of *P. sylvestris*, and is the best timber found in Siberia. It is dark in colour, but not so dark as larch, and is reputed never to rot, shrink, warp, or crack. It is soft and easy to work, fine in grain, and almost free from knots. (H. J. E.)

PINUS KORAIENSIS, KOREAN PINE

Pinus koraiensis, Siebold et Zuccarini, *Fl. Jap.* ii. 28, t. 116 (excl. figs. 1-4) (1844); Masters, in *Journ. Linn. Soc. (Bot.)* xviii. 504 (1881), and xxxv. 582 (1904); Mayr, *Abiet. jap. Reiches*, 73, t. v. f. 18 and t. vi. f. 18 (1890), and *Fremdländ. Wald- und Parkbäume*, 386 (1906); Shirasawa, *Icon. Ess. Forest. Japon.*, text 12, t. ii. ff. 17-33 (1900); Kent, *Veitch's Man. Coniferae*, 334 (1900); Komarov, *Fl. Manshurica*, i. 183 (1901); Clinton-Baker, *Illust. Conif.* i. 28 (1909). *Pinus mandshurica*² Ruprecht, in *Bull. Phys. Math.* xv. 382, and *Mél. Biol.* ii. 567 (1857); Maximowicz, *Prim. Fl. Amur.* 263, 393 (1859), and *Mél. Biol.* xi. 349 (1881).

A tree, attaining in Manchuria 150 ft. and in Japan 100 ft. in height, with a trunk 9 ft. in girth, but usually considerably smaller. Bark reddish grey, not unlike that of a spruce, with scales about 4 in. long and 2 in. broad, the freshly peeled places being reddish brown in colour. Buds, ½ to ¾ in. long, cylindrical-ovoid, resinous, bristly at the apex, owing to the long subulate free points of the scales. Young branchlets covered with a reddish brown tomentum, and similar to those of *P. Cembra*, but with the pulvini less prominent; older branchlets brownish or grey, and much smoother than in that species.

Leaves similar to those of *P. Cembra* in number, size, persistence, arrangement, and structure; differing in the blunter apex,³ which is closely and sharply serrulate to the extreme tip, the apex in *P. Cembra* being long-acuminate, more remotely and less sharply serrulate, and often entire at the extreme tip as viewed with a lens. The leaves of *P. koraiensis* are whiter on the inner surfaces than in *P. Cembra*, the stomatic lines being more numerous and more conspicuous, and occasionally show a few broken lines of stomata on the outer surface near the apex.

Staminate flowers in clusters, ¼ in. long, pinkish. Female flowers upright, reddish, about an inch long, on stout stalks about ½ in. long.

Cones subterminal, but often becoming lateral by the growth of a summer shoot, on short stalks, ovoid-cylindrical, 5 to 6 in. long, and about 3 in. in diameter at the base, opening when ripe. Scales, 1½ to 2 in. long, 1 in. broad, woody;

¹ *Siberia in Asia*, 234 (1882).

² This is identical with *P. koraiensis*, as pointed out by Maximowicz, *Mél. Biol.* xi. 349 (1881); and this opinion is shared by Komarov.

³ In the apical centimetre of the leaf the serrations average seventeen in *P. koraiensis* and only four in *P. Cembra*.

apophysis shining brown, broadly triangular, reflexed in its upper third, tipped by a resinous thickened umbo. Seed $\frac{1}{8}$ in. long, $\frac{1}{2}$ in. wide, obovoid, sharply angled on the two sides and on the upper margin, wingless, brownish, edible.

This species closely resembles *P. Cembra*, though the cones are very distinct; but differs in the bristly buds, more silvery foliage, smoother branchlets, and faster growth in this country; and examination with a lens will show the different character of the apex of the leaf in the two species.

Var. *variegata*.¹—A form introduced from Japan, in which the leaves when young are yellowish white in colour, and said to be liable to injury if planted in a place exposed to full sunshine. Though mentioned in the *Kew Handlist*, we have seen no specimens of this variety.

DISTRIBUTION

Pinus koraiensis is widely distributed in eastern Asia,² occurring in Amurland, Manchuria, Korea, and Japan. It is not a native of China, being represented in that country by *P. Armandi*, with which it has been much confused by several authors.³

Its northern limit in Amurland is, according to Maximowicz, about $51\frac{1}{2}^{\circ}$ lat. in the interior in the Bureja range, and about 49° on the coast. In Manchuria, according to Komarov, it grows throughout the mountain forests, extending westward to the valleys of the Chun-dsien⁴ and Sungari rivers, and southwards to the middle valley of the Yalu river; often growing in extensive forests mixed with *Picea ajanensis*, *Abies holophylla*, and many species of deciduous trees, between 500 and 5000 ft. altitude. It attains a great size, up to 150 ft. in height, and the wood is highly valued by the Chinese settlers in Manchuria, and is exported for making coffins and for building purposes. Timber which we believe to be of this tree, resembling that of *P. Cembra*, has lately been imported from Nikolaievsk to London, and is considered likely to serve as a good substitute for the wood of *P. Strobus*, if it can be procured in quantity of a good size. In Korea the pine attains its southern limit in the district of Kang-ge, and was seen by Mr. J. H. Veitch in 1892 wild in various localities, notably in the Diamond mountains, where it is very abundant.⁵ The seeds, which are much used by the Koreans, have been sent to Kew by Consul Carles. They are known to the Chinese in the north as *Hai-sung-tze*.

This tree was long believed by the Japanese⁶ to be an exotic in Japan, brought from Korea by the soldiers who invaded that country. It is now known to be a native of the great forests of central Japan, where it usually grows mixed with deciduous trees, and occasionally ascends into the higher region of firs and spruces. Mayr saw large trees wild in Kiso and in the virgin forests of the mountains of Kotzuke. It is largely planted in Japan as an ornamental tree, the finest specimens

¹ *Gard. Chron.* i. 710 (1887).

² This species has been erroneously supposed to grow in Kamtschatka and the Karagin Island, where the only pine known is *P. pumila*, Regel. Cf. Maximowicz, *Mit. Biol.* xi. 349 (1881).

³ *P. koraiensis* is erroneously stated to be a native of China in Veitch's *Man. Conifera*, 335, in *Gard. Chron.* xxxiii. 34 (1903), *Journ. Bot.* 1903, p. 269, etc. Beissner's record of it from Shensi is also incorrect. Cf. synonymy given under *P. Armandi*.

⁴ An affluent of the Yalu.

⁵ Kent, Veitch's *Man. Conifera*, 335 (1900).

⁶ It is known in Japan as *Chosen-matsu*, i.e. Korean pine.

being reputed to be those in a temple grove at Chusenji near Nikko, which measure about 100 ft. in height and 10 ft. in girth, with clean stems of 30 to 40 ft.

CULTIVATION

This tree was introduced in 1861 from a Japanese nursery by J. Gould Veitch.¹ It appears to be perfectly hardy, but rather slow in growth. The best specimens known to us are growing in Ireland—one at Fota, which was, in 1903, 32 ft. high, with a girth of 2 ft. 2 in.; and another at Kilmacurragh, 40 ft. by 2 ft., in 1907, when it bore cones. A tree at Bicton, 34 ft. high by 2 ft. in girth in 1908, has produced cones, with fertile seed, from which a seedling was raised three years ago. A good specimen at Highnam, about 25 ft. high, was bearing cones in March 1910. Another at Grayswood, planted in 1882, is 24 ft. by 1 ft. 4 in.; and one at Tregrehan is 20 ft. by 1 ft. We know of none in Scotland.²

At Segrez in France there is a fine specimen, which in 1904 was 40 ft. high and 4 ft. in girth. It has peculiar epicormic branches on the trunk, and bears cones and good seeds, from which plants have been raised. At Ansorge's nursery, Flottbeck, near Hamburg, there is a tree 25 ft. high, which has produced fertile seed.

It is perfectly hardy in New England,³ and on account of its dense foliage is very ornamental. It produces freely cones and good seeds. The finest specimen, which is growing in Mr. Hunnewell's pinetum at Wellesley, Massachusetts, was 38 ft. high in 1905, and was bearing cones when I saw it in 1906. (A. H.)

PINUS ARMANDI

Pinus Armandi, Franchet, *Plantae Davidianae*, i. 285, pl. 12 (1884), and in *Journ. de Bot.* xiii. 254 (1899); Beissner, in *Mit. deut. dend. Ges.* 1896, p. 68, *Nuov. Giorn. Bot. Ital.* iv. 184, t. 5, f. 2 (1897), and *Bull. Soc. Bot. Ital.* 1899, p. 310; Masters in *Journ. Linn. Soc. (Bot.)* xxvi. 549 (1902), xxxv. 582 (1904), in *Gard. Chron.* xxxiii. 66, figs. 30, 31 (1903), and in *Journ. Bot.* 1903, p. 269; Clinton-Baker, *Illust. Conif.* i. 6 (1909).

Pinus Armandi, Franchet, var. *Mastersiana*, Hayata, in *Tokyo Journ. Coll. Science*, xxv. 216, fig. 8 (1908).

Pinus quinquefolia, David, *Voyage en Chine*, i. 192 (1875), and in *Nouv. Archiv. Muséum*, vii. 95 (1884).

Pinus scipioniformis,⁴ Masters, in *Bull. Herb. Boissier*, vi. 270 (1898).

Pinus koraiensis, Masters, in *Gard. Chron.* xxxiii. 34, figs. 18, 19 (1903), in *Journ. Bot.* xli. 269 (1903), and in *Journ. Linn. Soc. (Bot.)* xxxv. 582 (1904) (in part); Beissner, in *Bull. Soc. Bot. Ital.* 1899, p. 310; Diels, *Flora von Central-China*, 215 (1901). (Not Siebold et Zuccarini.)

Pinus Mastersiana, Hayata, in *Gard. Chron.* xliii. 194 (1908).

A tree, attaining 60 ft. in height, with smooth and greenish bark. Buds cylindrical, obtuse, either non-resinous and bristly with free long-pointed scales, or

¹ *Gard. Chron.* 1861, p. 1114; *Hortus Veitchii*, 90 (1906).

² The tree at Ochertyre, reported in *Journ. Roy. Hort. Soc.* xiv. 534 (1892) as being 13 ft. in height in 1891, cannot now be found, and may have been wrongly named.

³ *Garden and Forest*, 1897, p. 296.

⁴ This species is based on a specimen of *P. Armandi*, with young cones, collected by myself. The aberrant position of the resin-canals in some of the leaves, noticed by Masters, is not unusual. Cf. Franchet, *Journ. de Bot.* loc. cit.

resinous with appressed scales. Young branchlets smooth, olive green, glabrous or with minute scattered hairs, becoming dark grey in the second year. Leaves in fives, spreading, and often bent as in *P. excelsa*, 4 to 6 in. long, green on the convex surface, conspicuously white with stomatic lines on the two flat surfaces, serrulate; resin-canals usually median; basal sheath and scale-leaves early deciduous.

Staminate flowers cylindrical, $\frac{3}{4}$ in. long, yellow, with spatulate scarious scales at the base.

Cones sub-terminal, on stalks about an inch long, pendulous or spreading, cylindrical, but tapering to an obtuse apex, 4 to 7 in. long, 2 to 3 in. in diameter. Scales rigid, woody, about $1\frac{1}{4}$ in. long and 1 in. broad; concealed part broadly triangular, reddish brown; apophysis triangular, yellow, tipped with a minute brown mucro; apex of the scale rounded and not reflexed, or shortly cuspidate and slightly reflexed. Seed edible, wingless, $\frac{1}{2}$ in. to $\frac{5}{8}$ in. long, mottled black on the convex surface, dark brown on the flatter surface, girt all round with a very narrow sharp ridge.¹

This species² is variable in the size of the cones, and in the shape of the scales, which are, however, never so much reflexed at the apex as in *P. koraiensis*. The foliage resembles that of *P. excelsa*; but the resin-canals are marginal in the latter species. The grey-coloured branchlets, which are either glabrescent, or show under the lens a very scattered minute pubescence, are characteristic of *P. Armandi*; and are very different from the glaucous glabrous branchlets of *P. excelsa*, or the reddish brown tomentose branchlets of *P. koraiensis*.

This species is widely spread throughout the mountains of western China, at elevations of 4000 to 6000 ft., from lat. 34° in Shensi to lat. 23° in Yunnan. It usually grows on wooded cliffs or on rocky situations, scarcely ever forming pure woods, and seldom attaining more than 50 ft. in height and 6 ft. in girth. The wood is used for building and for the coarser kinds of furniture; and the edible seeds are sometimes sold in the markets. It is called *kuo-sung* (fruit-pine) in Yunnan, and *ts'ung* or *niu-sung* (cow-pine) in Hupeh. It is one of the remarkable discoveries made by Père David in his third journey through China in 1873, when he first saw it in the Tsin-ling range, south of the Yellow River in Shensi, where it has since been collected by Père Giraldi. It was subsequently found by Père Delavay and myself in Yunnan and Hupeh, and by Père Farges, von Rosthorn,³ and Wilson in Szechwan.

This species has lately been discovered by several Japanese botanists in Formosa, where it grows on Mount Morrison at altitudes ranging from 8000 to 10,600 ft. The Formosan tree bears cones with scales slightly reflexed at the tip, as is commonly the case in Yunnan specimens, and on that account has been distinguished as a variety⁴ by Hayata.

Père Farges sent seeds of this species in 1895 to M. Maurice L. de Vilmorin,

¹ This rim-like margin is absent in the seeds of *P. koraiensis*.

² Some of Père Giraldi's specimens, which I saw in the museum of Florence, have been considered by Beissner to be *P. koraiensis*, on account of their short leaves; but in the branchlets, cones, and seeds they are indistinguishable from *P. Armandi*.

³ Diels, *Flora von Central-China*, 216 (1901).

⁴ Var. *Mastersiana*, Hayata, in *Tokyo Journ. Coll. Science*, xxv. 216, fig. 8 (1908); *Pinus Mastersiana*, Hayata, in *Gard. Chron.* xliii. 194 (1908).

who informs me that the largest specimen raised from this introduction is growing at Harcourt (Eure), and is now about 8 ft. high, and producing annual shoots about a foot in length. There are smaller trees at Les Barres and Verrières. There are also specimens of the same origin at the Arnold Arboretum, and some of these sent by Professor Sargent in 1902 to Kew are only about $2\frac{1}{2}$ ft. in height. A tree from the same source planted at Colesborne in 1905 has gradually pined away, possibly on account of the limy soil.

The finest specimens of this species in cultivation are seven trees at Kew, which were raised from seed sent by me from Mengtse in Yunnan in 1897. They are 10 to 15 ft. high; and three of them bore fully developed cones in 1909. Wilson¹ sent seeds from Hupeh to the Coombe Wood Nursery in 1900, and the seedlings raised are about $2\frac{1}{2}$ ft. high and very flourishing. *P. Armandi* promises to be a valuable ornamental tree. (A. H.)

PINUS PUMILA

Pinus pumila, Regel, in *Cat. Sem. Hort. Petersb.* 23 (1858), and in *Bull. Soc. Nat. Mosc.* xxxii. 1, p. 211 (1859); Mayr, *Abiet. jap. Reiches*, 80, 103, t. vi. fig. 21 (1890); Komarov, *Fl. Mansh.* 189, 190, 214 (1901); Clinton-Baker, *Illust. Conif.* i. 46 (1909).

Pinus pygmaea, Fischer, ex Endlicher, *Syn. Conif.* 142 (1847).

Pinus Cembra, Linnæus, var. *pumila*, Pallas, *Flora Rossica*, i. 3 (1784); Kent, Veitch's *Man. Conif.* 318 (1900).

Pinus Cembra, Linnæus, var. *pygmaea*, Loudon, *Arb. et Frut. Brit.* iv. 2276 (1838); Fischer, in Middendorf, *Reise, Flora Ochot.* 88 (1856).

Pinus mandshurica, Murray, in Lawson, *Pin. Brit.* i. 61 (1884). (Not Ruprecht.)

A shrub, usually prostrate, and rarely if ever exceeding 10 ft. in height. Buds resinous, about $\frac{1}{4}$ in. long, cylindrical-conic, ending in a sharp-pointed apex; scales reddish brown, closely appressed. Branchlets covered with a dense brown tomentum. Leaves closely crowded on the branchlets and directed forwards, parallel with them, in fives, those in each cluster appressed together, incurved, $1\frac{1}{2}$ to 2, rarely 3 in. long, white with stomatic lines on the two inner surfaces, entire or faintly serrulate² in margin; resin-canals marginal; basal sheath entirely deciduous.

Cones never opening, sub-sessile, about $1\frac{1}{2}$ in. long and 1 in. in diameter, ovoid, often curved, reddish or orange brown when ripe; scales few, about $\frac{1}{10}$ in. broad, concave interiorly with a partition between the cavities for the seeds, upper edge sharp and bevelled; umbo terminal, darker in colour than the rest of the apophysis, ending in a minute, thickened, triangular, reflexed tip. Seed about $\frac{1}{4}$ in. long, pear-shaped, convex on the lower, and flattened on the upper surface, brownish, wingless, edible.

¹ Cf. *Hortus Veitchii*, 343 (1906). Seeds of this species, erroneously ascribed to *P. koraiensis*, were sent by Wilson in 1899 from Ynanchiang in Yunnan, but do not appear to have germinated. Kent, in Veitch's *Man. Conifera*, 335 (1900), also erroneously considers the Yunnan tree to be *P. koraiensis*.

² Specimens from Japan show both entire and serrulate leaves. Those from other regions have apparently always entire leaves. The cones are identical.

This pine, which always remains a shrub, is distinct from *P. Cembra*, in the small size and different shape of the cones and seeds, and in the position of the resin-canals in the leaves, which are shorter, and entire or serrulate in margin.

It is widely spread¹ in eastern Asia, occurring in Kamtschatka, Siberia to the eastward of Yakutsk, Amurland, northern Russian Manchuria, Saghalien, Kurile Isles,² and Japan. It is a native of very cold regions, growing as a dense scrub on wind-swept plateaux or on mountains close to the snow-line. In Kamtschatka³ and the Kurile Isles to the north of Urup, it thrives where no other pine is known, at elevations little above sea-level. In Iturup it grows between 1000 and 3000 ft. elevation, and in Yezo at over 3000 ft. In central Hondo it is confined to mountain peaks over 7000 feet elevation, and is often seen in the vicinity of sulphur springs, the poisonous exhalations of which it bears without injury.

It is known to the Japanese as *Hai-matzu*, and to the Ainus as *Todonup* or *Henekkeri*; and its seeds⁴ are much esteemed by the natives of the Kurile Isles as an article of diet.

This species appears to have been early introduced into St. Petersburg from eastern Siberia; and Loudon mentions a plant at Dropmore which was only 6 in. high in 1837, though twenty years old, and had increased to 8½ in. in height in 1866 when it was examined by Murray. The latter procured seeds for sowing in this year from Regel, but we have not found any specimens now living in England.

Specimens with cones and seeds have lately been sent home by Capt. L. Clinton-Baker, R.N., who procured them from Nyoho San, near Nikko, at 8000 ft. elevation; and two plants⁵ from this locality have been planted at Bayfordbury.

(A. H.)

PINUS FLEXILIS

Pinus flexilis, James, in *Long's Exped.* ii. 34 (1823); Murray, in *Gard. Chron.* iii. 106, and iv. 356 (in part), f. 75 (1875); Sargent, *Silva N. Amer.* xi. 35, tt. 546, 547 (1897), and *Trees N. Amer.* 7 (1905); Kent, *Veitch's Man. Coniferae*, 330 (1900); Masters, in *Journ. Linn. Soc. (Bot.)* xxxv. 589 (1904); Clinton-Baker, *Illust. Conif.* i. 21 (1909); Shaw, *Pines of Mexico*, 12 (1909).

A tree, usually 40 to 50, occasionally 80 ft. high, with a short trunk 6 to 15 ft. in girth. Bark of young stems and branches thin, smooth, grey or silvery white; becoming on old trunks 1 or 2 in. thick, dark brown, and deeply fissured into broad, scaly ridges. Branches very tough and flexible. Buds ovoid, short-pointed, ⅜ in. long, resinous, with the scales appressed or free at their subulate tips. Young branchlets glabrous or covered by a minute dense brown pubescence.

¹ It is said by Masters, in *Journ. Linn. Soc. (Bot.)* xviii. 505 (1881), to have been found on the bay of Kotzebue in Alaska, but we have been unable to confirm this report.

² Miyabe, *Flora of the Kurile Isles*, 261 (1890).

³ This species was early mentioned by Abbé Chappe d'Auteroche, who, in *Voyage en Sibérie*, i. 360 (1768), says that little cedars, creeping on the ground and never growing upright, are found on the mountains and moss-covered plains of Kamtschatka. The inhabitants gather large quantities of the seed for food, and make a drink, something like *kwass*, by boiling and fermenting the young shoots, considered to be a cure for scurvy.

⁴ Batchelor and Miyabe, *Ainu Economic Plants*, 230 (1893).

⁵ One of these plants is figured in *Gard. Chron.* xlv. 93, fig. 41 (1909).

Leaves in fives, persistent for five or six years, densely crowded on the branchlets, directed forwards, 2 to 3 in. long, stout, rigid, curved, scarcely twisted, entire¹ in margin, sharp-pointed, marked on the three surfaces with three or four stomatic lines; resin-canals marginal; basal sheath ½ in. long, early deciduous.

Cones sub-terminal, erect when young, spreading in the second year, sub-sessile, 3 to 5, rarely 10 in. long,² ovoid-cylindrical; scales³ opening and spreading horizontally when mature, about 1 in. long and ¾ in. wide, obovate, with the upper margin reflexed; apophysis thickened, brown, tipped with a triangular umbo. Seed ovoid, compressed, ⅓ to ½ in. long, brownish, angled on the lateral and upper margins; wing rudimentary, about ⅓ in. long, lacerated when the seed falls.

This species is distinguished from all the cultivated five-leaved pines with a completely deciduous leaf-sheath, except *P. pumila*, by the leaves being entire in margin. The latter species, which in its continental form has also non-serrulate leaves, is readily distinguishable from *P. flexilis* by the shaggy reddish brown tomentum on its young branchlets.

VARIETY

Shaw considers the following to be a variety of this species:—

Var. reflexa, Engelmann, in Rothrock, *Rep. Geol. Surveys*, vi. 258 (1878).

Pinus reflexa, Engelmann, in *Bot. Gazette*, vii. 4 (1882); Mayr, *Fremdländ. Wald- u. Park-bäume*, 388 (1906).

Pinus strobiformis, Sudworth, *U.S. Forestry Bull.* No. 14, p. 17 (1897) (not Engelmann⁴); Sargent, *Silva N. Amer.* xi. 33, tt. 544, 545 (1897), and *Trees N. Amer.* 6 (1905).

This differs from the type in the much reflexed, usually thin cone-scales. The leaves, either entire or serrulate in margin, are with or without stomatic lines on the back. It was found in northern Chihuahua in Mexico by Pringle in 1887, and seems to be intermediate between *P. flexilis* and *P. Ayacahuite*, though all the cones seen by Shaw resembled those of *P. flexilis* in size and general appearance. According to Sargent, this pine attains 80 to 100 ft. in height, and is scattered singly, or in small groups, on rocky ridges of the Santa Catalina, Chiracahua, and Santa Rita mountains of southern Arizona, and on the Sierra Madre of Chihuahua in Mexico. It has not been introduced.

DISTRIBUTION AND CULTIVATION

This species is widely distributed on the eastern slope of the Rocky Mountains⁵ from Alberta to Texas, and occurs also in the mountains of northern Arizona, Utah,

¹ In rare cases the leaves are slightly serrulate, and have been distinguished as *var. serrulata*, Engelmann, in Rothrock, *Wheeler's Report*, vi. 258 (1878).

² Cones of abnormal length, in addition to those of the ordinary size, are produced on trees growing in the San Francisco mountains of northern Arizona; and have been distinguished as *var. macrocarpa*, Engelmann, in Rothrock, *Wheeler's Report*, vi. 258 (1878).

³ Shaw, *loc. cit.*, says: Scales straight or reflexed, and variable in thickness.

⁴ *P. strobiformis*, Engelmann, is a variety of *P. Ayacahuite*.

⁵ In the Rocky Mountains of Canada *P. flexilis* is found only on the margins of the rivers issuing from the mountains. Cf. Macoun, in *Trans. R. Soc. Canada*, xii. 4, p. 13 (1894).

Nevada, and south-eastern California, where it reaches the western side of the Sierra Nevada at the head of King's River. It occupies the sub-alpine zone, usually growing singly or in small groups, but forming open forests on the eastern foot hills of the Rocky Mountains in Montana and on the ranges of central Nevada. At low elevations it is associated with *P. contorta*, var. *Murrayana*, and at higher altitudes in the southern part of its area is often scattered with *P. aristata*. In Colorado, according to Engelmann, it has a tapering trunk, branching almost from the base, and attaining, at 200 or 300 years old, a diameter of one foot. It is largest in size in Arizona and in northern New Mexico, where Fendler saw it 60 to 80 ft. in height.¹ In the Sandia Mountains² in this state it ascends to 12,000 ft.; but in the north is restricted to elevations of 4000 to 6000 ft. It also occurs in a limited area in northern Mexico, where it was collected in Coahuila by Nelson. Sargent figures³ a fine tree, growing in the Yellowstone Park, at 7000 ft. elevation, which was 5 ft. in diameter.

P. flexilis was discovered in 1820 by Dr. Edwin James, near the base of Pike's Peak in Colorado. Plants³ were raised in the Harvard Botanic Garden from seeds collected in Colorado by Dr. Parry in 1861, but after thirty-five years' growth were not more than 5 ft. high with tufts of stunted foliage on the ends of naked branches. There are three trees in Kew Gardens, probably of the same origin, growing near the Isleworth gate, one of which produced cones⁴ for the first time in 1896, when it was 25 ft. high and 2 ft. in girth. This tree produces fruit every year, and is now 32 ft. by 2 ft. 10 in. At Highnam, a specimen, about 20 ft. high, has borne cones. There are also two trees at Terling Place, Essex, the origin of which is unknown. Both were bearing cones in 1907, the larger measuring 32 ft. by 2 ft. 4 in. They have smooth green bark and ascending branches. There are four trees about 15 ft. high at Westonbirt which are not thriving. Elwes saw a small tree at Murthly in 1906.

(A. H.)

PINUS ALBICAULIS, WHITE-BARK PINE

Pinus albicaulis, Engelmann, in *Trans. St. Louis Acad.* ii. 209 (1863); J. D. Hooker, in *Gard. Chron.* xxiv. 9, f. 2 (1885); Sargent, *Silva N. Amer.* xi. 39, t. 548 (1897), and *Trees N. Amer.* 8 (1905); Kent, Veitch's *Man. Coniferae*, 310 (1900); Masters, in *Journ. Linn. Soc. (Bot.)* xxxv. 588 (1904).

Pinus flexilis, Balfour, *Bot. Exped. Oregon*, 1, t. 2, f. 1 (1853) (not James).

Pinus flexilis, James, var. *albicaulis*, Engelmann, in Brewer and Watson, *Bot. California*, ii. 124 (1880).

Pinus Shasta, Carrière, *Conif.* 390 (1867).

A tree, attaining 80 ft. in height and 12 ft. in girth, usually smaller, and becoming at very high elevations a low shrub.⁵ Bark of young trees white or pale grey, smooth; on old trees remaining thin and scaling in small polygonal plates. Young

¹ *Trans. St. Louis Acad. Science*, ii. 208, 209 (1863).

² *Garden and Forest*, x. 162, fig. 19 (1897).

³ *Ibid.* 461.

⁴ *Garden*, li. 73 (1897).

⁵ On high cold sites, as in northern Montana, where I saw this pine in 1906, it dwindles in size till at absolute timber line it is prone on the ground in the depressions of the rock, with matted branches and a stem less than a foot in height.

branchlets reddish brown, with a scattered minute stiff pubescence. Leaves similar to those of *P. flexilis*, persisting five to eight years.

Cones sub-terminal, sessile, spreading, never opening, ovoid, 1½ to 3 in. long, dark purple when growing, light brown when mature; scales much thickened, very brittle at their base, ¾ in. long, ⅝ in. broad, many undeveloped and unfertile; apophysis triangular, ending in a sharp-pointed umbo. Seed, ⅓ to ½ in. long, ovoid, more or less compressed, pointed at the apex, pubescent; wing rudimentary or absent.

In the absence of cones, this species is best distinguished from *P. flexilis* by the minute scattered stiff hairs on the reddish brown branchlets. The young branchlets of *P. flexilis* are either quite glabrous or covered with a soft fine tomentum.

This species is more alpine in distribution than *P. flexilis*, forming the timber line on many mountain ranges from lat. 53° in Alberta and British Columbia,¹ southward along the Rocky Mountains to the Yellowstone plateau, and through Washington and Oregon in the Cascade and Blue mountains, and in California, along the Sierra Nevada to the San Bernardino mountains. It reaches an elevation of 5000 ft. in the north, and 12,000 ft. in the south. This species² endures great seasonal ranges of temperature from -60° to 100° Fahr.; severe winds and a very short growing season being characteristic of its habitat. It is probably the least exacting of all conifers as regards both soil and moisture—the annual precipitation, a large proportion of it in the form of snow, sometimes being as little as 15 in.

In north-western Montana this species³ does not cross the continental divide, and grows at elevations between 6000 and 8000 ft., usually in scattered groves, either pure or mixed with *Picea Engelmanni* and *Abies lasiocarpa*. It is often seen on high exposed ridges, and strongly resembles *P. Cembra* in general appearance, being often irregularly branched and with a flattened crown of foliage. The largest tree (Plate 276) measured by me on Mount Nicholas, and photographed by Prof. Elrod, was 84 ft. high and 9 ft. 2 in. in girth.

Sir Joseph Hooker describes and figures⁴ this tree on Mount Shasta, where the trunk becomes scored and polished by the sand blasts. Elwes saw it here in 1904 at about 7000 to 8000 feet elevation.

The most remarkable feature of this pine, in which it resembles *P. Cembra*, is that the cones never open, the seeds being distributed by squirrels, who readily break off the scales, which are very brittle towards the base.

P. albicaulis was discovered⁵ on the mountains rising above the valley of the lower Fraser river, near Fort Hope, in 1851 by John Jeffrey, who sent seeds from Mount Shasta, California, in 1852, to Scotland, from which a few plants were raised, but none of these appear to have survived. The only specimens we know in cultivation are seedlings at Kew about 6 in. high.

The timber when accessible is used by miners for props, fuel, and sleepers.

(A. H.)

¹ Dawson, in *Canad. Naturalist*, ix. 328 (1881) says: "In the coast or Cascade ranges as far north as the Iltsayouco river (lat. 53°)."

² Cf. *U.S. Syltical Leaflet 37, White Bark Pine* (1908).

³ It occurs also in the Helena National Forest in Montana.

⁴ *Gard. Chron.* xxiv. 9, fig. 2 (1885).

⁵ Sargent, *Silva N. Amer.* xi. 41 (1897).

PINUS BUNGEANA

Pinus Bungeana, Zuccarini, *ex* Endlicher, *Syn. Conif.* 166 (1847); Murray, *Pines and Firs of Japan*, 18 (1863); Hance, in *Journ. Linn. Soc. (Bot.)* xiii. 87 (1873); Maximowicz, *Mél. Biol.* xi. 348 (1881); Masters, in *Gard. Chron.* xviii. 8, figs. 1, 2 (1882), in *Journ. Linn. Soc. (Bot.)* xxvi. 549 (1902), and xxxv. 590, pl. 23, fig. 10 (1904); Lavallée, *Arbor. Segrezianum*, 111, t. 32 (1885); Kent, Veitch's *Man. Coniferae*, 316 (1900); Mayr, *Fremdländ. Wald- u. Parkbäume*; 372 (1906); N. E. Brown, in *Bot. Mag.* t. 8240 (1909); Clinton-Baker, *Illust. Conif.* i. 11 (1909).

Pinus excorticata, Lindley and Gordon, in *Journ. Hort. Soc.* v. 217 (1850).

Pinus Napoleoni, Simon, in *Bull. Soc. d'Acclim.* 1863, p. 281.

A tree, attaining in China 80 to 100 ft. in height, and 12 ft. in girth. Bark on young trees dark brown, smooth, and scaling off in thin flakes, exposing the whitish inner cortex; in old trees white¹ externally, as if washed with lime and marked by inconspicuous scattered brown lenticels; on the inner surface it is fawn-coloured and covered with minute resinous depressions. Buds spindle-shaped, brown, about $\frac{3}{8}$ in. long, slightly resinous; external scales few, lanceolate, acuminate, free at the tips. Young branchlets glabrous, greenish, with slightly raised pulvini, which disappear in the second year, leaving the surface smooth and greyish green.

Leaves in threes, with the basal sheaths entirely deciduous early in the first year, remotely placed on the branchlets, persisting three or four years, about 3 in. long, rigid, curved, serrulate, sharp-pointed, marked with stomatic lines on the three surfaces; fibro-vascular bundle undivided; resin-canals four, marginal.

Staminate flowers in a loose spike, about 4 in. long; each flower $\frac{1}{4}$ in. long, girt at the base by ovate-triangular acute bracts.

Cones, solitary or in pairs, sub-terminal, though often becoming apparently lateral by the growth of a summer shoot, on stout short stalks; globose-ovoid, 2 to 2 $\frac{1}{2}$ in. long; scales small at the base of the cone and unfertile, well-developed in the centre and about $\frac{7}{8}$ in. long and $\frac{1}{2}$ in. broad; apophysis brown, rhomboidal, with a transverse ridge near the upper margin; the narrow umbo terminating in a short triangular spreading or reflexed prickle. Seeds, one or two on each scale, brownish, pear-shaped, $\frac{3}{8}$ in. long, $\frac{1}{4}$ in. wide and thick, the testa produced into a narrow rim on each side and a short lacerated wing above, deciduous when the seed falls, incapable of flight, out of the cone.

This remarkable pine occurs wild in the mountains of northern China, where Mayr observed it growing on stony slopes; and it has recently been found by Wilson² south-west of Ichang in Hupeh, on precipitous mountains at an altitude of 2000 to 4000 ft. He saw many hundreds of trees scattered for miles, evidently the remains of a considerable forest. Many of these trees were curved at the butt, a few being branched near the ground. It was also collected in northern Shensi, by Père Giraldi,³ who reports it to be a rare tree 30 to 40 ft. high. It

¹ Mayr states that the bark is dazzling whitish-blue on the sunny side of the tree and greenish-white on the shady side. The name "lace-bark pine" occasionally given to the species is inappropriate.

² *Gard. Chron.* xli. 422 (1907).

³ Note in Botanical Museum at Florence.

was formerly only known as a tree cultivated around temples, as at Peking, Shanghai, and other localities in central and northern China. It is known to the Chinese as *pai-sung*, "white pine," or *pai-kuo-sung*, "pine with a white bark." *Chiu-lung-sung*,¹ the pine of the nine dragons, cited as the Chinese appellation by Endlicher, is the name given to a single tree of this species, standing in the celebrated temple of Tieh-tai-sze, near Peking; and was so named by the Emperor Chien Lung, who admired its nine tall stems. As usually seen in cultivation in China, the tree has a short trunk, sometimes 12 ft. in girth, dividing at a few feet from the ground into several upright stems, which, in the oldest examples, attain a height of 80 to 100 ft. Fortune² gives a good picture illustrating this peculiar habit. Wilson says that the wood is brittle, and only used for fuel. The seeds do not appear to be eaten by the Chinese.

P. Bungeana was discovered at Peking by Dr. A. Bunge in 1831, and Zuccarini's description was based upon his specimens. Fortune introduced this pine into cultivation in England in 1846; and young plants reared from seed sent by him were growing in 1857 in Glendinning's nursery, Turnham Green.³ Murray reported in 1863 that specimens about 5 ft. high had withstood without injury the severe winter of 1860. Simon⁴ sent young plants to Paris from Peking in 1862.

No trees in cultivation in Europe are as yet old enough to show the beautiful white bark which renders this pine so remarkable at Peking. As a small tree, however, it is fast in growth, ornamental and distinct in habit owing to its vivid green foliage, and is worthy of a place in all collections. The largest specimen known to us is growing at Pampisford, Cambridge, and is about 30 ft. high, dividing into four slender stems near the ground; but it has been retarded in growth by the crowding of other trees. At Kew, where there are several very healthy specimens, which have produced cones for several years, the tree either assumes an erect pyramidal habit or is rounded and bushy in appearance. The largest tree is 25 ft. high and 23 in. in girth at three feet from the ground. Small trees bearing cones also exist at Flitwick, Highnam, and Tregrehan.

At Messrs. Simon-Louis' nursery⁵ near Metz, it grows well on calcareous soil and ripened seed when only 12 ft. high. Mayr says that it is perfectly hardy at Grafrath, near Munich, where the winters are very severe.

It is very hardy in eastern Massachusetts, where, though it still retains a bushy habit, cones are produced in abundance. The largest specimen in the United States is growing in Mr. Josiah Hoopes' pinetum at West Chester, Pennsylvania.⁶

(A. H.)

¹ Cf. Hance, in *Journ. Bot.* xi. 91 (1873).

² *Yedo and Peking*, 377, 378 (1863). Cf. *Gard. Chron.* 1863, p. 776.

³ *Gard. Chron.* 1857, p. 216. Fortune received a further consignment of seed from Peking in 1864, according to *Gard. Chron.* 1864, p. 197.

⁴ *Bull. Soc. d'Acclim.* 1863, p. 281.

⁵ *Garden and Forest*, vi. 458 (1893) and x. 470 (1897).

⁶ Beissner, in *Mitt. deut. dendr. Ges.* 1905, p. 35.

PINUS GERARDIANA, GERARD'S PINE

Pinus Gerardiana, Wallich, *ex* Lambert, *Genus Pinus*, ii. 145, t. 79 (1832); Loudon,¹ *Arb. et Frut. Brit.* iv. 2254 (1838); Royle, *Illustr. Him. Plants*, 353, t. 85, f. 2 (1839); Forbes, *Pinetum Woburnense*, 53, t. 19 (1839); Cleghorn, in *Journ. Agric. Hort. Soc. India*, xiv. 266, t. 4 (1867); Hooker, *Fl. Brit. India*, v. 652 (1888); Kent, Veitch's *Man. Coniferae*, 331 (1900); Gamble, *Indian Timbers*, 709 (1902); Masters, in *Journ. Linn. Soc. (Bot.)* xxxv. 590 (1904); Brandis, *Indian Trees*, 690 (1906); Clinton-Baker, *Illustr. Conif.* i. 22 (1909).
Pinus Gerardi, Forbes, *Hort. Woburn.* 210 (1833).

A tree, attaining 80 ft. in height and 12 ft. in girth. Bark thin, grey, with scattered brown lenticels, exfoliating in irregular scales, which leave shallow brownish depressions, dotted over with minute holes.

Buds about $\frac{3}{8}$ in. long, conic, acuminate; scales appressed and resinous. Young branchlets glabrous, olive green, with prominent pulvini, which are less marked in following years. Leaves in threes, more crowded on the branchlets, duller in colour, and less rigid than those of *P. Bungeana*, straight or slightly curved, 3 to 4 in. long, serrulate, sharp-pointed, marked with stomatic lines on the three surfaces; fibro-vascular bundle undivided, resin-canals marginal; basal sheaths loose, $\frac{1}{2}$ in. long in the first year and completely deciduous in the second year.

Cones, on short scaly peduncles, subterminal, broadly ovoid, variable in size, 4 to 9 in. long, and 3 to 5 in. in diameter; scales $1\frac{1}{2}$ in. long, 1 in. broad, very thick and woody; apophysis triangular, reflexed downwards at nearly a right angle, and ending in a swollen umbo, which is often tipped with a recurved spine. Seed cylindrical, $\frac{5}{8}$ to 1 in. long, edible; rudiment of the wing present as a narrow deciduous border, remaining on the scale when the seed falls.

Gerard's pine is a native of the western Himalayas, extending eastward to the Niti Pass in Garhwal, and occurring also in the mountains of Baluchistan, northern Afghanistan, Kafiristan, and in the Hariab district. It grows in the inner arid valleys, beyond the reach of the south-west monsoon, never forming dense forests, but occurring in isolated groups on dry steep rocky slopes, especially on granite and slate formations; and ranges between 6000 and 11,000 ft. elevation. Thomson² describes it as a compact small tree, with twisted ascending branches and a mottled grey bark, smooth on account of the shedding of the outer layers. Aitchison³ speaks of it as a very handsome tree, branching more like an oak than a pine, and readily distinguished at a distance by its ashy grey bark, which on close examination consists of patches of all tints from light green to red and brown, due to the peculiar way in which it exfoliates.

According to Gamble, its growth is moderate, about 13 rings per inch of radius. The wood is tough, and used for the hook supporting the passenger's seat on the native rope bridges; but the tree is hardly ever felled as it is very valuable on

¹ Loudon cites as synonyms, *P. Neoza*, Govan, and *P. Chilghoza*, Elphinstone, MS. names without description; and it is doubtful whether they were applied to this species or to *P. longifolia*.

² *W. Himalaya and Tibet*, 74.

³ *Journ. Linn. Soc. (Bot.)* xviii. 98 (1881).

account of its edible seeds. These are known as *neoza* or *chilghoza*, and are an article of food in Kunawar and other parts of the Himalayas, being largely imported into the plains of India from the hills of the Punjab and Afghanistan. They are oily, with a slight flavour of turpentine, and are eaten roasted at dessert by Europeans. The bark is made into baskets and water buckets.

The forests of this pine in the Shinghar and Sherghali hills, in north-eastern Baluchistan, and on the adjoining Suliman range and the Maidan plateau, in the North-west Frontier Province of India, have been fully described¹ by Mr. E. P. Stebbing. In his account, which is accompanied by excellent illustrations of fine isolated trees and of scattered woods on the arid slopes of the mountains, Mr. Stebbing says that the species is here seen at its best, trees with fine straight stems 70 to 85 ft. high and 9 to 12 ft. in girth occurring at 7500 to 8500 ft. elevation. The tree grows on what is apparently solid limestone rock, with the scantiest possible supply of water. The tribesmen collect the cones into heaps, and extract the seeds by setting fire to the mass, which causes the cone-scales to gape asunder. Occasionally the tree is tapped for resin.

It was first introduced² into England by Lord Auckland, who sent seeds in 1839 to the Horticultural Society, from which plants were raised in the Chiswick Garden.

The tree has never thriven in this country, and is the rarest of all pines in cultivation, the only specimen, exclusive of nursery plants, that we know of in England being a tree, about 15 ft. high, in the Cambridge Botanic Garden, which is probably over thirty years old. In Ireland there is also a single specimen, growing in Lord Ardilaun's grounds at St. Anne's, near Dublin. It measured, in 1903, 25 ft. high and 1 ft. 9 in. in girth, and is pyramidal in habit, with mostly ascending branches. According to Mr. Campbell, the gardener at St. Anne's, it was about 5 ft. high in 1870. Seedlings planted out in 1908 endured the severe winter at Colesborne, with a slight protection of branches, and are now growing slowly.

This species has lived out of doors at Grafrath,³ near Munich, for nineteen years, but has made little growth in height. Elwes saw a tree in the Botanic Garden at Montpellier, which was about 20 ft. high in January 1910. It had produced cones⁴ in the preceding year.

(A. H.)

¹ *Indian Forest Bulletin*, No. 7 (1906); *The Chilghoza Forests of Zhob and the Takht-I-Suliman*, with map and 6 plates (Calcutta, 1906).

² Gordon, in Loudon, *Gard. Mag.* xvi. 6 (1848), in giving an account of the introduction, says that all the plants cultivated previously under the name *P. Gerardiana* were in reality *P. longifolia*. Cf. also *Gard. Chron.* 1842, p. 52.

³ Mayr, *Fremdländ. Wald- u. Parkbäume*, 373 (1906).

⁴ Cf. Pardé, in *Bull. Soc. Dend. France*, 1909, pp. 99, 108.

PINUS BALFOURIANA, FOXTAIL PINE

Pinus Balfouriana, Balfour, *Oregon Exped. Report*, 1, t. 3, f. 1 (1853); Murray, in *Gard. Chron.* v. 332, f. 58 (1876); Sargent, *Silva N. Amer.*, xi. 59, t. 553 (1897), and *Trees N. Amer.* 8 (1905); Kent, Veitch's *Man. Coniferae*, 313 (1900); Masters, in *Journ. Linn. Soc. (Bot.)* xxxv. 589 (1904).

A tree, usually 30 to 40 ft. high and 6 ft. in girth, rarely attaining 90 ft. in height and 15 ft. in girth. Bark of young trees thin, smooth, and whitish; becoming on old trunks $\frac{3}{4}$ in. thick, dark red brown, and deeply divided into broad flat scaly ridges. Young branchlets stout, yellowish brown, covered with a minute pubescence. Buds ovoid, acuminate at the apex, about $\frac{1}{4}$ in. long, with closely appressed brownish scales.

Leaves in fives, densely crowded on the branches, persisting ten or twelve years, nearly appressed together in the clusters, incurved, about $1\frac{1}{2}$ in. long, rigid, sharp-pointed, entire in margin, green and shining on the back, whitened with numerous stomatic lines on the inner surfaces; resin-canals marginal; basal sheath speedily splitting into five segments that become reflexed and form a rosette around the base of the leaf-cluster.

Cones sub-terminal, spreading, sessile, cylindrical-conic, $3\frac{1}{2}$ to 5 in. long; scales narrow, elongated; apophysis convex, rhomboidal, transversely keeled, with a minute incurved prickle. Seed pale mottled with violet, $\frac{1}{3}$ in. long; wing narrow and oblique at the apex, about 1 in. long.

This species is confined to California, where it is found on Scott Mountain in Siskiyou County, on the mountains at the head of the Sacramento river, on Mount Yolo Bally, in the northern coast range, and in the southern Sierra Nevada, where it attains its largest size. It occurs at elevations of 5000 to 12,000 ft., often forming the timber line,¹ and growing usually on bare rocky slopes and the summits of ridges, in loose granitic soil. At high elevations it occurs in small pure scattered groves or in mixture with *P. albicaulis*, while at lower levels it is associated with *P. monticola*, *P. contorta*, var. *Murrayana*, and other conifers.

The illustration (Plate 277) is from a photograph by Mr. F. R. S. Balfour in the Sierra Nevada mountains, between King's River and Kaweah River, at an elevation of 9000 to 10,000 ft.

This species was discovered in 1852 on Scott Mountain by Jeffrey, who sent a few seeds to the Oregon Association of Edinburgh. It is rare in cultivation, though specimens of small size are to be seen in the botanic gardens of Kew, Edinburgh, and Glasnevin. At Messrs. Little and Ballantyne's nursery, Carlisle, there is a tree about 20 ft. high, which was planted about thirty years ago. It has never produced a single cone; but large numbers of grafts have been propagated from it. At Welbeck, Elwes saw a small tree about 15 ft. high. (A. H.)

¹ Cf. Pinchot, *U.S. Forest Service, Sylvical Leaflet* 26 (1908).

PINUS ARISTATA, BRISTLE-CONE PINE

Pinus aristata, Engelmann, in *Trans. St. Louis Acad.* ii. 205, pl. 5, 6 (1863); Murray, in *Gard. Chron.* iv. 549, fig. 117 (1875); Sargent, *Silva N. Amer.* xi. 63, t. 554 (1897), and *Trees N. Amer.* 9 (1905); Masters, in *Journ. Linn. Soc. (Bot.)* xxxv. 590 (1904); Clinton-Baker, *Illust. Conif.* i. 5 (1909).

Pinus Balfouriana, Balfour, var. *aristata*, Engelmann, in Brewer and Watson, *Bot. California*, ii. 125 (1880); Webster, in *Gard. Chron.* xx. 719, fig. 126 (1896); Kent, Veitch's *Man. Coniferae*, 314 (1900).

A tree, occasionally attaining 40 to 50 ft. in height, with a short trunk 6 to 9 ft. in girth. Bark, buds, branchlets, and foliage, as in *P. Balfouriana*, though in cultivated specimens the young branchlets of *P. aristata* differ in being covered with a dense reddish brown pubescence; whilst both on wild¹ and cultivated trees of *P. aristata* the leaves are remarkable in being dotted over their outer surface with resinous exudations.

Cones subterminal, spreading, sessile, about 3 in. long, ovoid-conic; scales thin, oblong-cuneate, $\frac{3}{4}$ to 1 in. long; apophysis rhomboidal, transversely keeled, with a slender incurved brittle prickle, nearly $\frac{1}{4}$ in. long. Seed light brown, mottled with black, $\frac{1}{4}$ in. long; wing $\frac{1}{3}$ to $\frac{1}{2}$ in. long.

This alpine species is widely distributed from the eastern range of the Rocky Mountains in Colorado westward through the mountains of southern Utah, and central and southern Nevada, southwards in the San Francisco peaks of northern Arizona, and in the mountains of south-eastern California. It grows on rocky or gravelly slopes, forming the timber line in these mountainous regions at 9000 to 12,000 ft. elevation, and producing a soft light wood, which is occasionally used for fuel and in the mines.

This species was discovered² in 1861 by Dr. Parry on Pike's Peak in Colorado, and plants raised from seed sent by him to Boston had only attained 18 in. in height at the end of thirty-five years.³ Seeds were sent⁴ in 1863 from Colorado to England, and small trees may be seen in botanic gardens, the specimen at Glasnevin, which has produced cones of late years, being about 15 ft. high. The best specimen we have seen in England is one at Hardwick, near Bury St. Edmunds, which is about 25 ft. high by 2 ft. in girth. It was planted by Sir Joseph Hooker, and bore cones in 1905 when Elwes measured it. There is also one at Aldenham about 20 ft. high which bore cones in 1908. There are also specimens at Ponfield, Herts, and at Ochtertyre,⁵ in Perthshire. (A. H.)

¹ Cf. Engelmann, in *Trans. St. Louis Acad.* ii. 206 (1863).

² Murray, in *Gard. Chron.* iv. 549 (1875), says that it was first seen by Captain Gunnison in 1853, near Pike's Peak.

³ *Garden and Forest*, x. 470 (1897).

⁴ *Gard. Chron.* iv. 549 (1875). Gordon, in *Pinetum*, 292 (1875), says that it was first introduced by Mr. Cripps of Tunbridge Wells.

⁵ See Masters, in *Gard. Chron.* xxvi. 371 and 382 (1899).

PINUS MONOPHYLLA, ONE-LEAF NUT PINE

Pinus monophylla, Torrey, in Fremont, *Report*, 319, t. 4 (1844); Masters, in *Gard. Chron.* xx. 48, f. 8 (1883), *Ann. Bot.* ii. 126 (1888), and *Journ. Linn. Soc. (Bot.)* xxvii. 269, f. 10 (1891), xxxv. 584 (1904); J. D. Hooker, in *Gard. Chron.* xxvi. 136, f. 24 (1886); Sargent, *Silva N. Amer.* xi. 51, t. 551 (1897), and *Trees N. Amer.* 12 (1905); Clinton-Baker, *Illust. Conif.* i. 33 (1909).

Pinus Fremontiana, Endlicher, *Syn. Conif.* 183 (1847); Gordon, in *Journ. Hort. Soc.* iv. 293, fig. (1849).

Pinus cembroides, Zuccarini, var. *monophylla*, Voss, in *Deut. Gartenrat*, Beilage 123 (1904); Shaw, *Pines of Mexico*, 5 (1909).

A tree usually 25 to 30 ft., occasionally¹ 40 to 50 ft. high, with a short trunk rarely more than 5 ft. in girth. Bark reddish, divided by deep irregular fissures into narrow connected scaly ridges. Young branchlets slender, grey, with scattered minute pubescence. Buds cylindrical, obtuse, $\frac{1}{4}$ in. long; scales few, closely imbricated, greyish tinged with brown, ovate, apiculate, entire in margin.

Leaves solitary, remotely placed on the branchlets, persistent for four or five years or longer, incurved and directed forwards, rigid, terete, about $1\frac{1}{2}$ in. long, $\frac{1}{16}$ in. in diameter, marked with about twenty stomatic lines, and ending in a sharp cartilaginous point; resin-canals, 3 to 14, marginal. Basal sheath $\frac{1}{4}$ in. long, its upper part deciduous in the first year, while the lower part persists in the following years as an irregular rosette of reflexed segments. According to Dr. Masters, the solitary leaf is due to the arrested development in the bud of one leaf of a two-leaved cluster. Occasionally the second leaf is fully developed, and two-leaved clusters result. In cultivation adventitious shoots bearing flattish primordial leaves are occasionally produced on the lower branches.

Cones sub-terminal, short-stalked, $1\frac{1}{2}$ to 2 in. long; scales few, with a thick pyramidal non-prickly apophysis and a central umbo. Seed edible, about $\frac{5}{8}$ in. long and $\frac{1}{4}$ in. wide, brownish, oblong, full and rounded at the base, acute at the apex, with a thin brittle shell, and a narrow wing, about $\frac{1}{3}$ in. wide, remaining attached to the scale. Cotyledons 7 to 10. The primary flattened leaves, about an inch in length, persist on the seedling till it is about five years old; after which they become shorter, buds forming in their axils and producing the adult leaves.

This species is readily distinguished by its glaucous terete solitary² leaves, with reflexed basal sheaths, and its peculiar buds. When two-leaved clusters appear the leaves are semi-terete and entire in margin.³

This pine is widely distributed, extending from the western base of the Wasatch mountains in Utah, westward through the mountain ranges of Nevada, to the Sierra Nevada in central California, and southwards to Arizona, and the coast ranges of

¹ According to Pinchot, *U.S. Forest Service, Syltical Leaflet* 16 (1908), a few trees have been seen in the Tehachapi mountains, 4 ft. in diameter and nearly 100 ft. in height.

² Solitary leaves occasionally occur as a sport in other pines, as in *P. sylvestris*, var. *monophylla*, but such cases present no difficulty, as the buds, leaves, and basal sheaths are entirely different.

³ Cf. Engelmann, in Rothrock, *Report Geol. Surveys*, vi. *Botany*, 259 (1878).

southern California and of northern Lower California. It grows in a very dry climate, the rainfall varying from 16 in. in the northern part of its area to 5 in. in the southern part, while the temperature is extreme, ranging from a minimum of -2° Fahr. in the Sierra Nevada to a maximum of 122° Fahr. in the Mojave desert. It occurs in arid situations on foothills, gravelly slopes, and rocky elevations, at elevations of 3800 to 6800 ft. in Utah and Nevada, and 4000 to 9500 ft. in the San Bernardino mountains, where the tree is abundant. It usually grows in mixture with other species, but frequently forms pure open woods over large areas. In Arizona it is associated with *Pinus edulis*, *Juniperus monosperma*, *J. pachyphloea*, and *Cupressus arizonica*. In Utah its chief companion is *Juniperus utahensis*, while in southern California it occurs sparingly in the chaparral formations, together with *J. californica*, oaks, and tree yuccas. Occasionally it grows with *Abies concolor* or with *Pinus Jeffreyi*.

P. monophylla was considered by Newberry¹ to be a depauperate or desert form of *P. edulis*, which has a more easterly distribution. Sir Joseph Hooker, however, was convinced that the two species are distinct, and that two-leaved forms of *P. monophylla* are not identical with *P. edulis*. The latter has dull leaden grey foliage, whereas that of *P. monophylla* is glaucous with a silvery sheen. *P. monophylla* is the stronger plant of the two, and cannot be regarded as depauperate.

This peculiar pine was discovered by Fremont in 1844, and was introduced into Europe by Hartweg² in 1848. It is extremely slow in growth, a specimen $5\frac{1}{2}$ in. in diameter from Utah, which was examined by Sargent, showing 113 annual rings. It is occasionally seen in botanic gardens, there being a healthy specimen about 5 ft. high at Cambridge. Hooker, writing in 1886, mentions a tree at Kew, no longer living, which was only 6 ft. high, though it was twenty years old, yet he considered it to be faster in growth than *P. edulis*. The best specimen we know of in England is a tree at Dunburgh House, Beccles, which is about 14 ft. high, and bore a single cone in 1908. Another at Paul's Nursery, Cheshunt, was 13 ft. high in 1909. Seedlings received from Kew have proved hardy at Colesborne, though they grow very slowly. Elwes saw a specimen, about 20 ft. high, in the Botanic Garden at Montpellier, which bore young and old cones with good seed in 1910.

The seeds are the staple food of the Indians in Nevada, and are highly esteemed by white people, who eat them roasted. The timber is used for firewood, and is also largely employed in the mines. (A. H.)

¹ *Bull. Torrey Bot. Club*, xiii. 183 (1886). M. E. Jones, in *Zoe*, iii. 307 (1893), states that the leaves of *P. monophylla* are much more robust and vigorous than those of *P. edulis*.

² *Journ. Hort. Soc.* iii. 226 (1848).

PINUS EDULIS

- Pinus edulis*, Engelm., in Wislizenus, *Tour Mexico, Bot. App.* 88 (1848), and in Rothrock, *Geol. Surveys, vi. Botany*, 260 (1878); Sargent, *Silva N. Amer.* xi. 55, t. 552 (1897), and *Trees N. Amer.* 11 (1905); Masters, in *Gard. Chron.* xii. 563, fig. 86 (1892), and in *Journ. Linn. Soc. (Bot.)* xxxv. 587, fig. 2 (1904); Clinton-Baker, *Illust. Conif.* i. 19 (1909).
- Pinus monophylla*, Torrey, var. *edulis*, M. E. Jones, in *Zoe*, ii. 251 (1891).
- Pinus cembroides*, Zuccarini, var. *edulis*, Voss, in *Deut. Gartenrat, Beilage* 123 (1904); Shaw, *Pines of Mexico*, 6 (1909).

A tree, usually small in size, rarely attaining 40 ft. in height and 8 ft. in girth, with a short, often divided trunk. Bark $\frac{1}{2}$ to $\frac{3}{4}$ in. thick, irregularly divided into scaly ridges. Young branchlets stouter than in *P. cembroides*, grey, glabrous. Buds ovoid, acute, $\frac{1}{5}$ in. long, with brownish, densely imbricated, apiculate scales.

Leaves in pairs, with occasional three-leaved clusters, persistent three to five years, not so crowded on the branchlets as those of *P. cembroides*, appressed together in each cluster, $\frac{3}{4}$ to $1\frac{1}{2}$ in. long, rigid, stout, curved, sharp-pointed, entire in margin, with numerous stomatic lines on both surfaces; resin-canals marginal; basal sheath as in *P. cembroides*.

Cones similar to those of *P. cembroides*, but usually smaller, with the pyramidal apophysis of each scale more elevated than in that species, and the slightly deflexed umbo armed with a minute prickle, often obscured by resin. Seed smaller and lighter in colour than in *P. cembroides*; shell thin and brittle; wing rudimentary, about $\frac{1}{8}$ in. in length.

This species is widely distributed along the eastern foothills of the Rocky Mountains, from Colorado through New Mexico to western Texas, and extends westward through south-western Wyoming to Utah, northern and central Arizona, and southward over the mountains of northern Mexico. Associated with junipers (*J. monosperma* and *J. pachyphloea*), it forms extensive open forests between 5000 and 7700 ft. elevation, rarely ascending as a stunted shrub to 9000 ft. F. J. Phillips¹ states that in southern Colorado, Arizona, and New Mexico it is a tree of great economic and silvicultural importance. It succeeds in arid localities, where the average annual precipitation is less than 13 in. Its wood is much used for fuel; and to a lesser extent for fencing, railway sleepers, and mining timber. The seeds are an important article of food among Indians and Mexicans, and are sold in the markets of Colorado and New Mexico.

This species was described by Engelm. from specimens collected in 1846 by Dr. Wislizenus in New Mexico; and was introduced into cultivation² at Kew many years ago, but is now only represented there by one or two small plants. We have not seen it elsewhere.

(A. H.)

¹ In *Bot. Gaz.* xlviii. 216-223 (1909).² Cf. J. D. Hooker, in *Gard. Chron.* xxvi. 136 (1886).

PINUS CEMBROIDES

- Pinus cembroides*, Zuccarini, in *Abhand. Akad. München*, i. 392 (1832); Sargent, *Silva N. Amer.* xi. 47, t. 550 (1897), and *Trees N. Amer.* 10 (1905); Kent, Veitch's *Man. Coniferae*, 321 (1900); Masters, in *Journ. Linn. Soc. (Bot.)* xxxv. 586 (1904); Clinton-Baker, *Illust. Conif.* i. 15 (1909); Shaw, *Pines of Mexico*, 5 (1909).
- Pinus Llaveana*, Schlechtendal, in *Linnaea*, xii. 488 (1838).
- Pinus osteosperma*, Engelm., in Wislizenus, *Tour Mexico, Bot. App.* 89 (1848).

A tree, usually 20 ft. high with a short trunk rarely more than a foot in diameter, occasionally attaining in sheltered cañons 50 or 60 ft. in height. Bark about $\frac{1}{2}$ in. thick, slightly fissured, and separating on the surface into thin reddish brown scales. Young branchlets slender, glaucous, minutely pubescent or glabrous. Buds spindle-shaped, acute at the apex, brownish, about $\frac{1}{4}$ in. long, with densely imbricated scales, free at their subulate points.

Leaves in threes, with occasional two-leaved clusters, densely crowded on the branchlets, persistent for three or four years, nearly appressed together in each cluster, $1\frac{1}{2}$ to 2 in. long, curved, sharp-pointed, entire in margin, conspicuously whitened with stomatic bands on the inner surface, green with two or three stomatic lines on the outer surface; resin-canals marginal; basal sheath $\frac{3}{10}$ in. long, the basal segments speedily becoming reflexed and forming a rosette around the bases of the leaf cluster.

Cones subterminal, nearly sessile, almost globose, $1\frac{1}{2}$ to 2 in. in diameter; scales few and only well-developed and fertile in the middle of the cone, about an inch long; apophysis pyramidal, with a sharp transverse keel, and a depressed brown oval unarmed dorsal umbo. Seed, rather more than $\frac{1}{2}$ in. long; ovoid, irregularly conical or obscurely three-angled; blackish on the lower surface, dark brown on the upper surface; wing rudimentary, about $\frac{1}{3}$ in. in length, remaining attached to the scale when the seed falls.

This species is widely distributed through northern Mexico, where it often forms scattered open forests of considerable extent on the lower slopes of the mountain ranges, though it occasionally ascends to 10,000 ft. The seeds are sold in the markets of Mexican cities, forming an important article of food, and are eaten roasted or are ground into flour. This pine also occurs in the mountains of central and southern Arizona, usually above elevations of 6500 ft., and was found by Brandegee, forming a forest, on the top of the Sierra de Laguna in Lower California.

This species¹ was introduced into England in 1830, when the Horticultural Society obtained a plant from Mr. Otto of Berlin; and seeds were subsequently sent from Mexico by Hartweg in 1839. The largest specimen is at Highnam, and measured, in 1908, 33 ft. by 2 ft. 8 in. Another at Glasnevin, which is about 25 ft. high, divides into two stems at 8 ft. from the ground, and bears cones freely. There are smaller trees at Kew and Menabilly.

(A. H.)

¹ Loudon, in *Arb. et Frut. Brit.* iv. 2267 (1838), gives an incorrect figure of the cone of *P. Llaveana*, a synonym of the species; but in his *Trees and Shrubs*, 993 (1842), cones of *P. cembroides*, both from Otto of Berlin and from Hartweg, are correctly figured; and the tree in the Horticultural Society's Garden, which was $4\frac{1}{2}$ ft. high in 1837, appears to have been undoubtedly this species. Cf. also Loudon, *Gard. Mag.* xv. 128 (1839).

PINUS PARRYANA

Pinus Parryana, Engelmann, in *Amer. Journ. Science*, xxxiv. 332, note (1862) (not Gordon), and in Brewer and Watson, *Bot. California*, 124 (1880); Masters, in *Journ. Linn. Soc. (Bot.)* xxxv. 586, fig. 1 (1904); Sargent, in *Bot. Gaz.* xlv. 227 (1907); Clinton-Baker, *Illust. Conif.* i. 39 (1909).

Pinus quadrifolia, Parry, ex Parlatore in DC., *Prod.* xvi. 2, p. 402 (1868); Sudworth, *U.S. Forestry Bull.* No. 14, p. 17 (1897); Sargent, *Silva N. Amer.* xi. 43, t. 549 (1897), and *Trees N. Amer.* 10 (1905).

Pinus cembroides, Zuccarini, var. *Parryana*, Voss, in *Deut. Gartenrat*, Beilage 123 (1904); Shaw, *Pines of Mexico*, 6 (1909).

A tree, usually 20 to 30, occasionally 40 ft. in height, and rarely exceeding 5 ft. in girth. Bark, buds, and branchlets similar to *P. monophylla*.

Leaves in fours, with occasional five-leaved clusters, remotely placed on the branchlets, appressed together in the clusters, persistent three or four years, $1\frac{1}{4}$ to $1\frac{1}{2}$ in. long, incurved, rigid, sharp-pointed, entire in margin, with white stomatic bands on the inner surfaces; resin-canals marginal; basal sheath as in *P. monophylla*.

Cones and seeds similar to those of *P. monophylla*.

This species, which is scarcely distinguishable, except in the leaves, from *P. monophylla*, is restricted in its distribution to the Santa Rosa¹ and Toro mountains in the San Jacinto range of southern California, and to Lower California, where it grows as far south as the foothills of the San Pedro Martir mountain.² It was discovered in 1850 by Dr. Parry, 60 miles south-east of San Diego, California, at 2000 ft. altitude.

The four-leaved *piñon* requires a moister climate³ than *P. monophylla*, thriving where the annual rainfall is 15 to 25 in. and growing at elevations between 2500 and 8000 ft. It usually occurs in open forests, mixed with other species, as *P. monophylla*, oaks, and juniper.

It appears to be exceedingly rare in cultivation, the only specimen which I have seen being a small tree at Grignon in France. Dr. Masters appears to have seen young plants, as he states that the species is remarkable for the abundance and long duration of the primary needles, which are of a beautiful bluish colour.

(A. H.)

¹ It was found, according to S. B. Parish, in *Erythea*, vii. 89 (1899), by H. M. Hill on the desert slope of Santa Rosa mountain, where it exists in considerable quantity at about 5000 ft. altitude. It does not exist on the San Jacinto peak. H. M. Hill, in *Univ. Calif. Publications, Bot.* i. 20 (1902), reports it to be growing sparingly in the neighbourhood of Mount Toro.

² Cf. Brandegee, in *Zoe*, iv. 210 (1893).

³ Cf. Pinchot, *U.S. Forest Service, Sylvical Leaflet* 17 (1908).

PINUS MONTEZUMÆ, MONTEZUMA PINE

Pinus Montezumæ,¹ Lambert, *Gen. Pin.* i. 39, t. 22 (1832); Loudon, *Arb. et Frut. Brit.* iv. 2272 (1838); Kent, Veitch's *Man. Conif.* 345 (1900); Masters, in *Journ. Linn. Soc. (Bot.)* xxxv. 600 (1904); Clinton-Baker, *Illustrations of Conifers*, i. 35 (1909); Shaw, *Pines of Mexico*, 21, t. xiv. (1909).

Pinus Devoniana, Lindley, in *Bot. Reg.* xxv. Misc. 62 (1839).

Pinus Russelliana,² Lindley, in *Bot. Reg.* xxv. Misc. 63 (1839).

Pinus macrophylla, Lindley, in *Bot. Reg.* xxv. Misc. 63 (1839).

Pinus filifolia,² Lindley, in *Bot. Reg.* xxvi. Misc. 61 (1840).

Pinus Grenvillea, Gordon, in *Journ. Hort. Soc.* ii. 77 (1847); Masters, in *Gard. Chron.* xv. 112, fig. 22 (1881).

Pinus Gordoniana, Hartweg, in *Journ. Hort. Soc.* ii. 79 (1847).

Pinus Winchesteriana, Gordon, in *Journ. Hort. Soc.* ii. 158 (1847).

Pinus occidentalis, Humboldt, Bonpland, and Kunth, *Nov. Gen. et Sp.* ii. 4 (1817) (not Swartz).

A tree, attaining in Mexico 70 ft. in height. Bark brownish red, irregularly divided into scaly plates. Young branchlets stout, glabrous, reddish brown; their decurrent pulvini prominent, keeled, and persistent, with the epidermis peeling off in the second or third year, leaving a greyish-coloured surface. Buds ovoid, pointed, about an inch long, reddish brown, scarcely resinous; scales ending in long acuminate points, with their bases interlaced by whitish marginal fimbriæ. The brown linear-lanceolate scale-leaves with white fimbriæ, persist during the first year.

Leaves in fives, persistent three years, 4 to 18 in. long, crowded on the branchlets, spreading, serrulate, with stomatic lines on the three surfaces, ending in a cartilaginous point; resin-canals median; basal sheath $1\frac{1}{4}$ to 2 in. long, persistent. Flower buds, with the staminate catkins concealed, and not apparent as swellings externally.

Cones, in the first year, subterminal, single or in clusters of 2 to 5, stalked, pale or deep brown, blue, or dull black; scales armed with usually reflexed prickles. Mature cones $2\frac{1}{2}$ to 10 in. long, sessile or stalked, spreading or deflexed, nearly cylindrical or ovoid-conic and tapering, often curved, opening when ripe, and falling soon afterwards, when their stalks and a few basal scales often remain on the branch; scales variable in size; apophyses flat, pyramidal, tumid, or slightly protuberant and reflexed, dull yellowish, reddish brown, dark brown, or nearly black, prickles usually obsolete. Seed oval, brownish mottled with black, $\frac{1}{4}$ in. long; wing narrow, an inch or more in length.

This species is very variable, both in the length of the leaves and in the size of the cones; and is met with, according to Shaw, at all altitudes³ in Mexico, except in the lowlands of the coast, and below 3000 ft. in the interior, where the climate is

¹ Roehl's Catalogue of 82 new Mexican species, published in 1857, does not contain, according to Shaw, a single new species. They represent six or seven pines, all of which had been previously described. Roehl's list is given by Masters, in *Journ. Linn. Soc. (Bot.)* xxxv. 648, and will not be further noticed by us.

² The type specimens of the cones of these two species are preserved in the Botanical Museum, Cambridge. *P. filifolia* is labelled Guatemala.

³ Gadow, in *Journ. Linn. Soc. (Bot.)* xxxviii. 432 (1909), makes the timber line in southern Mexico 13,500 to 14,000 ft., where there are only a few scattered trees of *P. Montezumæ*.

tropical. At 9000 ft. and below, this pine mingles with the oaks in the more fertile and moister soil; while above, and more especially on the summit ridges, it sometimes forms dense forests. Large trees 3 to 4 ft. in diameter occur above Oaxaca.¹ *P. Montezumæ* was discovered near the city of Mexico in 1803 by Humboldt and Bonpland, who mistook it for the West Indian *P. occidentalis*; and it was first recognised and described by Lambert in 1832.

VARIETIES

The following account of the principal forms of this species in the wild state is taken from Shaw, who has made a special study of the Mexican pines:—

1. The typical form is sub-tropical, inhabiting the slopes and table-lands between 3000 and 6000 ft. It is characterised by long leaves, with basal sheaths exceeding an inch in length; by large non-resinous buds; and by cones 6 to 10 in. long, brown in colour, the apophyses of the scales being elevated, with usually prominent brownish umbos.

2. Var. *Lindleyi*, Loudon, *Encyc. Trees*, 1004, fig. 1882 (1842); Shaw, *Pines of Mexico*, 22, t. xv. (1909).

Pinus Lindleyana, Gordon, *Pinetum*, 229 (1858).

Leaves often very slender, and drooping like those of *P. pseudostrabus*, 6 to 10 in. long; cones 4 to 6 in. long; apophyses small and numerous, flat or slightly pyramidal, often rectangular and very like var. *Hartwegii*, but pale brown and not black in colour.

This variety occurs at altitudes with a temperate climate.

3. Var. *rudis*, Shaw, *Pines of Mexico*, 22, t. xvi. figs. 1-5, 8 (1909).

Pinus Montezumæ, Gordon, in *Journ. Hort. Soc.* i. 234 (1846); Masters, in *Gard. Chron.* viii. 466, figs. 91-94 (1890), xv. 273, figs. 29-32 (1894), and xxv. 146, fig. 53 (1899).

Pinus rudis, Endlicher, *Syn. Conif.* 151 (1847).

Pinus Ehrenbergii, Endlicher, *Syn. Conif.* 151 (1847).

Pinus Hartwegii, Parlatore, in DC., *Prod.* xvi. pt. 2, p. 399 (1868) (in part).

Leaves 4 to 6 in. long. Cones in the first year blue or bluish-black; when mature, 2½ to 4 in. long, dull, sometimes shining brown.

This variety, which usually has leaves in fives, though there are occasionally six or seven in a cluster, grows at altitudes with a warm temperate climate, and is connected by intermediate forms with var. *Lindleyi*.

4. Var. *Hartwegii*, Engelmann, in *Trans. St. Louis Acad. Sc.* iv. 177, 181 (1880); Shaw, *Pines of Mexico*, 23, t. xvii. figs. 6, 7 (1909).

Pinus Hartwegii, Lindley, in *Bot. Reg.* xxv. Misc. 62 (1839); Loudon, *Encycl. Trees*, 1000, fig. 1875 (1842); Kent, Veitch's *Man. Conif.* 348 (1900); Masters, in *Journ. Linn. Soc. (Bot.)* xxxv. 600 (1904); Clinton-Baker, *Illust. Conif.* i. 24 (1909).

Pinus Donnell-Smithii, Masters, in *Bot. Gaz.* xvi. 199 (1891), and in *Journ. Linn. Soc. (Bot.)* xxxv. 600 (1904); Smith, in *Bot. Gaz.* xix. 13, t. 2 (1894).

Leaves 3 to 6 in. long, often in threes and fours, as well as in fives. Cones

¹ Cf. *Garden and Forest*, ix. 102 (1896).

similar to those of var. *rudis*, but very dark brown, or almost black in colour when mature.

This variety occurs in colder regions and at higher altitudes than any other Mexican pine, forming the timber line and descending to some distance below it. Mr. Godman wrote to Dr. Masters that this pine forms a complete belt around the Volcan de Fuego, commencing at about 10,000 ft., and on the Volcan d'Agua ascends to the summit. The mixed forest of Cheirostemon and other trees ceases abruptly at about 10,000 ft., and one steps suddenly out of it into the more open pine belt, where the only undergrowth is a coarse grass.

CULTIVATION

Both the typical form and the varieties were introduced by Hartweg in 1839, when numerous plants were raised in the garden of the London Horticultural Society.

As seen in cultivation, this species is readily distinguishable into two principal forms; one, probably identical with the type, as defined by Shaw, and characterised by long leaves, averaging 9 in. in length, with basal sheaths 1¼ to 2 in. long, and large, scarcely resinous buds. In the only specimen which we have seen in fruit, a tree cultivated at Bicton¹ as *P. Russelliana*, the cones produced are 5 in. long, and 2¼ in. in diameter, with large shining pale brown elevated apophyses, terminating in a dark coloured projecting umbo. It was 60 ft. by 6 ft. 9 in. when measured by Elwes in 1906. The gardener in May 1909 reported that this tree was nearly dead, though it was still bearing a few old cones.

The typical form is well represented at Pencarrow, where two trees planted in 1849 measured in 1907, 50 ft. by 9 ft., and 49 ft. by 5 ft. These differ strikingly in habit, but show no differences in botanical characters. Elwes saw a fine spreading tree at Endsleigh in August 1906 which measured about 50 ft. by 9½ ft. in girth. There are good specimens at Tregothnan, Heligan, and other places in Cornwall.

At Eastnor Castle, a small spreading tree, 26 ft. high, seems healthy.

At Grayswood, Haslemere, a tree planted in 1881 had attained 25 ft. by 2 ft. 10 in. in 1906, and did not suffer in the winter of 1895.

In Ireland this succeeds well, as at Woodstock, Kilkenny, where a tree was 48 ft. by 6 ft. in 1904; and at Old Connaught House, near Bray, where a tree planted in 1869 was 34 ft. by 2 ft. 9 in. in 1904.

The other form, which is probably var. *Hartwegii*, produces cones freely, which are ovoid-conic and tapering to an acute apex, 3 to 3½ in. long, with numerous small scales, with flat apophyses, and slightly raised dark brown umbos. The leaves, often in fours as well as in fives, are 5 to 6 in. long, with basal sheaths not exceeding an inch in length. The buds are slender, ½ to ¾ in. long, with usually resinous appressed scales.

Var. *Hartwegii* is much the hardiest form; and we have found specimens, even in the eastern counties, as at Pampisford, near Cambridge, where a tree in a sheltered position is 28 ft. by 1 ft. 10 in. At Bayfordbury, Herts, a tree planted in 1845 died

¹ The Hon. Mark Rolle wrote to the Director at Kew that this tree produced cones for the first time in 1899.

in 1854; another specimen planted in 1875 is now 20 ft. high and 2 ft. 3 in. in girth. At Flitwick Manor, Bedford, a tree measured in 1908, 34 ft. by 2 ft. 7 in. Much finer trees, most of them producing cones, exist farther west, as at Westonbirt, where a tree planted in 1869 measured in 1909, 45 ft. high, and looked very vigorous. At Bicton there are two good specimens, 74 ft. by 5 ft. 3 in. and 46 ft. by 4 ft. 4 in. At Eastnor Castle, a fine tree was 55 ft. by 4 ft. 8 in. in 1909. At Bury Hill, Dorking, a tree, which R. Barclay, Esq., informs us was planted in 1847, is 36 ft. high and 3 ft. 8 in. in girth at 4 ft. from the ground. At Strete Raleigh, Exeter, H. M. Imbert Terry, Esq., reports a tree 52 ft. by 5 ft. 11 in., from which he raised about fifty seedlings in the spring of 1909. It was planted about 1855. At Pencarrow a tree measured 44 ft. by 3 ft. in 1906. At Escot, Devonshire, the seat of Sir John Kennaway, Elwes measured a tree 65 ft. by 7 ft. in 1909, with a clean bole about 35 ft. long, which is the finest of its kind that he has seen. We have also received specimens of this variety from Wadebridge and Luscombe Castle, Dawlish.

A third form, represented by a tree at Menabilly,¹ and another at Fota, has longer leaves and longer cones than in var. *Hartwegii*, though the latter are similar in every respect except in size, and may be referred in all probability to var. *rudis*. The tree at Fota (Plate 278) is a fine one, and measured 50 ft. by 7 ft. 3 in. in 1908, the branches covering an area 52 paces around. Lord Barrymore informs us that it was planted in 1878. (A. H.)

PINUS PSEUDOSTROBUS

Pinus pseudostrobus, Lindley, in *Bot. Reg. xxv. Misc. 63* (1839); Loudon, *Encycl. Trees*, 1008, figs. 1887, 1888 (1842); Masters, in *Journ. Linn. Soc. (Bot.) xxxv. 605* (1904); Shaw, *Pines of Mexico*, 19, t. xii. (1909).
Pinus orizabæ, Gordon, in *Journ. Hort. Soc. i. 237* (1846).

A tree attaining 100 ft. in height and 6 ft. in diameter. Bark of branches and young trees smooth; in old trees very rough at the base. Branchlets slender, glabrous, very glaucous; the decurrent bases of the leaves persistent, conspicuous at first, but ultimately becoming merged in the smooth bark of the older branchlets, on which they are visible as transverse lines. Buds and leaves, the latter 6 to 12 in. long, similar to those of *P. Montezumæ*, but usually more slender.

Cones sub-terminal, described by Shaw as ovate or oblong, 3 to 5½ in. long, nearly symmetrical or oblique, opening when ripe and falling soon afterwards, the peduncle and a few basal scales usually remaining persistent on the branch; apophysis variable, flat or protuberant.

1. Var. *apulcensis*, Shaw, *Pines of Mexico*, 19, t. xii. (1909).

Pinus apulcensis, Lindley, in *Bot. Reg. xxv. Misc. 63* (1839); Loudon, *Encycl. Trees*, 1014, figs. 1899, 1900 (1842).

Differs in the prolongation of the apophyses of the scales of the cone. It grows

¹ Figured in *Gard. Chron.*, *loc. cit.* It bore cones in 1899, when it was 20 ft. high, but Mr. Rashleigh said that no perfect seed was produced.

in Mexico in company with the type, and is connected with it by intermediate forms.

2. Var. *tenuifolia*, Shaw, *Pines of Mexico*, 20, t. xiii. (1909).

Pinus tenuifolia, Bentham, *Pl. Hartw. 92* (1842).

Cones ovate or long-ovate; basal scales and peduncles persistent on the branch. Hypoderm of the leaves extending from the epiderm to the endoderm, forming partitions across the green tissue.¹ Abundant at altitudes with a sub-tropical climate in the western and south-western states of Mexico, and extending southward to north-western Nicaragua.

According to Shaw, *P. pseudostrobus* occurs in Mexico at altitudes between 6000 and 10,000 ft., where the climate is temperate, with warm days and cool nights. This zone includes the tableland and the slope immediately above it.

This species, and var. *apulcensis*, were discovered in 1839 by Hartweg, who sent home in the same year cones and seeds, from which, according to Loudon, numerous plants were raised. Nearly all these have died, as the tree is evidently only suitable for cultivation in districts where the climate is mild, like Cornwall and southern Ireland. The only specimens which we have found, are two trees in Cornwall. One at Pencarrow, was obtained from Knight and Perry in 1849; and measured, in 1906, 47 ft. high, and 5 ft. 8 in. in girth. Mr. Bartlett kindly sent us photographs of this tree, and of several trees of *P. Montezumæ*, and the difference in the bark of the two species is remarkable. That of *P. pseudostrobus* is smooth, and only slightly furrowed; whereas in *P. Montezumæ*, the bark is very rough and scaly. Another, growing at Tregothnan, was measured by Mr. A. B. Jackson as 50 ft. by 6 ft. in 1909. Neither tree has produced cones. (A. H.)

PINUS TORREYANA

Pinus Torreyana, Parry, *ex Torrey*, in Emory, *Bot. Mex. Bound. 210*, tt. 58, 59 (1858); Sargent, *Silva N. Amer. xi. 71*, tt. 557, 558 (1897), and *Trees N. Amer. 34* (1905); Kent, *Veitch's Man. Conif. 348* (1900); Masters, in *Journ. Linn. Soc. (Bot.) xxxv. 602* (1904); Clinton-Baker, *Illust. Conif. i. 56* (1909).

Pinus lophosperma, Lindley, in *Gard. Chron. 1860*, p. 46.

A tree, attaining 60 ft. in height and 8 ft. in girth, but usually considerably smaller. Bark an inch in thickness, deeply divided irregularly into broad flat scaly ridges. Young branchlets glabrous, glaucous; become dull grey in the second year. Buds cylindrical-conic, ½ in. long; scales pale brown, interlaced by their marginal white fimbriæ, and with appressed points.

Leaves² in fives, persistent two years, dark green, 7 to 13 in. long, 1½ in.

¹ A very fine tree near the hotel at Bussaco, Portugal, which Elwes measured in April 1909, 90 ft. in height and 9 ft. in girth, is probably this variety; but in the absence of cones, the identification is uncertain.

² On young plants the leaves are frequently in clusters of three and four.

wide, rigid, marked on three sides by stomatic lines, serrulate, ending in a sharp cartilaginous point; resin-canals median; basal sheath an inch long.

Cones sub-terminal, spreading or deflexed, on long stalks, broadly ovoid, 4 to 6 in. long; scales thick, 2 in. long, $1\frac{1}{4}$ in. wide, shining brown; apophysis rhomboidal, transversely ridged, with an elevated pyramidal four-sided acute umbo, with or without a minute prickle. Seed oval, $\frac{3}{4}$ to 1 in. long, dull brown and mottled below, pale brown above; surrounded by a dark brown wing, thickened at the upper margin of the seed, and extending beyond its apex about $\frac{1}{2}$ in.

Masters describes the seedlings, raised at Kew, as robust, with a long tapering radicle, stout cylindrical stem, and twelve linear cotyledons, succeeded by primary leaves, elliptic in section.

This species is more circumscribed in its distribution than any other pine. It occurs in two localities, the main body growing in a narrow belt, about eight miles long, on the Californian coast, near the mouth of the Soledad river, north of San Diego, nowhere penetrating inland more than a mile and a half. This grove was discovered by Dr. Parry in 1850, whose attention was directed to this pine by J. L. Le Conte, the distinguished entomologist, who was then collecting at San Diego. A single grove, of about one hundred trees, with numerous seedlings, discovered by Brandegee in 1888, also grows on the eastern end of Santa Rosa island,¹ on a bluff 500 ft. above the level of the sea. These trees average 30 ft. high.

Miss Sessions of San Diego, who sends us an account of this pine, which was fast disappearing, states that of late steps have been taken, which will ensure its preservation. It grows on the sea-coast, buffeted, twisted, and often prostrated by the ocean winds, and averages 30 to 40 ft. in height. At Del Mar, 22 miles north of San Diego, the South Coast Land Company has bought a large tract, including all the sandstone cliffs and cañons leading down to the sea, where the Torrey pines grow in this neighbourhood. The Company has built an hotel, and is protecting all the old pines, and preserving the natural seedlings, and planting in addition. The Torrey Pine Park, which is public property, is on a high and exposed point, south-west of Del Mar; and here all the trees are carefully guarded.

William Lobb sent specimens, with cones and seed, to Low's nursery at Clapton in 1860, which were described by Lindley² as *P. lophosperma*. Plants were reported³ to be growing in the Edinburgh Botanic Garden in 1868. It has, however, proved tender there and at Kew, and seems unsuited for cultivation except in warm districts like Cornwall and southern Ireland. The only specimen now living, that we are acquainted with, was planted at Bayfordbury in 1908. Mayr, however, states⁴ that he raised seedlings in Japan, which bore a temperature of -12° Cent. without injury. There are three fairly large trees of this species in the Public Gardens, Christchurch, New Zealand, which bear a few cones.⁵

(A. H.)

¹ *Garden and Forest*, x. 232 (1897).

² *Gard. Chron.* 1860, p. 46.

³ *Gard. Chron.* 1868, p. 237.

⁴ *Wald. Nordamer.* 276 (1890).

⁵ T. W. Adams, *Genus Pinus*, 10, paper read at Phil. Inst., Canterbury, N.Z., 7th August 1907.

PINUS COULTERI, COULTER'S PINE.

Pinus Coulteri, Don, in *Trans. Linn. Soc.* xvii. 440 (1836); Loudon, *Arb. et Frut. Brit.* iv. 2250 (1838); Lawson, *Pinet. Brit.* i. 23 (1884); Masters, in *Gard. Chron.* xxxiii. 415, figs. 73, 74 (1885), iv. 764, fig. 109 (1888), and in *Journ. Linn. Soc. (Bot.)* xxxv. 597 (1904); Sargent, *Silva N. Amer.* xi. 99, tt. 571, 572 (1897), and *Trees N. Amer.* 24 (1905); Kent, *Veitch's Man. Conifera*, 325 (1900); Clinton-Baker, *Illust. Conif.* i. 17 (1909).
Pinus macrocarpa, Lindley, in *Bot. Reg.* xxvi. app. 61 (1840).

A tree, attaining in America 80 ft. in height and 12 ft. in girth. Bark about 2 in. thick, dark brown, deeply divided into broad rounded connected scaly ridges. Young branchlets stout, glabrous, glaucous, with very prominent pulvini. Buds ovoid, acuminate or cuspidate, very large, 1 to $1\frac{1}{2}$ in. long, and $\frac{3}{4}$ in. thick; scales appressed, coated with resin, light brown, with white fimbriæ on their margins.

Leaves in threes, spreading, persistent for three or four years, 8 to 12 in. long, $\frac{1}{16}$ to $\frac{1}{12}$ in. wide, rigid, curved, twisted, serrulate, marked with numerous stomatic lines on the three surfaces, ending in a long sharp cartilaginous point; resin-canals median; basal sheath $1\frac{1}{2}$ in. long.

Cones¹ lateral, on short stout stalks, pendulous, ovoid, 10 to 14 in. long, and 4 to 5 in. in diameter, yellowish brown; scales thick, $2\frac{1}{2}$ in. long, $1\frac{1}{2}$ in. broad; apophyses obliquely pyramidal, terminating in flattened elongated umbos, straight or curved, and armed with flattened incurved resinous spines. Seeds, on deep depressions on the scales, oval, compressed, $\frac{1}{2}$ in. long, dark brown or blackish, encircled by the wings which, very narrow and rim-like on the sides, expand above, and are oblique, brown, and about an inch in length. Cotyledons, 10 to 14.

The cones open in autumn in California, remaining, after the seeds escape, on the branches for several years. Occasionally the cones are shorter and thicker than usual, with short spurs, and then resemble those of *P. Sabiniana*; but they may always be distinguished by the long-winged seeds, which leave long depressions on the inner surface of the scales.

This species is scattered singly or in small groves through coniferous forests on the dry slopes and ridges of the coast ranges of California, from Mount Diablo and the Santa Lucia mountains southwards to the Cuyamaca mountains, at elevations between 3000 and 6000 ft. It is most abundant on the San Bernardino and San Jacinto² ranges, at 5000 ft. altitude. It is usually known as the big-cone pine, from the size of the cones, which often weigh three or four pounds. The seeds were formerly gathered in large quantities and eaten by the Indians. *P. Coulteri* differs

¹ According to Lawson, *Pinet. Brit.* i. 24 (1884), a tree, eighteen years old, in the Jardin des Plantes, Paris, produced two cones in 1852.

² H. M. Hall, in *Univ. Calif. Publications, Botany*, i. 20, 53 (1902), says it is commonly met with on the south and west sides of the San Jacinto mountain, where it forms small groves and narrow strips along the lower edge of the belt of *P. ponderosa*. It is also found scattered among the other pines up to 6500 to 7500 ft. on south slopes, but does not occur on the sides of the mountain facing the Colorado desert. The seeds have a strong oily taste, and are not gathered by the Saboba and Santa Rosa Indians, those of *P. monophylla* and *P. Parryana* being much preferred.

much in habit¹ from *P. Sabiniana*, always having a straight undivided stem, with wide spreading branches, forming a broad pyramid of foliage.

This species was discovered by Coulter² in the Santa Lucia mountains in 1832; and in the same year Douglas sent home specimens with seeds, from which plants were raised in the garden of the Horticultural Society. Young plants were raised³ at Kew in 1840 from the seed of a cone, the origin of which is not stated. A further consignment of seed was sent home by William Lobb⁴ in 1851.

P. Coulteri is rare in cultivation, and the finest specimens appear to be in Herts, where a tree at St. Cross, Hoddesdon, planted by Miss Warner in 1857 (Plate 279), bore twenty large cones in December 1908, and measured, according to Mr. Clinton-Baker, 80 ft. in height and 9½ ft. in girth, but Elwes, who measured it carefully in February 1909, only made it 74 ft. by 9 ft. 4 in. Its branches, one of which is 36 ft. long, sweep the ground. At The Frythe, Welwyn, a tree, 56 ft. by 8 ft., bore cones in 1906, and had a few old cones persistent on the stem. At Youngsbury, Ware, a tree, planted in 1866, measured 51 ft. by 6 ft. 5 in. in 1907. At Ponfield, a tree, 40 ft. by 3 ft. 10 in. in 1906, also had a cone persistent on the stem at 25 ft. from the ground. At Bayfordbury, a tree planted in 1841 is 56 ft. by 8 ft. 8 in., and in 1909 for the first time bore a single cone. A larger tree here, planted in 1838, was cut down in 1906, when it measured 72 ft. by 8 ft. 11 in. A plank from it is preserved in the forestry museum, Cambridge. At Garston Manor, Watford, the seat of Mr. Watney, Sir Hugh Beevor has measured a tree⁵ 75 ft. by 9 ft. 10 in. in girth, dividing into two stems at 15 ft. from the ground, which bore cones in 1909.

At Knaphill Nursery, near Woking, Elwes measured in 1907 a tree, 71 ft. by 8 ft. 10 in., which has since died. A fine healthy tree, with a few cones near the top, growing at Enville Hall, Stourbridge, measured, in 1905, 71 ft. by 9 ft. 7 in. At Orton Hall, Peterborough, there is a fine specimen 70 ft. by 7 ft. 9 in. in 1909, which has only produced a few cones at rare intervals.

The largest tree in Kew Gardens is situated near the Succulent House, and measured 55 ft. by 8 ft. in 1909. There is a healthy tree at Toddington Grange, Gloucestershire, the seat of H. Andrews, Esq., which bore cones in 1909 and measures 62 ft. by 6½ ft. At Tortworth, there was a tree, growing on a slope with a westerly exposure, on the lower shaly beds of carboniferous limestone, cones⁶ of which were sent to Dr. Masters in 1896. It died and was cut down in 1902.

We have not seen or heard of any tree in Scotland; but at Powerscourt, Ireland, a tree measured 57 ft. by 7 ft. 1 in. in 1903. (A. H.)

¹ Mayr, in *Wald. Nordamer.* 332 (1890), states that it attains in favourable conditions a height of 150 ft.; but this great height is not confirmed by Sargent or Jepson.

² An account of Coulter's expeditions in Mexico and California is given by Coville in *Bot. Gazette*, xx. 519 (1895).

³ Loudon, *Encycl. Trees*, 985 (1842).

⁴ *Hortus Veitchii*, 343 (1906).

⁵ Cones weighing 3 lb. from this tree were shown at a meeting of the Scientific Committee of the Royal Horticultural Society on 10th October 1905.

⁶ Two cones, dried after keeping seven years, weigh 1½ lb. each. Masters mentions a tree at Kenfield near Canterbury, which produced cones in 1886. The gardener informs us that it is no longer living.

PINUS SABINIANA, DIGGER PINE

Pinus Sabiniana, Douglas, in *Trans. Linn. Soc.* xvi. 747 (1833); Loudon, *Arb. et. Frut. Brit.* iv. 2246 (1838); Lawson, *Pin. Brit.* i. 85, t. 11. (1884); Masters, in *Gard. Chron.* iv. 44, fig. 4 (1888), and v. 44, fig. 6 (1889), and in *Journ. Linn. Soc. (Bot.)* xxxv. 597 (1904); Sargent, *Silva N. Amer.* xi. 95, tt. 569, 570 (1897), and *Trees N. Amer.* 23 (1905); Kent, *Veitch's Man. Conif.* 375 (1900); Clinton-Baker, *Illust. Conif.* i. 50 (1909).

A tree, usually 20 to 50 ft. high, occasionally attaining 80 ft. in height and 12 ft. in girth. Bark about 2 in. thick, dark brown, irregularly divided into thick connected scaly ridges. Young branchlets slender, glabrous, glaucous, with prominent pulvini. Buds narrowly cylindrical, acute at the apex, about 1 in. long; scales closely appressed, more or less coated with resin, pale brown, with long white fimbriae on the margins.

Leaves in threes, persistent for three years, spreading or drooping, 7 to 12 in. long, ½ in. wide, twisted, greyish green, with numerous stomatic lines on the three surfaces, serrulate, ending in a cartilaginous point; resin-canals median; basal sheath 1 in. long.

Cones lateral, on stout stalks, pendulous, ovoid, dark brown, 6 to 10 in. long, 4 to 5 in. in diameter; scales thick, about 2 in. long and 1 in. broad, with an obliquely raised pyramidal apophysis, prolonged into a hooked process, usually ending in a sharp incurved spine. Seeds in deep hollows on the scale, oblong, dark brown or blackish, ¾ in. long, ½ in. wide, with a thick shell, encircled by the wing, which is reduced to a very narrow sharp rim below, expanding above into a brown thickened membrane, about ½ in. long. The seeds are eaten and distributed by the Douglas squirrel, and, having a sweet resinous flavour, were formerly used as food by the Indians of California. Cotyledons about 15 to 18.

This species is readily distinguished from *P. Coulteri* by the greyish green foliage and slender glaucous branchlets. Both have very massive cones, with spurred scales, armed with spines, and very large seeds, differing, however, in the length of the wing. The cones of *P. Sabiniana* are shorter and broader, and in this country open more freely than those of *P. Coulteri*. According to Jepson,¹ the trees in Mitchell Cañon, Mount Diablo, which he refers to *P. Coulteri*, resemble very closely those of *P. Sabiniana* in cones and foliage, and are intermediate between the two species.

This pine, which often divides into three or four stems 14 to 20 ft. above the ground, forming a round-topped tree, remarkable for the sparseness of its foliage, is scattered singly or in small groups over the dry and hot foot-hills of the inner Coast Range, of the Sacramento Valley, and of the Sierra Nevada, throughout almost the whole length of California, attaining its largest size east of the Sierra Nevada near the centre of the state, where it is often the most conspicuous feature of the vegetation.

Muir, in an article in *Harper's Magazine*,² notes that in the Sierra Nevada it grows only in the torrid foot-hills, often amongst thickets of scrubby oaks, *Ceanothus*,

¹ *Flora W. Mid. California*, 22 (1901).

² Reproduced in *Gard. Chron.* iv. 44 (1888).

and Manzanita, and ranges from 500 to 4000 ft. elevation. No other tree that he knows, is so thin and pervious to light, even the largest giving no shade.

In California *P. Sabiniana* is occasionally tapped, and exudes a nearly colourless liquid with a strong aromatic smell, resembling that of oil of orange, which is sold in San Francisco under the names abietene, erasine, aurantine, or theoline, as a substitute for benzine in removing grease spots from clothes. Wenzell described¹ in 1871 as abietene the hydrocarbon obtained by distilling the crude product; and Thorpe² afterwards showed that this was pure heptane, of which he obtained as much as 7 litres from 7½ litres of the liquid exudation of the tree.

This species was discovered by Douglas in 1826, but he did not send seeds till 1832, when plants were raised in the Horticultural Society's garden. It is very rare in cultivation, and is not quite hardy, as Palmer mentions a tree, 46 ft. high, at Rolleston Hall, Staffordshire, which was killed in the severe winter of 1860. A tree planted at Bayfordbury in 1837 was also killed in the same year.

There is a fine tree at Madresfield Court, close to the church, which when measured by Elwes in 1908 was 60 ft. high by 6 ft. 9 in. in girth. It has borne ripe cones, and there were young ones near the top in 1908. At Ledbury, in Lord Biddulph's grounds, a tree (Plate 280) 65 ft. high by 9½ ft. in girth bore cones in 1909. A tree at Tortworth, planted by Lord Ducie in 1856, is now about 63 ft. high and 7 ft. in girth below the fork. It is, however, sickly in appearance. A tree at Eastnor Castle, 62 ft. by 6½ ft., bore fruit in 1908.

At Orton Longueville, a tree with a large lateral branch at 20 ft. up, measured 58 ft. by 7 ft. 8 in. in 1909. At Hunstanton Hall, Norfolk, the seat of Hamon le Strange, Esq., there are fourteen trees growing in the park, variable in height, some with single stems, others branching into two or three stems. The largest is 52 ft. by 7 ft.; and only one tree is bearing fruit, a single old cone.

There are two trees in Kew Gardens, the larger³ of which, in 1909, was 55 ft. high and 6 ft. 4 in. in girth. A tree at Flitwick Manor, Bedford, was reported in 1908, by Mr. H. Clinton-Baker, to be 50 ft. high and 4 ft. 4 in. in girth. Miss Woolward sends us a branch from a tree, 40 ft. high and 4 ft. in girth, growing in a field belonging to Mr. Kennet-Were, Cotlands, Sidmouth. Kent reports trees at Pampisford, Cambridge, and at Highnam Court, Gloucestershire, which appear to be no longer in existence.

(A. H.)

¹ In a paper read before the Californian Pharmaceutical Society on 13th December 1871, and reprinted in *Pharm. Journ.* for 30th March 1872.

² *Journ. Chem. Soc.* xxxv. 296 (1879) and xxxvii. 213 (1881). Cf. *Pharm. Journ.* iii. 2, p. 789.

³ Figured in *Gard. Chron.* v. 44, fig. 6 (1889).

PINUS PONDEROSA, YELLOW PINE

Pinus ponderosa, Lawson, *Agric. Manual*, 354 (1836); Loudon, *Arb. et Frut. Brit.* iv. 2243 (1838); Forbes, *Pinet. Woburn.* 44, t. 15 (1839); Sargent, in *Garden and Forest*, viii. 392 (1895), *Silva N. Amer.* xi. 77, tt. 560, 561 (1897), and *Trees N. Amer.* 15 (1905); Masters, in *Gard. Chron.* viii. 557, figs. 110, 111, 114, 115 (1890), and in *Journ. Linn. Soc. (Bot.)* xxxv. 593 (1904); Kent, Veitch's *Man. Conif.* 363 (1900); Shaw, *Pines of Mexico*, 24, pl. 17 (1909); Clinton-Baker, *Illust. Conif.* i. 45 (1909).

Pinus Benthamiana, Hartweg, in *Journ. Hort. Soc.* ii. 189 (1847), and iv. 212, with fig. (1849).

Pinus brachyptera, Engelm., in Wislizenus, *Tour in N. Mexico*, 89 (1848).

Pinus Beardsleyi, Murray, in *Edin. New Phil. Journ.* i. 286 (1855).

Pinus Craigana, Murray, in *Edin. New Phil. Journ.* i. 286 (1855).

Pinus Engelmanni, Torrey, in *Pacific Rly. Rep.* iv. 141 (1856).

Pinus Parryana, Gordon, *Pinetum*, 277 (1875).

A tree, attaining in America 150 to 230 ft. in height, and 15 to 25 ft. in girth. Bark for eighty to a hundred years broken into rounded ridges, covered with small appressed brownish scales; on older trees 2 to 4 in. thick, deeply divided into large plates, separating on the surface into thick reddish scales. Young branchlets stout, glabrous, shining, reddish, becoming nearly black in the second or third year. Buds cylindrical-conic, acute, ¾ in. long; scales reddish brown, closely appressed, resinous.

Leaves in threes, persistent three years, spreading, densely crowded on the branchlets, 6 to 10 in. long, ¼ to ½ in. broad, rigid, curved, marked with stomatic lines on the three sides, serrulate, ending in a sharp cartilaginous point; resin-canals median; basal sheath ⅞ in. long. The lanceolate-acuminate fimbriated scale-leaves persist long on the branchlets.

Cones sub-terminal, solitary or clustered, sessile or sub-sessile, spreading or slightly deflexed, ovoid, 3 to 5 in. long, light reddish brown; scales oblong, about 1¼ in. long, ½ in. wide, thin towards the base and thickened at the apex; apophysis rhomboidal, with a sharp transverse ridge and elevated umbo, armed with a slender prickle. Seed oval, about ¼ in. long, with a dark, mottled shell; wing about 1 in. in length. The cones shed their seeds¹ at the end of the second year, and usually fall soon after, generally leaving some of the lower scales attached to the peduncle on the branch; and hence this species and its varieties are called "broken-cone pines" by Lemmon.

This species spread over an immense area, consists of a number of geographical races which have been distinguished as distinct species by various authors. As these gradually pass into one another, and do not occupy isolated areas, they are best treated as varieties.

1. The typical form described above occurs mainly on the Pacific slope, where it grows to a large size, and is mainly distinguishable from var. *Jeffreyi* by its glabrous, shining, non-glaucous branchlets, which emit when cut an odour of turpentine, and its resinous buds with appressed scales. The cones are ovoid-conic,

¹ R. Douglas states that seeds of this species germinate as well in the fifth year as in the first. Cf. *Gard. Chron.* iv. 185 (1888).

4 to 5 in. long, narrow in proportion to their length. The leaves are variable in size, and average 6 or 7 in. long.

2. Var. *scopulorum*, Engelmann, in Brewer and Watson, *Bot. Calif.* ii. 126 (1880).

Pinus ponderosa, Engelmann, in *Amer. Journ. Sci. Arts*, xxxiv. 332 (1862) (not Lawson); Hooker, in *Gard. Chron.* ix. 796, fig. 138 (1878).

Pinus scopulorum, Lemmon, in *Garden and Forest*, x. 183 (1897); Mayr, *Fremdländ. Wald- u. Parkbäume*, 370 (1906).

Usually 50 to 75, occasionally 150 ft. in length, and 4 ft. in diameter. Bark dark and furrowed, or bright red broken into large plates. Leaves in clusters of both twos and threes, 3 to 6 in. long. Cones, in clusters of two, ovoid-conic, smaller than in the type, about 3 in. long. This variety occurs in the Rocky Mountains and eastward, in eastern Montana, Nebraska, Dakota,¹ Colorado, western Texas, northern New Mexico, and Arizona.

3. Var. *Jeffreyi*, Vasey, *U.S. Rep. Dept. Agric.* 179 (1875); Sargent, *Silva N. Amer.* xi. 79, tt. 562, 563 (1897), and *Trees N. Amer.* 16 (1905); Kent, *Veitch's Man. Coniferæ*, 364 (1900); Shaw, *Pines of Mexico*, 24 (1900).

Pinus Jeffreyi, Balfour, *Bot. Exped. Oregon*, 2, fig. (1853); Lawson, *Pin. Brit.* i. 45, t. 6 (1884); Masters, in *Gard. Chron.* v. 360, fig. 65 (1889); Clinton-Baker, *Illust. Conif.* i. 27 (1909); Hemsley, in *Bot. Mag.* t. 8257 (1909).

Pinus deflexa, Torrey, in Emory, *Rep. Mex. Bound.* 209 (1858); Murray, in *Gard. Chron.* iv. 295, fig. 65 (1875).

Attaining 150 to 200 ft. in height, and 20 ft. in girth. Bark bright red, divided into large irregular scaly plates. Young branchlets glaucous, exhaling, when cut, an aromatic odour like that of lemon. Buds reddish brown, non-resinous, and with the points of the scales free. Cones ellipsoid, very large, 5 to 12 in. long, short-stalked, with either stout or slender recurved prickles. Seeds often $\frac{1}{2}$ in. long, with long wings. This variety occurs in the Sierra Nevada, San Bernardino, San Jacinto, and Cuyamaca mountains in California, and on the San Pedro Martir mountain in Lower California.

4. Var. *Mayriana*, Sargent, *Silva N. Amer.* xi. 81 (1897).

Pinus latifolia, Sargent, in *Garden and Forest*, ii. 496, fig. 135 (1889); Brandegee, in *Garden and Forest*, v. 111 (1892); Koehne, *Deut. Dendr.* 36 (1893).

Pinus Engelmanni, Lemmon, in *Erythraea*, i. 134 (1893) (not Torrey or Carrière).

Pinus Mayriana, Sudworth, *U.S. Forestry Bull.* No. 14, p. 21 (1897); Mayr, *Fremdländ. Wald- u. Parkbäume*, 367 (1906).

Leaves very long and stout, 14 to 15 in. long, $\frac{1}{16}$ in. broad. Cones very oblique; scales with projecting knobbed umbos, armed with sharp prickles.

This variety,² said to be a tree about 80 ft. high, was discovered on the southern slope of the Santa Rita mountains in Arizona by Mayr in 1887.

¹ Cf. Graves, *Black Hills Forest Reserve*, published in *U.S. Geol. Survey*, 1897-98, pt. v. *Forest Reserves* (1899).

² Toumey, in *Garden and Forest*, viii. 22, fig. 4 (1895), figures this tree, or a similar form, on Mount Chiricahui, in south-eastern Arizona, and believes that all the varieties of *P. ponderosa* occur there, gradually passing into one another. Lemmon, in *Erythraea*, ii. 103, fig. 3 (1894), describes and figures the Chiricahui pine as *P. apachea*.

5. Var. *arizonica*, Shaw, *Pines of Mexico*, 24 (1909).

Pinus arizonica, Engelmann, in Rothrock, *Rep. Geol. Surveys*, vi. 260 (1878); Sargent, *Silva N. Amer.* xi. 75, t. 559 (1897), and *Trees N. Amer.* 14 (1905).

A tree 80 to 100 ft. high, with black and deeply furrowed bark. Young branchlets glaucous. Leaves usually in fives, but occasionally also in threes, according to Shaw. Cones ovoid, small, 2 to $2\frac{1}{2}$ in. long.

This occurs on the sides of cañons of the mountain ranges of southern Arizona at 6000 to 8000 ft. elevation, sometimes forming nearly pure forests. It is more abundant and attains its largest size on the sierras of northern Mexico, in Sonora, Chihuahua, and Nuevo Leon.

6. Var. *macrophylla*, Shaw, *Pines of Mexico*, 24 (1909).

Pinus macrophylla, Engelmann, in Wislizenus, *Tour N. Mexico*, 103 (1848), and in *Trans. St. Louis Acad.* iv. 181 (1880).

Pinus Engelmanni, Carrière, in *Rev. Hort.* 227 (1854).

A tree 70 to 80 ft. high. Leaves 12 to 16 in. long, stout, in threes, fours, and fives. Cones large (according to Engelmann, $4\frac{1}{2}$ in. long); scales with apophysis prolonged into a reflexed protuberance, armed with either a stout or slender prickle.

Discovered by Wislizenus on the mountains of Cosiquirachi, where it is said to be abundant. According to Shaw, it occurs in Sonora and Chihuahua in northern Mexico. (A. H.)

DISTRIBUTION AND HISTORY

This splendid tree is the most important species of pine in western North America, being the most widely distributed, the largest except *P. Lambertiana*, and the most variable. It occurs over a vast region, extending eastwards to Montana, the Black Hills of Dakota, Nebraska, Colorado, and western Texas, and westwards to the shores of the Pacific, attaining its most northerly limit in the dry interior of British Columbia,¹ in the north Thompson valley, and around Shushwap lake, in lat. $51\frac{1}{2}^{\circ}$, descending the Fraser river to thirty miles above Yale. It reaches southwards to Lower California, Arizona, New Mexico, and northern Mexico. It is essentially a tree of dry regions and sunny aspects, yet able to endure a great degree of cold in winter. It is the first pine which the traveller sees on going west across the prairies in western Nebraska,² and forms the greater part of the forests, now rapidly disappearing, which cover the Black Hills of Dakota, where it attains a maximum height of 100 ft. and a diameter of 19 in.

In Montana it becomes a larger tree, attaining a height of 150 ft. on the dry slopes of the mountains near Helena, where it ascends to 6000 ft., in company with the Douglas fir and Western larch. In the Flathead valley it grows in scattered groups on the margin of the prairie in the plain of Kalispell, and gradually advances

¹ Macoun, *Cat. Canad. Plants*, i. 466. Palmer, in *Brit. Columbia Bull.* No. 21, p. 10 (1905), gives its habitat as the dry plateau between the Coast and Gold Ranges, where it is largely used for lumber. The seeds were formerly eaten by the natives.

² Bessey, in *Bot. Gazette*, xxii. 245 (1896), gives its distribution in Nebraska, as along the northern border in the valley of the Niobrara river, in the south-western corner, along the river Platte, where I saw it in 1904, and in patches in the centre of the state in cañons of the Loup.

into the dense mixed coniferous forest of the surrounding mountains. Plate 281, from a negative taken by Prof. Elrod, represents a yellow pine near Flathead Lake. Near Whitefish, Henry measured an average tree, 148 ft. in height and 11½ ft. in girth, which showed when felled 3½ in. thick of bark, 3 in. of sapwood, and 360 annual rings. In the Blackfoot valley, near Missoula, I measured a tree 140 ft. high by 15 ft. in girth.

In Colorado the mountain form¹ forms very extensive pure forests on the plateau between 7000 and 8200 ft., ascending occasionally to 9000 ft., and descending to 4500 ft. Here the tree rarely exceeds 80 ft. in height and 3 ft. in diameter. It extends southwards along both sides of the Rockies to western Texas, northern New Mexico, and Arizona, exhibiting in the latter state several peculiar forms, which have been distinguished, on account of their very long needles and peculiar cones, as distinct species (*P. Mayriana*, *P. apachea*). It also spreads into the northern states of Mexico² in varieties with leaves varying in number, distinguished as *P. macrophylla* and *P. arizonica*, the latter being also a native of Arizona.

In wet regions, like the coast of British Columbia and Vancouver Island, the tree is unknown; but it grows in Washington, close to Puget Sound, on dry gravelly prairies. In eastern Washington it forms an open pure forest on the lower timber line, bordering on the arid region, and ranges from 400 to 6200 ft. According to Piper,³ it has a marked preference for granitic soil, though it grows on basaltic clay in the Blue Mountains. It here attains its maximum development at 2000 ft., reaching a height of 200 ft. and a diameter of 6 ft. It is common along the eastern slopes and foothills of the Cascade range, and becomes a conspicuous tree in southern Oregon, where the climate is drier, forming considerable forests at Grant's Pass and in the Siskiyou mountains.

In California it occurs in the coast ranges,⁴ as in Sonoma and Napa counties, and there is a fine forest of this species on the Howell mountain plateau; but no trees are known in the inner coast ranges bounding Solano and Yolo counties. It is not recorded from the San Francisco Bay ranges, except from the Mt. Hamilton ridges. It is abundant in the Sierra Nevada, at or above 5000 ft.; and, according to Muir,⁵ ranges on the western slope from 2000 ft. to timber line, and, crossing the range by the lowest passes, descends to the eastern base, and pushes far out into the hot volcanic plains. The largest tree measured by Muir grew in the Merced valley, and was 220 ft. high and 8 ft. in diameter.

Var. *Jeffreyi* occurs in California,⁶ from Scott's Mountain in Siskiyou county, and along the eastern slopes of the Sierra Nevada, forming large forests at the headwaters of the Pitt and McCloud rivers, and often grows on the most exposed and driest ridges, wandering out among the volcanoes of the Great Basin. Sudworth records it from Douglas county in southern Oregon; and it is the chief pine on the lower slopes of Mount Shasta, which it ascends to about 5500 ft., the largest that I

¹ A tree growing in Monument Park, Colorado, is figured by Sir J. Hooker in *Gard. Chron.* ix. 796, fig. 138 (1878).

² Shaw, *op. cit.* 2, states that *P. ponderosa* extends in Mexico southwards to lat. 23° or 24°.

³ *Contrib. U.S. Nat. Herb.* xi. 50, 92, tt. xiv. xv. (1906).

⁴ Jepson, *Flora W. Mid. California*, 21 (1901).

⁵ In *Harper's Magazine*, xxii. 719.

⁶ Sir J. Hooker, in *Gard. Chron.* xxii. 814, fig. 141 (1884), gives a sketch of a tree growing in the Silver Mountains in the Sierra Nevada range, on the eastern slope, and says he met with no specimens nearly so large as 200 ft., the height given by Sargent.

measured here being 120 ft. high by 13½ ft. in girth. It extends southwards to the San Bernardino and the San Jacinto ranges, up to 8000 ft. elevation, in the Cuyamaca mountains, and finds its most southerly point¹ on the San Pedro Martir mountain,² in Lower California.

P. ponderosa was first mentioned by Lewis and Clarke, who saw it in 1804 on the Upper Missouri, on their memorable journey across the Rocky Mountains. It was not made known to science, however, until David Douglas found it³ on the Spokane river, in Washington, in 1826, and in the *Companion to the Botanical Magazine*, ii. 111, published in 1836, mentioned it as a new pine under the name of *P. ponderosa*. This name was taken up in 1836 by Lawson,⁴ to whom Sargent attributes its description, which was taken from a tree in the Caledonian Horticultural Society's Garden, raised from the seeds sent by Douglas in 1827 to the London Horticultural Society.

The variety *Jeffreyi* was discovered by Jeffrey in October 1852 in the Shasta valley, in northern California, and introduced in the following year.⁵

CULTIVATION

So far as I have seen, this tree succeeds best and attains the greatest size on dry, well drained, but deep soil in the south of England, while it often becomes unhealthy and dies in damp situations; and, though perfectly hardy⁶ in Scotland, is not so large or so thriving there as in the south. It ripens seeds freely in good seasons, from which many plants have been raised at Tortworth and other places. The seedlings are best raised in a box and planted out when a year or two old; when once established they grow fast, and do not seem to suffer from early or late frosts.

There are several trees of *P. ponderosa* in England, which are about 90 ft. in height and some over; but we have seen none to equal the tree at Powis Castle near the Welshpool entrance to the park, which, when I measured it in 1908, was 105 ft. high⁷ and 10 ft. in girth with a clean bole of about 60 ft.

At Bayfordbury a tree planted in 1837, and growing on good loamy soil, was carefully measured with a sextant and different base lines in 1906, when it was 100½ ft. in height, its girth being 9 ft. 4 in. Exactly three years later, in April

¹ The southern form, growing on the mountains east of the San Rafael valley of southern California, and on the mountain of San Pedro Martir, in a dry climate, is figured in *Garden and Forest*, v. 184, fig. 28 (1892), under the name *P. Jeffreyi*, var. *peninsularis*, Lemmon, in *3rd Report Calif. State Forestry Board*, p. 200 (1891).

² Brandegee, in *Zoe*, iv. 201 (1893), describes this mountain as a plateau 7000 to 8000 ft. elevation, with ridges 2000 to 3000 ft. higher. It is cold in winter, ice lasting until May, and the rainfall is considerable. *P. Jeffreyi* is the most common tree on the plateau, a few trees of *P. Lambertiana* occurring on the ridges. *P. Parryana* is common at lower elevations than the plateau.

³ A specimen, collected by Douglas, in the Kew Herbarium, bears a parasitic plant, *Arceuthobium occidentale*, Engelm., figured by Loudon, t. 2137, as *A. oxycedri*, Bieb.

⁴ Lawson, *Agricultural Manual*, 354 (1836).

⁵ These particulars are taken from Jeffrey's advice note, which Prof. I. B. Balfour has allowed us to consult.

⁶ At Thorpe Perrow, Bedale, all the conifers raised from seeds collected by Hartweg were killed in the severe winter of 1860-61, when 46° of frost were registered, except *P. Benthamiana*, the Californian coast variety of *P. ponderosa*, of which two fine trees were surviving in 1888. Cf. *Gard. Chron.* iii. 236 (1888).

⁷ This is the tree mentioned in the notes supplied to the Royal English Arboricultural Society on their visit in 1909 as a Corsican pine, No. 6.

1909, two measurements taken by Mr. H. Clinton-Baker make it 101 ft. by 9 ft. 7 in. It girthed in 1865, 4 ft. 9 in., and in 1900, 9 ft. Sir H. Beevor has measured another at Garston Manor, Watford, 90 ft. by 8 ft. 2 in.

Another at Dropmore is believed to be one of Douglas's original seedlings, planted in 1829, and, as measured by Mr. Page in 1909, was 99 ft. by 8 ft. 9 in.; in 1905 I made it 92 ft. by 8½ ft. At Arley Castle two trees of the same origin, measured by Mr. R. Woodward in 1909, were 104 ft. by 7 ft. 8 in., and 96 ft. by 6 ft. 7 in. At Highnam there is a tree 72 ft. by 9 ft. 4 in. At Escot St. Mary, Miss F. Woolward measured a tree 94 ft. by 7 ft. 8 in. At Brocklesby Park, Mr. Havelock measured, in 1904, a tree 87 ft. by 6 ft. 10 in. On the heavy clay at Orton Longueville the largest is only about 70 ft. by 7½ ft.

In the damper climate of the west it does not seem to grow so fast, the best tree at Killerton being only 72 ft. by 6½ ft. At Eastnor Castle, there are two trees of the typical form, 65 ft. by 7 ft., and 65 ft. by 8 ft. 4 in., and a specimen of var. *Jeffreyi*, 58 ft. by 5 ft., all the measurements being taken by Mr. Mullins in 1909. Var. *Jeffreyi* is 60 ft. by 5 ft. 3 in. at Westonbirt, and 56 ft. by 5 ft. 1 in. at Orton.

In Wales I have not noticed any specially noteworthy trees, the climate at Penrhyn being clearly too wet to suit its requirements.

In Scotland the best we have seen is at Smeaton Hepburn. A tree¹ of var. *Jeffreyi*, planted in 1856, measured in 1902, 72 ft. high and 4 ft. 9 in. in girth. A tree at Scone, Perthshire, measured² in 1891, 50 ft. by 6 ft. 8 in.

Though it grows fairly well in central and eastern Scotland, we have seen no large trees in the west, and Sir H. Maxwell mentions none.

In Ireland also it seems to be unsuccessful; none of the reports of the Conifer Conference in 1891 speak well of it, and we have seen no trees worth recording for their size.

In Germany cones matured³ for the first time in 1894, on a tree at Schaffenberg, near Berlin, which was 25 ft. high and growing with great vigour and apparently hardy. Both *P. ponderosa* and var. *Jeffreyi* have been experimented with in forest plots⁴ in Prussia, and succeeded for a time, but afterwards for some inexplicable reason gradually withered and died. The seedlings are very liable to the leaf-shedding disease, *Lophodermium Pinastri*.

As a timber tree it is not likely to have any importance in Europe, the timber being coarse in comparison with that of the native species. In North America, however, it is one of the most useful for mining and general building purposes.

As a rule, according to Sargent,⁵ *P. ponderosa* and its varieties have not proved satisfactory in the eastern states. The long-leaved Californian forms are not hardy in New England. Var. *scopulorum* is hardy near Boston, where it is impossible, however, to keep it alive more than a few years, as a fungoid disease disfigures and soon destroys it. Var. *Jeffreyi* is more successful, and the best specimens probably

¹ *Hist. Berwickshire Nat. Club*, xviii. 211 (1904).

² *Journ. Roy. Hort. Soc.* xiv. 536 (1892).

³ *Garden and Forest*, vii. 95 (1894), where it is stated that at Berlin *P. Sabiniana* succumbed in the severe winter of 1893; while *P. Coulteri* is hardy, but grows slowly.

⁴ Cf. Schwappach, *Anbauversuche fremdländ. Holzkart.* 57 (1901), and Unwin, *Future Forest Trees*, 57 (1905).

⁵ *Garden and Forest*, x. 470 (1897).

in the eastern states are in Delaware Park, Buffalo, where there are eight trees which, planted in 1871, were in 1897, 25 to 37 ft. high. A fine weeping variety, var. *pendula*, Masters, which was imported from England in 1851, and planted at Woodenethe, Fishkill on Hudson, New York, is figured¹ in *Garden and Forest*, i. 392, fig. 62 (1888); and was, in 1882, 59 ft. high and 5 ft. 7 in. in girth. We have not seen any tree showing this habit either in England or in its native country.

(H. J. E.)

PINUS TUBERCULATA, KNOB-CONE PINE

Pinus tuberculata, Gordon, in *Journ. Hort. Soc.* iv. 218 (1849), and *Pinetum*, 288 (1875), (not D. Don); Lawson, *Pinet. Brit.* i. 93, t. 13 (1884); Masters, in *Gard. Chron.* xxiv. 786, fig. 184 (1885), and *Journ. Linn. Soc. (Bot.)* xxxv. 594 (1904); Kent, Veitch's *Man. Conif.* 386 (1900); Sargent, in *Bot. Gaz.* xlv. 227 (1907); Clinton-Baker, *Illust. Conif.* i. 57 (1909).

Pinus californica, Hartweg, in *Journ. Hort. Soc.* ii. 189 (1847) (not *P. californiana*, Loiseleur).

Pinus attenuata, Lemmon, in *Mining and Scientific Press*, Jan. 16, 1892, ex Sargent, *Silva N. Amer.* xi. 107, t. 575, 576 (1897); Sargent, *Trees N. Amer.* 22 (1905).

A tree, usually 20 to 30 ft. high and 1 ft. in diameter, occasionally attaining 100 ft. in height and 2½ ft. in diameter; often divided about the middle into two ascending stems. Bark ¼ to ½ in. thick, brown, irregularly broken into large loose scales. Young branchlets slender, glabrous, reddish brown, with prominent pulvini separated by linear grooves. Buds cylindrical, pointed, brown, about an inch long, with closely appressed scales.

Leaves in threes, persistent three or four years, spreading, usually 4 to 5 in. long, slender, firm and rigid, serrulate, ending in a sharp cartilaginous point, marked by stomatic lines on the three surfaces; resin-canals median; basal sheath ½ in. long.

Cones lateral, in one, two, or three whorls on the same year's shoot, in clusters of two to four, deflexed, asymmetrical, oblique at the base, short-stalked, pale brown, elongated-conical, 3 to 5 in. long; scales thin, flat; apophyses transversely keeled, on the outer side of the cone, pyramidal, raised into conical knobs, and armed with sharp spines, on the inner side flattened and with minute prickles. Seed oval, black, grooved, ¼ in. long; wing about an inch long.

The cones are developed at an early age, often appearing in whorls on the stem, when it is only 2 or 3 ft. high; and remain both on the stem and branches unopened until the advent of a forest fire or the death of the tree. They are sometimes found embedded in the bark of old trunks.

This species is found in arid sunny situations on the mountains of south-western Oregon, south of the Mackenzie river, in the Siskiyou mountains, and southward along the western slopes of the Cascades and the Sierra Nevada, and in the coast range of California from Santa Cruz to the San Bernardino mountains, where it is abundant at 4000 ft. It is most common in Oregon, usually growing in small groves

¹ This tree is also figured in *Gard. Chron.* x. 236, fig. 42 (1878).

amidst the chaparral, and where I saw it on the boundary between Oregon and California, never attained a greater height than 30 ft. with a maximum diameter of a foot, all the trees being narrowly pyramidal with short branches, and bearing numerous whorls of unopened cones on the main stem. Its range here appears to be between 2500 and 3000 ft. Sargent says it occasionally attains a height of 100 ft., but neither Mr. F. R. S. Balfour nor myself saw any but small trees, those of exceptional size being probably restricted to deep ravines on good soil. The hills on which it grows are very liable to be swept by forest fires, and there is no doubt that it rarely if ever reproduces itself, except on burnt areas,¹ when the scorched cones let out the seeds. It is often attacked by mistletoe. In the same region it is occasionally accompanied by a peculiar variety of *P. contorta* with small cones, a tree of similar size and habit.

P. tuberculata was discovered by Hartweg² in 1847 in the Santa Cruz mountains, about twenty miles north of Monterey, and was introduced by him into the garden of the Horticultural Society, London, in the same year. This species grows slowly in England, and is of rare occurrence in collections; the best specimen we have seen is a tree 50 ft. high at Bury Hill, Dorking, which divides into several stems at 1 ft. from the ground, where it girths 10 ft. 5 in. There is an ill-shaped and decaying tree at Bayfordbury, 36 ft. high, dividing at 3 ft. from the ground into two stems, 3 ft. and 3½ ft. respectively in girth. A branch of the tree 4 ft. in length bore forty-one cones. A tree at The Heath, Leighton Buzzard, measured by A. B. Jackson in 1908, was about 35 ft. high. Smaller specimens occur at Kew, Blackmoor in Hants, and Ochertyre.

In New Zealand,³ this species is a rapid grower, second only to *P. radiata*. At Canterbury, three varieties have arisen, all of which come true from seed and are very constant in character. (A. H.)

¹ A graphic account of this pine and its relation to forest fires, by Muir in *Harper's Magazine*, xxii. 715, is reproduced in *Gard. Chron.* xxiv. 786 (1885). Jepson, in *Flora W. Mid. California*, 23 (1901), says that a burnt forest of the knob-cone pine is promptly re-sown with its own seed.

² Hartweg described it in *Journ. Hort. Soc.* ii. 189 (1847), but erroneously supposed it to be identical with *P. californiana*, Loiseleur.

³ Adams, *Genus Pinus*, 6, paper read at the Philosophical Institute, Canterbury, New Zealand, 7th August 1907.

PINUS RADIATA, MONTEREY PINE

Pinus radiata,¹ Don, in *Trans. Linn. Soc.* xvii. 442 (1836); Sargent, *Silva N. Amer.* xi. 103, tt. 573, 574 (1897), and *Trees N. Amer.* 21 (1905); Kent, Veitch's *Man. Coniferae*, 370 (1900); Masters, in *Journ. Linn. Soc. (Bot)* xxxv. 595 (1904).

Pinus tuberculata, Don, *loc. cit.* (not Gordon).

Pinus insignis, Douglas, *ex Loudon, Arb. et Frut. Brit.* iv. 2265 (1838); Forbes, *Pin. Woburn.* 51, t. 18 (1839); Lawson, *Pin. Brit.* i. 37 (1884); Baines, in *Gard. Chron.* ix. 108, figs. 22, 23 (1878); Masters, in *Gard. Chron.* ix. 337, fig. 77 (1891); Clinton-Baker, *Illust. Conif.* i. 26 (1909).

Pinus Sinclairii, Hooker et Arnott, *Bot. Beechey's Voyage*,² 392, t. 93 (1841).

Pinus Montereyensis, Rauch, *ex Gordon, Pinetum*, 197 (1858).

A tree, attaining at Monterey about 100 ft. in height and 20 ft. in girth. Bark about 2 in. thick, dark brown, deeply divided into broad flat scaly ridges. Young branchlets glabrous, reddish brown, with prominent pulvini. Buds ½ to ¾ in. long, cylindrical, pointed, brown; scales closely appressed and coated with resin.

Leaves in threes, persistent three years, densely crowded on the branchlets, bright green, 4 to 5 in. long, about 1/8 in. broad, slender and flexible, serrulate, ending in a short cartilaginous tip, marked with stomatic lines on the three sides; resin-canals median; basal sheath ½ in. long.

Cones lateral, on stout short stalks, solitary or in clusters of two or three, deflexed or spreading, about 3 to 5 in. long, ovoid with a pointed apex, shining brown, very asymmetrical, with the scales much thickened from the middle to the base on the outer side, their apophyses elevated into protuberances, directed downwards; elsewhere with the apophyses flatter, rhomboidal, marked with a transverse linear ridge and a dark brown umbo, armed with a minute prickle. Seed oval, about ¼ in. long, blackish and tuberculate; wing light brown, with darker longitudinal stripes, about an inch long.

In this species the shoots, when vigorous, are multinodal, and often show a ring of buds in the middle of the branchlet, as well as one subtending the terminal bud. At Monterey,³ the shoots regularly produce two whorls of cones; and many trees show three, four, or even five whorls, but in this case many of the cones remain unfertilised and shrivel up at the beginning of the second year. In cultivated trees in this country and in dense stands at Monterey the cones are persistent, remaining unopened on the branches for several years, or in some cases even retaining the cones on the main stem or on the largest and oldest branches. In exposed trees at Monterey, the cones usually open, immediately after ripening, with the onset of the warm weather that occurs in autumn.

The seedlings have five to seven cotyledons, and are variable in habit, some

¹ This is the oldest certain name, and the one exclusively used by American botanists and foresters. *P. adunca*, Poir., in Lamarck, *Encycl. Suppl.* iv. 418 (1816), may be this species, but the description is very imperfect.

² The drawing and description represent a large coned form of *P. radiata*. The cone in the Kew Museum labelled "*P. Sinclairii* (?)" is *P. Montezumae*; but it is not the cone described by Hooker and Arnott; and Engelmann in Brewer and Watson, *Bot. Calif.* ii. 128 (1880), is incorrect in assuming *P. Sinclairii* to be a factitious species.

³ J. B. Hickman, in *Erythea*, iv. 194 (1896).

young plants giving off lateral shoots immediately above the cotyledons, while others have a long unbranched stem.¹ The primordial needles are very long, narrow, and finely serrate; and are succeeded by the ternate leaves when the stem attains 6 or 8 in. in height.

VARIETIES

Both in wild and cultivated trees there is great variation in the size of the cones; and the length of the leaves is not constant. *P. radiata* was formerly supposed to differ from *P. insignis* in having larger cones; but intermediate forms are numerous.²

Var. *binata*, Engelm., in Brewer and Watson, *Bot. California*, ii. 128 (1880).—Leaves usually in twos. Specimens³ at Kew bear much smaller cones than in the type, symmetrical at the base and with scales not swollen on the outer side. This variety was discovered in 1875 by Dr. Palmer on Guadalupe island, off the coast of Lower California, and was found in 1888 by Brandegee⁴ on Santa Cruz and Santa Rosa isles, off Santa Barbara in California. Dr. Franceschi says⁵ that this pine is found on the northern and north-western part of Guadalupe, which in times past must have been covered with a dense forest. It grows in company with a palm, *Erythea edulis*, and with *Quercus tomentella*, at considerable elevations. The trees⁶ are vigorous and handsome, averaging 70 ft. in height and 7½ ft. in girth. Near the sea they are cut like a hedge owing to the force of the wind.

Var. *aurea*. A form with bright golden foliage has appeared in New Zealand, and is being propagated there for sale.⁷

DISTRIBUTION

This species has a very restricted distribution, occurring only in a narrow belt a few miles wide on the coast of California from Pescadero to San Simeon Bay; on the islands of Santa Rosa and Santa Cruz off Santa Barbara, and on Guadalupe island, off the coast of Lower California, the insular form belonging as described above, to var. *binata*.

It is most abundant and of its largest size on Point Pinos,⁸ south of the Bay of Monterey. At Pacific Grove,⁹ where the forest of this pine is extremely important,

¹ Cf. *Gard. Chron.* ix. 337 (1891).

² Large cones, var. *macrocarpa*, Gordon, *Pinetum*, 206 (1858), are said by Hartweg, in *Journ. Hort. Soc.* iii. 226 (1848), to be characteristic of the pines forming a wood at San Antonio, some distance from the sea. Lemmon, however, in *West American Cone-Bearers*, 6 (1895), says that trees with large cones occur near the sea, those with small cones being seen on the outskirts of the forest, farthest from the ocean.

³ Collected in Guadalupe by Dr. Palmer in 1875, by Dr. Franceschi in 1892, and by A. W. Antony in 1896.

⁴ Cf. *Proc. Calif. Acad.* i. pt. ii. 217 (1889).

⁵ In *Zoe*, iv. 130 (1893).

⁶ According to Palmer, in Watson, *Proc. Amer. Acad.* xi. 119 (1876).

⁷ Cf. T. W. Adams, *Genus Pinus*, 4, a paper read at the Philosophical Institute of Canterbury, New Zealand, on 7th August 1907. Mr. Adams saved seed from a cone without any knobs on its outer side, and all the trees raised are now bearing cones of the ordinary type. A number of varieties have arisen in New Zealand, remarkable for the variation in the size of the cones and in the colour of the foliage.

⁸ Here it mixes slightly with *P. muricata*.

⁹ Cf. G. J. Pierce, in *Bot. Gazette*, xxxvii. 448 (1904), who describes the attacks of a fly, *Diplosis pini-radiata*, Snow, which produces a basal hypertrophy of the needles of this pine. It is also much attacked by a kind of mistletoe, *Arceuthobium occidentale*, Engelm.; and an interesting account of the dissemination of the seeds of this parasite on the pine is given by Pierce in *Ann. Bot.* xix. 99-113 (1905).

being the main protection of the town of that name against the sand, which now piled up in large dunes would otherwise be blown inland over the town. Paths and roads have been cut through the forest, and a few years ago a serious fire swept over part of it, so that the pine is now having a hard struggle for existence.

Prof. Jepson informs me that this pine grows on the Monterey peninsula from the sand dunes of the seashore inland over the adjoining hilly ridges, which nowhere exceed 400 ft. elevation. The average rainfall¹ for the twenty-three years, 1878 to 1900, was 15·37 in. annually, occurring on forty to sixty days in the winter from October to April. The months of June, July, and August are perfectly dry. The number of cloudy days in the year varies from 120 to 150. The thermometer never rises above 89° F., and rarely descends below freezing-point, and then only for short periods in the night,—though 24° F. was registered in 1905, and 27° F. in 1906.

This species was discovered² by Douglas during his stay at Monterey in 1831 and 1832; and from seeds sent home by him in 1833 plants were raised in the garden of the Horticultural Society and in the Duke of Devonshire's grounds at Chiswick, which were 3 to 5 ft. in height in 1838. Coulter also sent cones at about the same time, from Monterey, which were described by Don as *P. radiata* in 1836. Subsequently, in 1850 and 1851, consignments of seed were sent to Messrs. Veitch by William Lobb.³

(A. H.)

CULTIVATION

Near the sea in almost all parts of Great Britain, but especially in the south-west of England, in Wales, and in Ireland, *Pinus radiata* has proved to be a tree of great value for shelter and ornament; and though its timber is too coarse to come into competition with that of Baltic or even home-grown pine, its growth is so extremely rapid that it may prove profitable to grow for mining timber in Cornwall and South Wales.

It produces seed freely at an early age. The seedlings grow more rapidly than those of any other pine which I have raised; and though they are not so easy to transplant as those of the Scots pine, the proportion of losses in transplantation is much less than in the Corsican species. In a mixed plantation made by C. Daubuz, Esq., of Killiow, about two miles from Truro, in 1864, Monterey pines when I saw them in 1902 averaged about 8 ft. in girth, larch 3 ft., chestnut 3 ft., and silver fir about 40 in. The pines were raised from seeds of a home-grown tree under twenty years old; and it seemed to me that in this locality, if planted thick enough and cut at the right size, they might be equal to imported pit-props.

Though the tree is hardy enough to grow in many inland parts of England, it seems to succeed best near the sea; and at Colesborne, though it has endured frosts as low as zero in sheltered places, the growth is slow, the young shoots are

¹ The rainfall, however, has been more considerable lately:—in 1905, 21·63 in.; in 1906, 25·03 in.; and in 1907, 28·98 in.

² Colligon, a gardener who accompanied the La Peyrouse expedition, is supposed to have sent a cone of this species to the museum at Paris in 1787, which was described by Loiseleur in *Novv. Duhamel*, v. 243 (1812) as *P. californiana*. The latter states that a plant raised from the seed of this cone was living in 1812 in the open in the Jardin des Plantes. The seed, however, is described as being large and edible like that of *P. Cembra*, and the foliage as being in twos and threes; and in all probability this plant was *P. Pinna*.

³ *Hortus Veitchii*, 39 (1906).

often killed back by frost, and in low-lying or exposed situations the trees are killed outright in cold seasons.

In the garden of the Rev. A. Boscawen at Ludgvan, near Penzance, the growth of seedlings is extraordinary, and the ability of the tree to bear sea-winds is greater than that of any other pine. As regards soil it must be well drained and light to ensure success.

Mr. Rogers, of Penrose, Cornwall, says¹ that he planted about 1000 trees, many in the most exposed borders of plantations near the sea in Mount's Bay, most of them being seedlings from his older trees. He considers it one of the best of nurses, giving better shelter and growing faster than either the Austrian or maritime pine; but it suffers severely from snow in a cold winter, losing entire limbs and often dying from its effects.² He has used wood of thirty years' growth both for furniture and for wheelbarrows, etc., and finds it easily worked, light in weight, tough and strong, though liable, as might be expected from immature timber, to be worm-eaten. If planted closely, it will produce clean straight timber.

REMARKABLE TREES

The largest specimens reported in 1891 were at Dropmore, then 90 ft. by 11 ft., planted in 1839, and Boconnoc, then 68 ft. by 13 ft.; but these are now far surpassed by many others.

The most remarkable that I have seen is a tree in a sheltered dell called the Wilderness at Cuffnell's, near Lyndhurst, which in 1907 was 116 ft. by 8½ ft., with a clean bole about 40 ft. long. Plate 282 shows how very unlike this is to its usual habit both in California and England.

The next tallest was a tree, no longer living, which, as I am told by Rev. A. Boscawen, was carefully measured at Heligan in Cornwall in 1897 by the Hon. Charles Ellis, who found it to be 108 ft. high. This was a seedling of unknown age, raised from a tree which I saw on the lawn at Heligan in 1905; a very rugged and wide-spreading tree which, though only about 50 ft. high, was 18 ft. in girth. It was blown down in May 1909.

There are many other very large trees, of which I give particulars in tabular form as follows:—

	Height.	Girth.	Year.	By whom measured.
Haldon House, Devonshire . . .	90 ft.	14 ft. 6 in.	1903	H. J. Elwes.
Heanton Satchville, Devonshire . . .	92 ft.	14 ft.	1905	„
Knowle Hotel, Sidmouth, Devonshire	83 ft.	14 ft. 2 in.	1907	Miss F. Woolward.
Lamorran, Cornwall	90 ft.	13 ft. 6 in.	1905	H. J. Elwes. Not over fifty years old; very rough tree.
Coldrennick, Cornwall	83 ft.	14 ft. 5 in.	1905	A. Bartlett.

¹ *Woods and Forests*, 1883, p. 19.

² Loudon, in *Gard. Mag.* xv. 269 (1839), states that plants were killed nearly everywhere in Britain by the severe winter of 1838-39; but one survived at Sunning Hill, in the grounds of Mr. R. Mangles. It was growing on dry elevated ground. A tree at Gunnersbury, 48 ft. high, was reported in *Gard. Chron.* 1868, p. 152, to have been killed by the severe frost of 1867. In the severe winter of 1908-9, when the temperature fell at Kew to 10° F. on 30th December, the leaves on this pine tree were injured, and turned a rusty brown colour. Cf. *Kew Bull.*, 1909, p. 225.

	Height.	Girth.	Year.	By whom measured.
Northerwood, Hants	106 ft.	14 ft. 6 in.	1907	H. J. Elwes. A very fine tree, painted by Mr. Short.
Dropmore, Bucks	77 ft.	15 ft.	1909	C. Page.
Bury Hill, Surrey	98 ft.	14 ft. 6 in.	1908	H. J. Elwes.
Deepdene, Surrey	86 ft.	9 ft. 2 in.	1905	A. Henry.
Goodwood, Sussex (Plate 283)	83 ft.	9 ft.	1906	H. J. Elwes. Very clean stem to 35 ft.; not spreading.
Beauport, Sussex	90 ft.	12 ft. 9 in.	1905	H. J. Elwes. Raised about 1855 from seed of tree by house.
Sandling Park, Kent	85 ft.	15 ft. 10 in. at 2½ ft.	1907	H. J. Elwes. Large branches coming off at 5 ft.
Cobham Hall, Kent	90 ft.	11 ft. 9 in.	1906	A. Henry.
Trebah, Cornwall	95-100 ft.	12 ft. 5 in.	1909	A. B. Jackson.
Essendon Place, Herts ¹	69 ft.	10 ft.	1906	H. Clinton Baker.
Fulmodestone, Norfolk	70 ft.	10 ft. 10 in.	1905	Sir Hugh Beevor.
Eastnor Castle, Herefordshire ²	80 ft.	10½ ft.	1909	J. Mullins.
Bellshill, Northumberland	55 ft.	9 ft.	1906	H. J. Elwes. Healthy in this cold county three to four miles from the sea.
Stackpole Court, Pembrokeshire	90 ft.	9 ft. 9 in.	1906	H. J. Elwes.
Bodorgan, Anglesea	75 ft.	17 ft. at ground	1906	H. J. Elwes. Large branches come off at 5 ft.; 72 paces round.

At Dropmore³ trees from cuttings planted in 1839, treated exactly the same way as seedlings put out in the same year, were in 1882 somewhat smaller in height and in girth. At White Knights, Reading, a tree eighteen years old, from seed, measured in 1904, 52 ft. high by 4 ft. in girth. At Highnam Court, Gloucester, there are two trees, one with short leaves and small cones, which measured in 1906, 54 ft. by 8 ft. 4 in. The other, with much larger cones and larger leaves, was 56 ft. by 4 ft. 7 in. At Bicton a remarkable specimen, 75 ft. high and about 15 ft. in girth near the ground, dividing into many large branches higher up, was measured by me in 1902. A large tree at Longford Castle, planted in 1845 and growing on yellow loam close to the river Avon, in 1893 was 60 ft. high and 15½ ft. in girth at a foot from the ground, dividing above into eleven great branches.⁴ Now it is about 65 ft. high and 75 ft. in diameter, perfectly healthy, and unhurt by frost. There are several fine trees at Osborne.

In Scotland this species was killed⁵ in many places in the severe winter of 1860-1861; and has not thriven subsequently in other places, as it is a failure at Glamis Castle, Forfarshire, and at Murthly, Perthshire. At Hopetoun, Linlithgowshire, the best specimen was killed in 1860, and a survivor was so much injured by the frost of 1879-80 that it was cut down in 1881. Similarly in the north of England, at Lambton Park, Co. Durham, it has been repeatedly tried and failed.

The Monterey pine, however, thrives on the west coast of Scotland; and a tree planted at Monreith, Wigtownshire, in 1884 was 63 ft. high by 5 ft. in girth in 1908.

¹ A tree at Essendon Place, perhaps the same as this, measured, in 1866, 50 ft. high by 2½ ft. in diameter, according to *Gard. Chron.* 1866, p. 950.

² *Gard. Chron.* ix. 108, fig. 23 (1878).

³ Cf. Hutchison, in *Trans. Highland and Agric. Soc. Scotland*, xiv. 59 (1882). Mr. Frost expressed the opinion that cuttings of this pine thrive as well as seedlings.

⁴ *Gard. Chron.* xiv. 725 (1893).

⁵ Cf. Hutchison, *op. cit.* 58.

At Castle Kennedy there are two trees, which girthed in 1904, 9 ft. 4 in. and 8 ft. 6 in., both being 68 ft. in height. At Bargaly, Kirkcudbright, a tree was 75 ft. by 11 ft. 8 in., in 1904. At Keir, Perthshire, there is a healthy tree, although it has never borne cones, which measured in 1905, 73 ft. by 11 ft.

This species thrives amazingly in most parts of Ireland. The finest specimens which we have seen are as follows:—

	Height.	Girth.	Year.	By whom measured.
Woodstock, Kilkenny . . .	110 ft.	12½ ft.	1909	H. J. Elwes.
" " . . .	90 ft.	14½ ft.	1909	H. J. Elwes.
Curraghmore, Waterford ¹ . . .	95 ft.	13 ft. 3 in.	1909	H. J. Elwes.
" " . . .	98 ft.	11 ft. 3 in.	1909	H. J. Elwes.
Fota, Cork . . .	90 ft.	15 ft. 2 in.	1908	H. J. Elwes. An immense tree, 96 paces in circumference.
Muckross, Kerry (Plate 284) . . .	85 ft.	14 ft. 10 in.	1909	H. J. Elwes.
Powerscourt, Wicklow ² . . .	97 ft.	11 ft. 5 in.	1904	A. Henry. Planted 1865.
Kilruddery, Wicklow . . .	82 ft.	16 ft.	1904	A. Henry.
Charleville, Wicklow . . .	86 ft.	11 ft. 9 in.	1904	A. Henry.
Mountshannon, Limerick ³ . . .	89 ft.	15 ft. 2 in.	1905	A. Henry.
Adare, Limerick . . .	87 ft.	6 ft. 10 in.	1905	A. Henry. A narrow, pyramidal tree.
Glenstal, Limerick . . .	91 ft.	15 ft.	1903	A. Henry.
Clonbrock, Galway . . .	90 ft.	12½ ft.	1903	A. Henry. Planted 1857.
Hamwood, Meath . . .	70 ft.	17 ft. at ground	1905	A. Henry. Divided into four stems.

The Monterey pine has been largely planted on the Pacific coast as far north as Washington, and as a rule has been successful. It thrives well near the coast at San Francisco; but requires careful watering in the arboretum of the Stanford University in the Santa Clara valley.

It has been largely planted of late years in South Africa, but is only climatically suited to the winter rainfall districts, and the wholesale planting of the tree in Natal and the Transvaal has produced disappointment.⁴ According to Mr. J. S. Lister, Conservator of Forests, the average annual increment per acre of ten-year-old trees has been no less than 526 ft., as compared with 152 ft. for Blue Gum and 203 ft. for *Pinus Pinaster*. Lately the leaves have been injured by the larva of a moth, *Antheræa cytherea*.

In New Zealand,⁶ no other tree approaches this species in rapidity of growth, and even should it be found that the timber is not of a durable kind, the rate at which it is produced will render it profitable to grow. Mr. T. W. Adams says that his experience of the wood grown in New Zealand satisfies him that it will prove valuable for many purposes.

In Madeira, as I am informed by Dr. Watney, it grows with extraordinary rapidity. A tree at Camacha, sown *in situ* in 1883, measured in 1907, 99 ft. high, and about 8 ft. in girth at the base. (H. J. E.)

¹ Here trees about ten years old and 10 to 23 ft. in height were killed in the severe winter of 1879-80. Cf. Hutchison, *op. cit.* 64.

² Seedlings have been raised from home-grown seed at Powerscourt.

³ This tree was reported, no doubt erroneously, by the gardener, H. Lynch, to have been 98 ft. high in 1878. Cf. *Gard. Chron.* xv. 21 (1894).

⁴ Hutchins, in Flint and Gilchrist, *Science in South Africa*, 396 (1905).

⁵ In *Agric. Journ. Cape of Good Hope*, xxii. 447 (1903), and in *Rep. Conserv. Forests*, 1899, p. 93, *app.* N.

⁶ Adams, *loc. cit.*

PINUS PATULA, MEXICAN PINE

Pinus patula, Schlechtendal et Chamisso, in *Linnaea*, vi. 354 (1831), and xii. 488 (1838); Lambert, *Genus Pinus*, i. 36, t. 19 (1832); Loudon, *Arb. et Frut. Brit.* iv. 2266 (1838); Masters, in *Gard. Chron.* xxiii. 108, tt. 20, 22 (1885), and in *Journ. Linn. Soc. (Bot.)* xxxv. 598 (1904); Kent, Veitch's *Man. Conif.* 355 (1900); Clinton-Baker, *Illust. Conif.* i. 41 (1909); Shaw, *Pines of Mexico*, 29, t. xxii. (1909).

A tree, attaining 80 ft. in height. Bark towards the base fissured longitudinally into large scaly plates; higher up thin, papery, reddish brown, and scaling off similarly to that of *P. sylvestris*. Young branchlets glabrous, glaucous, with slightly raised pulvini, becoming reddish brown in the second year. Buds cylindric-conic, acuminate, ½ in. to ¾ in. long; scales brown, interlaced by their white marginal fimbriæ, with apices free and directed upwards or spreading.

Leaves in threes, persistent two to four years, very filiform and slender, 6 to 9 in. long, ⅓ in. or less in width, flexible, bent, pendulous, serrulate, ending in a cartilaginous point, marked with stomatic lines on the three sides; resin-canals median; basal sheath about an inch long.

Cones lateral, in clusters of two to five, on stout short scaly stalks, deflexed, ovoid-conic, slightly curved, oblique at the base, about 3 to 4 in. long, pale brown, shining; scales oblong, thin, ⅞ in. long, ½ in. wide; apophysis rhomboidal, with upper margin rounded, and a slightly elevated linear ridge; umbo dark grey, depressed, with a minute or obsolete prickle. Seed triangular, grey mottled with black, ⅓ in. long; wing ½ in. to ¾ in. long.

Cones are borne freely on cultivated trees in Cornwall and the south of Ireland, and apparently contain good seed, though we have not heard of any seedlings being raised. These cones remain closed on the old branches for seven or eight years, as they also do on native trees in Mexico.

This species is easily recognisable by its bark, peeling off in the upper part of the stem like *P. densiflora* and *P. sylvestris*, its very slender filiform long needles, multinodal glaucous reddish branchlets, and buds with scales free at the points.

This species, according to Shaw, attains 40 to 50 ft. in height, and grows, in company with *P. Teocote*, at warm temperate altitudes in the central and eastern states of Mexico. Near Jalapa it occurs at 7000 to 8000 ft., mixed with *P. Montezumæ* and various species of oak. Hartweg found it in the mountains around Real del Monte at 9700 ft. Stahl, in Karsten and Schenk, *Vegetationsbilder*, ii. pl. 13 (1905), figures a wood of this species under the Vigas, about 7000 ft. above sea-level, on the road from Perote to Jalapa.

This species was discovered by Schiede and Deppe in 1828, and was probably introduced by them, as Lambert, according to Loudon, had a plant 6 ft. high at Boyton in 1837. Hartweg collected seeds in 1838 from which plants were raised in the garden of the Horticultural Society. (A. H.)

This species succeeds in the mild climate of the south-west of England as in

Cornwall, and of the south of Ireland, where there are many fine specimens. One at Carclew (Plate 285) measured, in 1908, 61 ft. in height and 6 ft. 3 in. in girth. At Luscombe Castle, Dawlish, a tree 55 ft. by 6 ft. 3 in. was bearing cones abundantly when I saw it in 1908. At Tregrehan, a tree,¹ 42 ft. by 8 ft. in 1898, was 60 yards round the branches. At Bicton, Mr. A. B. Jackson measured in 1908 a tree 48 ft. high, dividing at 2 ft. from the ground into two stems, 5 ft. 11 in., and 7 ft. 5 in. in girth. At Pencarrow, Lamorran, and Menabilly, I have seen other specimens of less dimensions. At Fota, near Queenstown, a branchy tree, with a short bole of 8 ft. dividing into wide-spreading limbs, measured in 1908, 63 ft. high by 11 ft. in girth. Many of the branches had been broken by previous gales. This tree was planted in 1847.

(H. J. E.)

PINUS TEOCOTE

Pinus Teocote,² Schlechtendal et Chamisso, in *Linnæa*, v. 76 (1830); Lambert, *Genus Pinus*, i. 37, t. 20 (1832); Loudon, *Arb. et Frut. Brit.* iv. 2266 (1838), and *Encycl. Trees*, 991 (1842); Kent, Veitch's *Man. Conif.* 356 (1900); Masters, in *Journ. Linn. Soc. (Bot.)* xxxv. 598 (1904); Shaw, *Pines of Mexico*, 16, t. ix. (1909).

A tree, attaining 90 ft. high in Mexico, with bark fissured into scaly plates. Young branchlets glabrous, glaucous, pale brown; the epidermis of the decurrent pulvini peeling off in the second and third year. Buds cylindric-conic, obtuse, about $\frac{3}{4}$ in. long, resinous; scales with tips free, interlaced at their bases by white marginal fimbriæ.

Leaves in threes, persistent three years, 4 to 8 in. long, $\frac{1}{20}$ in. broad, spreading, rigid, sharp-pointed, serrulate, with stomatic lines on the three surfaces; resin-canals median; basal sheath about an inch long.

Cones sub-terminal, rarely lateral, single or in pairs, spreading or reflexed, short-stalked, opening when ripe, and falling soon afterwards, ovoid-cylindrical, about $2\frac{1}{4}$ in. long, dull brown or slightly shining; scales numerous, $\frac{3}{4}$ in. long, $\frac{1}{3}$ in. broad; apophysis thickened at the margin, slightly raised, transversely ridged; umbo usually depressed and ashy-grey, with a minute, straight, often obsolete prickle. Seed small, with a narrow wing.

Var. *macrocarpa*, Shaw, *Pines of Mexico*, 17, t. x. (1909).

Pinus leiophylla, Bentham, *Pl. Hartw.* 58 (1842) (in part).

Leaves in threes, fours, or fives. Cones considerably larger than in the type, and illustrated by Lambert's plate. Recorded from a few localities in Mexico, Chiapas, and Tlaxcala.

P. Teocote, according to Shaw, grows at temperate altitudes in the southern, central, western, and north-western Sierras of Mexico, associated with *P. leiophylla*,

¹ This tree is figured in *Gard. Chron.* xxiii. 108, fig. 22 (1885). Fig. 20 represents a cone from a Carclew tree. Three trees are mentioned as existing at Carclew in 1885, measuring 30 ft. by 6 ft., 40 ft. by 6½ ft., and 30 ft. by 5 ft., the girths being taken at three feet from the ground. One of these has since been destroyed by lightning. The dimensions of other trees in 1885 were:—Lamorran, 24½ ft. by 3 ft. 10 in.; Pencarrow, 43 ft. by 7 ft. 3 in.; and Bicton, 36 ft. in height.

² According to Shaw, the word "ocote," from which the tree derives its name, signifies in Mexico, pitch pines and their products. Small bundles of firewood offered for sale in the markets of the cities are also called "ocote."

Schiede and Deppe. It grows on the high lands, particularly on the sloping sides of the mountains of Orizaba and Real del Monte. It is also plentiful in Oaxaca,¹ at 9000 ft. elevation, on dry, hard, and poor soil, composed of reddish clay, where it is a slender tree, of moderate size, with hard and resinous reddish wood.

According to Loudon, a single plant was in cultivation at Boyton in 1826. Subsequently, in 1839, cones were sent by Hartweg to the Horticultural Society of London, who distributed the seed, from which many plants were raised. Most of these succumbed in severe winters; and only a few trees are now living in this country. There are two at Bicton, one² of which, measured by Mr. H. Clinton-Baker in 1898, is 60 ft. by 5 ft. 9 in.; the other is 57 ft. by 6 ft. 10 in. At Luscombe Castle, another is about 50 ft. high by 5 ft. 4 in. in girth. A small tree also exists at Fota, which I saw in 1907.

(A. H.)

PINUS RIGIDA, NORTHERN PITCH PINE

Pinus rigida, Miller, *Dict.* ed. 8, No. 10 (1768); Loudon, *Arb. et Frut. Brit.* iv. 2239 (1838); Sargent, *Silva N. Amer.* xi. 115, t. 579 (1897), and *Trees N. Amer.* 20 (1905); Kent, Veitch's *Man. Conifera*, 373 (1900); Masters, in *Journ. Linn. Soc. (Bot.)* xxxv. 599 (1904); Mayr, *Fremdländ. Wald- u. Parkbäume*, 361 (1906); Clinton-Baker, *Illust. Conif.* i. 49 (1909); Bean, in *Gard. Chron.* xlv. 178, fig. 75 (1909).

Pinus Taeda, Linnæus, var. *rigida*, Aiton, *Hort. Kew.* iii. 368 (1789).

Pinus Taeda, Linnæus, var. *A.*, Poiret, in Lamarck, *Dict.* v. 340 (1803).

A tree, attaining in America 80 ft. in height and 9 ft. in girth. Bark on young stems thin and broken into reddish brown scales, on old trunks an inch thick and deeply and irregularly fissured into broad flat scaly ridges. Young branchlets glabrous, reddish brown, with prominent keeled pulvini. Buds cylindrical or conical, sharp-pointed, $\frac{1}{2}$ to $\frac{3}{4}$ in. long; scales interlaced and matted together by their white fimbriated edges, their long acuminate brown apices free and spreading.

Leaves in threes, persistent two years, spreading, $3\frac{1}{2}$ to $4\frac{1}{2}$ in. long, rigid, slightly curved and twisted, serrulate, ending in a callous point, marked on the three faces by numerous stomatic lines; resin-canals median; basal sheath $\frac{3}{8}$ to $\frac{1}{2}$ in. long.

Cones lateral, usually clustered, sub-sessile, spreading, variable in size, averaging $2\frac{1}{2}$ in. in length, ovoid, light brown, symmetrical at the base; scales thin, flat, $\frac{7}{8}$ in. long, $\frac{3}{8}$ in. wide; apophysis shining, rhomboidal, with a raised sharp transverse keel, and an elevated dark-coloured umbo, terminating in a recurved slender prickle. Seed triangular, with a blackish roughened shell, and a pale brown wing, broadest below the middle; seed with wing about $\frac{3}{4}$ in. long. Cotyledons five. The cones often persist on the branches, and even on the stem, for many years, many opening when ripe and letting out the seed, others remaining closed for an indefinite period. Cones are freely produced on very young trees.

This species is remarkable amongst pines for the frequent occurrence on untouched old stems of adventitious buds, which usually produce branchlets, the shortest of these resembling tufts of leaves arising from the bark, the largest

¹ Cf. *Garden and Forest*, ix. 102 (1896).

² This tree was labelled *P. oocarpa*. The other was named correctly *P. Teocote*.

attaining a few inches in length and branching. Carrière¹ records an instance where clusters of staminate flowers, without any foliage, issued from the trunk of a tree of this species.

In New Jersey,² after the destruction of the trees by fires or by felling, sprouts arise from the stumps, which grow to a considerable size, 6 to 8 in. in diameter; and suckers also spring from the roots, giving rise to a dense bush-like growth. At Grafrath,³ near Munich, only 4 per cent of a number of trees, broken by snow, gave stool-shoots, most of which were short-lived. Similarly, at Les Barres, numerous stool-shoots were produced from the stumps of felled trees, but M. Pardé⁴ believes that these will never make trees. This faculty of regeneration by coppice shoots, so rare amongst conifers, appears in this case to be of no economic value.

DISTRIBUTION

This species is the one always known in eastern North America as the pitch pine, though having nothing in common with the pitch pine of commerce (*P. palustris*). It is widely distributed, crossing the northern boundary of the United States, as far north as the valley of the St. John River in southern New Brunswick, the north shore of Lake Ontario, and the valley of the lower Ottawa river; extending southward in the Atlantic States from Franklin County, Maine, where it is a mere shrub, to northern Georgia, and crossing the Alleghany Mountains to their western foot-hills in eastern Ohio, Pennsylvania, West Virginia, Kentucky, and Tennessee. It is common in the New England states, often forming extensive forests, and grows mainly on sandy plains and dry gravelly slopes, though occasionally it is seen in swamps. In New Hampshire, where I saw this species, the greater part of the land on which it occurs has been repeatedly burnt over;⁵ and it appears to be adapted for regeneration after forest fires, as, like *P. Banksiana*, it produces cones freely and at an early age; and a considerable percentage of the cones hold the seed for several years. Near Hinsdale, it grows in pure open woods on poor sand, the trees scarcely ever exceeding 60 ft. in height and 4 ft. in girth; but in slightly better soil, where the sand contained the mould of decayed leaves, *P. Strobus* grows with it in mixture, and will eventually suppress it, owing to the taller growth of the Weymouth pine.

Sargent⁶ gives an account of a pure forest of the species in Ocean County, New Jersey, which occupies land that had been farmed fifty years previously. An illustration shows a forest of crowded small slender trees about 50 ft. in height. According to Prof. Cooke,⁷ it is one of the most profitable trees to plant in this

¹ *Conif.* 448 (1867).

² *Garden and Forest*, viii. 472 (1895), and x. 192, fig. 24 (1897), the figure showing new growth after the destruction of all the foliage by fire.

³ Mayr, *Fremdländ. Wald- u. Parkbäume*, 363, fig. 116 (1906), the figure showing a burnt tree with numerous adventitious shoots on the stem.

⁴ *Principaux Végét. Ligneux Exotiques*, 37. Mr. T. W. Adams, in a paper read 7th August 1907, at the Philosophical Institute, Canterbury, New Zealand, says:—"Trees nearly a foot in diameter, which I cut down in thinning a plantation, sent out leaves along the trunk, while lying on the ground, as some broad-leaved trees do."

⁵ Cf. Chittenden, *U.S. Forestry Bulletin*, No. 55, p. 55 (1905).

⁶ *Garden and Forest*, i. 166 (1888).

⁷ *Ibid.* 59.

state, where, after thirty years, it yields a net profit averaging \$15 per acre. Owing to the facility with which it can be raised by sowing¹ on the poorest soil, it has lately been planted in barren tracts on the coast of Massachusetts and New Jersey, for the production of firewood, though old houses timbered and floored a hundred years ago with this wood, grown on better soil, are still in a good state of preservation. Grown singly, it assumes a ragged appearance, as is well shown in a picture of a wind-swept specimen given in *Garden and Forest*, iv. 397, fig. 65 (1891).

(A. H.)

CULTIVATION

According to Aiton, it was in cultivation at Woburn before 1759; but though it grows better and lives longer than any of the eastern American pines, except *P. Strobus*, it has never become common, and has no qualities which make it desirable to cultivate in this country, except in botanic gardens and collections of conifers. It is hardy, and often ripens seed in the south of England; and as it grows well on the seashore and does not object to salt in the soil, it might be planted on barren sandy shores, though it might not be so suitable for this purpose as *P. radiata* or *P. austriaca*. It has been tried as a forest tree in Germany, where it was at first believed to be the species which produced the pitch pine of commerce, but has not shown any promise of success.² In France, according to M. M. de Vilmorin,³ it is only fit for firewood and of no economic importance, though it might be tried on sandy soils in localities too cold for *P. Pinaster*.

I saw trees at Baleine, near Moulins, and at Geneste and Catros, near Bordeaux, of considerable age, but of no great size, which seems to prove that a warmer climate does not favour its development.

In the Hertogenwald, in Belgium, about fifty trees⁴ of this species, planted in mixture with the common pine at 1500 ft. elevation, on poor soil, at fifty-five years old, average 48 ft. high, and, though healthy and bearing cones, show no advantage in this situation over *P. sylvestris*.

Forbes states that there were several trees of this species believed by him to have been planted in 1743 in the evergreens at Woburn in 1839, one of which measured 75 ft. high and 11 ft. in girth; but I could hear of none now living.

The largest tree, which we have seen or heard of, is growing at Dropmore, and in 1909 was 84 ft. high by 7 ft. 8 in. in girth. It was probably planted in 1847. There are three good trees at Arley Castle, two of which, represented in Plate 286, measured in 1904, 69 ft. and 66 ft. in height, both being 7 ft. 2 in. in girth. The third is 66 ft. high by 5 ft. 11 in. in girth. A tree in Mr. Kaufmann's grounds, The Wilderness, White Knights, measured in 1904, 48 ft. by 8 ft. 1 in., and has thrown out from the stem numerous small adventitious branchlets. Mr. A. B. Jackson measured in 1909 a tree at Bury Hill, Dorking, 56 ft. by 4 ft. Another at Essendon Place, Herts, measured 45 ft. by 6½ ft. in 1908. There are also smaller

¹ It is sown broadcast or in shallow drills. No other conifer grows so rapidly in New England on dry sterile gravels. Cf. Sargent, in *Garden and Forest*, x. 470 (1897).

² Cf. Mayr, *op. cit.*; Schwappach, *Anbauversuche fremdländ. Holzarten*, 58 (1901); and Unwin, *Future Forest Trees*, 49, 86 (1905).

³ *Garden and Forest*, x. 113 (1897).

⁴ Seen by Henry in 1908.

specimens in Kew Gardens, where most of the trees of the species show similar adventitious branchlets; at Nuneham Park, Beauport, Bayfordbury, and Tortworth. A tree at Bargally, in Kirkcudbright, measured 42 ft. by 4 ft. 1 in. in 1904. Trees at Coollattin, Wicklow, about 30 ft. high, are very thriving.

TIMBER

The wood¹ of this pine is little valued in its own country except for firewood, being light, soft, and brittle; and so far as I know is never exported. It contains large quantities of resin; and a century ago was of some economic importance in the production of tar and turpentine, though when the pitch pine of the south became more generally known, it was superseded by the abundant supplies yielded by that tree. (H. J. E.)

PINUS SEROTINA, POND PINE

Pinus serotina, Michaux, *Fl. Bor. Amer.* ii. 205 (1803); Sargent, *Silva N. Amer.* xi. 119, t. 580 (1897), and *Trees N. Amer.* 20 (1905); Masters, in *Journ. Linn. Soc. (Bot.)* xxxv. 599 (1904); Clinton-Baker, *Illust. Conif.* i. 51 (1909).
Pinus rigida, Miller, var. *serotina*, Loudon, *Arb. et Frut. Brit.* iv. 2242 (1838); Engelmann, in *Trans. St. Louis Acad. Science*, iv. 183 (1880); Kent, Veitch's *Man. Conif.* 374 (1900).

This species, which is probably only a southern geographical variety of *P. rigida*, is distinguished from the latter by its more resinous buds, and by its longer leaves, usually 6 to 7, rarely 8 to 10 in. long. The cones are variable in shape, either sub-globose or shortly ovoid, or elongated conical, 2 to 3 in. in length, similar in position and colour to *P. rigida*, but with the more slender prickles usually deciduous. The cones, moreover, as a rule, remain closed on the tree for several years before opening and letting out their seeds. Adventitious branches are produced on old trunks.²

The pond pine grows in low wet flats or in sandy or peaty swamps, near the Atlantic coast from Albemarle Sound southward to the head of St. John's river in Florida, and occurs also, according to Roth,³ on the west side of the peninsula of Florida, and along the Gulf of Mexico westward to near Pensacola. In its manner of growth it resembles *P. Tæda*, and produces similar timber, and is occasionally⁴ tapped for turpentine. It is generally found, either mixed with *P. Tæda* or with *P. Caribæa*, occasionally associating in North Carolina with broad-leaved trees, and is rarely seen in considerable quantity. It often takes possession of abandoned fields.

This species was introduced in 1713, according to Loudon,⁵ who mentions trees about 30 ft. high, at Dropmore, Syon, Pains Hill, and Kenwood. It is probably

¹ Hough, *Trees N. States and Canada*, 9 (1907), says the wood is of medium weight and hardness, with coarse conspicuous grain, resinous and of a brownish red colour with abundant lighter sapwood. It is used for coarse lumber, flooring, sills, etc.; and to some extent for fuel and charcoal.

² Cf. *Garden and Forest*, x. 209 (1897). Engelmann, *loc. cit.*, states that felled trees or posts set in the ground sometimes produce sprouts bearing primary leaves.

³ In *U.S. Forestry Bulletin* No. 13, p. 169 (1897).

⁴ According to Sargent, in *Trees N. Amer.* 21 (1905), but it is not mentioned by Mohr, and must be done on a very small scale.

⁵ *Ency. Trees and Shrubs*, 979 (1842).

short-lived in our climate, where it bears shorter foliage than in America; and the only trees we have been able to identify, are one at Bickton,¹ which was 53 ft. by 4 ft. 8 in. in 1908; and another at Bayfordbury, in an unhealthy state, measuring 41 ft. in height, and 5 ft. 7 in. in girth. This was planted in 1842. (A. H.)

PINUS PALUSTRIS, LONG-LEAF PINE, PITCH PINE

Pinus palustris, Miller, *Dict.* ed. viii. No. 14 (1768); Sargent, *Silva N. Amer.* xi. 151, t. 589, 590, (1897), and *Trees N. Amer.* 17 (1905); Kent, Veitch's *Man. Conifera*, 352 (1900); Masters in *Journ. Linn. Soc. (Bot.)* xxxv. 604 (1904); Clinton-Baker, *Illust. Conif.* i. 38 (1909).
Pinus lutea, Walter, *Fl. Carol.* 237 (1788).
Pinus longifolia, Salisbury, *Prod.* 398 (1796).
Pinus australis, Michaux, *Hist. Arb. Amer.* i. 64, t. 6 (1810); Loudon, *Arb. et Frut. Brit.* iv. 2255 (1838).

A tree, attaining in America 120 ft. in height and 9 ft. in girth. Bark thin, dark, scaly. Young branchlets thick, orange-brown, much roughened by the numerous prominent pulvini. Buds non-resinous, cylindrical, pointed, 1½ in. to 2 in. long; scales lanceolate-acuminate, silvery white, interlaced by their white marginal fimbriae and with their apices free and reflexed. These persist as a dense sheath of reflexed bud-scales at the apex of the branchlet of the second year.

Leaves in threes, deciduous at the end of the second year, about 8 in. long on old trees, 9 to 18 in. long on young vigorous trees, densely crowded on the branchlets, slender, flexible, serrulate, ending in a cartilaginous point, with stomatic lines on all three sides; resin-canals median; basal sheath ¾ in. to 1 in. long.

Cones sub-terminal, spreading or pendulous, on short stout scaly stalks, cylindrical-conic, slightly curved, 5 to 8 in. long; scales thin, flat, 2 in. long, ¾ in. wide; apophysis rhomboidal, slightly elevated, crenate in upper margin, with a transverse sharp ridge, and projecting umbo, armed with a small reflexed prickle. Seed triangular-oval, rather less than ½ in. long, inner surface whitish and three-ridged, outer surface dark-spotted; wing narrow, 1½ in. long. The seeds are shed during dry weather in autumn; and occasionally, when wet sultry weather sets in late, begin to sprout in the cones. The cones usually fall, after dehiscence of the seeds, in the latter part of the winter of the second year, leaving as a rule the lowest rows of scales attached to the branch.

(A. H.)

This² is perhaps of all the pines of North America the one which formerly existed in greatest abundance, throughout a wide belt of country from Virginia through the Carolinas, Georgia, Alabama and Florida, where it extends south to Tampa bay, west to the valley of the Trinity river in Texas, and up the Mississippi valley to the northern borders of Louisiana. It is mainly confined to low-lying tertiary sands and gravels; but Mohr³ found it in Talladega county, Alabama, up to

¹ This tree has long been labelled erroneously "*P. resinosa*."

² A complete account of this pine is given by Mohr in *U.S. Forestry Bulletin*, No. 13, pp. 29-75 (1897). Cf. also G. F. Schwarz, *The Longleaf Pine in Virgin Forest*, pp. 135, 23 illustrations (1907).

³ Mohr, *op. cit.* p. 73.

2000 ft. above the sea. It averages about 100 ft. in height, and occasionally reaches 120 ft., girthing 6 ft. to 8 ft.; and grows usually in pure forests, but near the limits of its area is mixed with other trees.

No tree has suffered so much at the hand of man as the pitch pine. When I first passed through the southern States in 1888 it formed an almost unbroken forest for hundreds of miles along the railway, but is now diminishing so rapidly, that to use Sargent's words, "it seems hopelessly doomed to lose its commercial importance at no distant day."

The literature of this species is very voluminous, and has been largely quoted by Sargent and Loudon; but as it seems impossible to cultivate in this country, we need not say much about it, except that it has been repeatedly tried since 1730 and has usually failed to grow¹ for more than a few years. However, a tree of about 12 ft. high exists in a stunted state at Kew; and another similar in size and unhealthy was seen by Mr. H. Clinton-Baker in 1908 at Menabilly, Cornwall. A seedling raised at Steventon and planted in the Tubney arboretum near Oxford, survived about 25° of frost in the winter of 1908-9.

In France *P. palustris*² has been grown successfully in one place at least, as we learn from an article³ by M. Maurice de Vilmorin, who gives an excellent photograph of two trees at Geneste, near Bordeaux, which were sown in 1831, and are the only survivors of seventeen. In 1897 the largest was 18 metres high by 1.70 metre in girth, the other 16 metres by 1.50 metre. Near them was a Loblolly pine, whose volume was said to be twice as great, though no dimensions were mentioned. They grow on the edge of the dunes near the sea, and M. de Vilmorin states that as producers of timber they cannot in that region compare with *P. Pinaster*, which is mature at forty years old. I visited Geneste, the property of Mlle. Ivoy, in April 1909, and measured these trees carefully. The two largest are 68 ft. by 6 ft. 3 in., and 59 ft. by 5 ft. They seem perfectly healthy, but bear no cones. As the temperature in occasional severe winters, as in 1893, descends at Bordeaux to -16° Cent., it seems as though the want of sufficient heat in summer is the reason why this tree will not grow in England. I believe that on the coast of Portugal it would succeed well.

On the banks of Lago Maggiore, however, in the garden of Rovelli Frères, there is a pitch pine with a clean trunk measuring about 60 ft. by 5½ ft.; and at Intra, in the grounds of the Villa Barbot, I measured a still finer tree, about 75 ft. by 7 ft.

Though the import of the timber of this species to Europe has only assumed great importance in the last twenty years, it is now shipped in larger quantity than any other American timber. Marshall Ward⁴ identified the pitch pine of commerce with *P. rigida*, which it certainly is not; but Laslett himself was evidently writing of the true pitch pine, which he said came chiefly from the ports of Savannah, Darien, and Pensacola, where *P. rigida* is not found. He says it was much used for masts in shipbuilding, and in architecture wherever long, straight, and large

¹ Webster in *Hardy Coniferous Trees*, 95 (1896), says a few specimens have done well at Penrhyn and Woburn. There are no trees of this species at either place, the tree named *P. australis* at Penrhyn being *P. ponderosa*.

² According to *Ann. Hort. Paris*, xix. 212, quoted by Loudon, *Gard. Mag.* xv. 236 (1839), the species may be grafted on *P. Laricio*, and is then rendered much hardier.

³ *Garden and Forest*, x. 112 (1897).

⁴ Laslett, *Timber and Timber Trees*, 367 (1894).

scantlings were needed; and gives details of experiments on its strength and elasticity made for the Admiralty.

Sargent describes the timber as exceedingly hard, very strong, tough-grained, and durable, of light red or orange colour, with nearly white sap-wood. In the United States it is preferred to any other wood for the construction of railway cars, and is now in great demand for railway sleepers, which are replacing those made of oak and chestnut in the northern states.

In consequence of the large consumption in America, and of the great quantity of trees destroyed for resin and by fire, the price has lately risen very much in the English market, being in February 1906 as much as 1s. 6d. to 2s. per cubic foot; and for very long squared balks a higher price is obtained.

Mr. Weale writes as follows:—"The heaviest of the American pines; principally exported from Pensacola and Mobile. It contains resin in quantity, which makes it very durable, and permits its employment in exposed situations. Is moderately hard and straight-grained, and being easily obtainable in long lengths, is in demand for bridge and pier work, and as a building timber. The wood is frequently figured, and used for panelling. For school fittings and furniture, church pews and seatings, it is eminently suitable. In America it is in request for railway sleepers and mining timber, but the low prices at which the Baltic goods are imported prevents its use for the latter purposes in this country."

A handsomely marked variety of this wood, known as curly pitch pine, is found on the outside of some logs, which, when polished, has a nice effect in panels, and being cheap and easy to match, is oftener used in England than the more beautiful, though softer, curly redwood, a variety of the wood of *Sequoia sempervirens*.

Pinchot¹ states that in the Government statistics, under the heading "Yellow Pine," are grouped all the reports of pine production in the south and west, except those of white pine (*P. Strobus*) and Norway pine (*P. resinosa*). Several species, such as *P. palustris*, *P. Tæda*, *P. caribæa*, *P. echinata*, and *P. rigida*, enter into this total. Most of the lumber cut in Texas, Louisiana, Mississippi, Alabama, Georgia, and Florida is *P. palustris*; while practically all that of Arkansas and Missouri is *P. echinata*. Most of the pine cut in Virginia and North and South Carolina is *P. Tæda*.

The resin² or crude turpentine obtained by tapping *P. palustris*, and to a lesser extent *P. caribæa*,³ furnishes the raw material for the production of resin and spirits of turpentine. At present these two species furnish the great bulk of the supply for the whole world. France and Austria, the only other countries where resin is produced on a considerable scale, account for perhaps one-tenth of the total produce. In 1907 the total export of resin from the eastern states was 2½ million barrels, valued at \$11,000,000; while that of spirits of turpentine amounted to 16 million

¹ *U.S. Forestry Bull.* 77, p. 18 (1906).

² This industry is known in America as turpentine orcharding, and is well described by Ashe in *N. Carolina Geol. Survey Bull.* No. 5 (1894); by Mohr, *op. cit.* 67 (1897); and by Bastin and Trimble, *N. Amer. Conifera*, 48 (1897).

³ *P. serotina* is occasionally tapped in the coast region of North Carolina. *P. Tæda* is never tapped. See our remarks under these species.

gallons, valued at \$10,000,000. Judging from the statistics,¹ the annual production is stationary, but the price has increased enormously since 1903. *P. rigida* was tapped for resin in the colonial days in the northern States.

Pine-wool,² used in the manufacture of carpets and mats, is prepared from the leaves of this species. (H. J. E.)

PINUS TÆDA, LOBLOLLY PINE

Pinus Tæda, Linnæus, *Sp. Pl.* 1000 (1753); Lambert, *Genus Pinus*, i. 14, t. 15 (1832); Loudon, *Arb. et Frut. Brit.* iv. 2237 (1838); Forbes, *Pin. Woburnense*, 43, t. 14 (1839); Sargent, *Silva N. Amer.* xi. 111, tt. 577, 578 (1897), and *Trees N. Amer.* 19 (1905); Mohr and Roth, *U.S. Forestry Bulletin* No. 13, p. 113, tt. 17-20 (1897); Kent, *Veitch's Man. Conif.* 382 (1900); Masters, in *Journ. Linn. Soc. (Bot.)* xxxv. 598 (1904); Clinton-Baker, *Illust. Conif.* i. 54 (1909).

A tree, 80 to 100 ft. high, with a straight trunk, usually 6 ft., occasionally 15 ft. in girth. Bark about an inch thick, reddish brown, divided by shallow fissures into broad flat scaly ridges. Young branches glabrous, glaucous, becoming yellowish brown, roughened by the raised and imbricated pulvini. Buds conic, about $\frac{1}{2}$ in. long; scales brown, matted together by their white marginal fimbriæ, and with their apices free and reflexed.

Leaves in threes, persistent for three years, densely crowded, spreading, 6 to 9 in. long, $\frac{1}{16}$ in. wide, rigid, slightly twisted, serrulate, ending in a sharp cartilaginous point, pale green, with numerous stomatic lines on the three sides; resin-canals median; basal sheath nearly an inch in length. The reflexed bud-scales remain as a persistent sheath at the apex of the shoots of the second and third years.

Cones lateral,³ solitary or clustered, sub-sessile, spreading, cylindrical-conic, usually 3 in. long, occasionally 4 or 5 in., light brown; scales thin, about an inch long and $\frac{1}{2}$ in. wide; apophysis rhomboidal, raised, with a transverse elevated ridge, and a triangular umbo, ending in a short, usually reflexed prickle. Seed rhomboid, $\frac{1}{4}$ in. long, with two or three distinct ridges, dark brown mottled with black, surrounded to the base by the narrow border of the delicate wing, which is pale brown, shining, and about an inch long. Cones are produced abundantly every year, opening in autumn and winter of the second year, and falling off in the succeeding season through the decay of their short stalks. The seedlings have usually six cotyledons, and grow fast, producing adult ternate leaves in their first season, when they attain 6 to 8 in. in height. They average in the forest at the end of the fourth year 3 ft. in height.

The Loblolly pine extends along the coast from Cape May in New Jersey, and the Delaware and Maryland peninsula, southwards to Cape Malabar and Tampa Bay in Florida, and westward to near New Orleans, extending inland as far northward as

¹ Pinchot, *U.S. Forest Circular* No. 153 (1908).

² Cf. J. R. Jackson, in *Gard. Chron.* xlv. 366 (1908), who states that pine-wool is also prepared in Breslau, Silesia, from the leaves of the Austrian pine (*P. Laricio*, var. *austriaca*). The latter is used for stuffing cushions, and is made, mixed with ordinary wool, into a kind of flannel. Specimens of both kinds may be seen in the Kew museum.

³ They are subterminal in badly-developed trees.

the parallel of 35°, occupying large tracts in the Carolinas, Georgia, Alabama, and Mississippi, extending into southern Tennessee. West of the Mississippi river it occurs as far north as the south-eastern border of Indian Territory and southern Arkansas, where it frequently grows in extensive nearly pure forests on the rolling uplands, and occurs in Louisiana and eastern Texas as far west as the valley of the Colorado river.

On the Atlantic slope, near its northern limit, it grows most frequently on the flat lands of the tidewater districts, usually crowded with other pines, oaks, and hickories; and in Virginia and North Carolina springs up rapidly on lands exhausted by agriculture, the primeval forests having nearly all disappeared. In the swamps bordering the Albemarle and Pimlico sounds, gigantic trees of this species, known as the Rosemary pine, sometimes attained¹ a height of 170 ft.

In Berkeley county, South Carolina, the forest land² consists of four distinct regions. On the fresh and moist uplands, where the soil is a light sandy loam, *P. Tæda* occurs both in pure stands or in mixture with *P. palustris* and broad-leaved trees. *P. palustris* is confined mainly to the higher situations and the drier and lighter soils, either pure or mixed with *P. Tæda* and hardwoods. In the alluvial land, either along rivers or bordering swamps, where the soil is best, the forest is mixed, consisting of maple, ash, hickory, oaks, with *P. Tæda* and *P. serotina*. In the swamps, where there is standing water all the year round, there is the same admixture of species, with the addition of *Taxodium distichum*. (A. H.)

This pine is of considerable economic importance in the southern and south-western states, where it forms considerable forests; and though there are no reliable statistics, it appears to be one of the main trees cut for lumber at the present time in Virginia and the Carolinas.³ A considerable proportion of the long and heavy sticks of hewn timber reaching the Mobile market from Alabama for export as "pitch pine" are Loblolly pine.⁴ Half the lumber cut in Arkansas and shipped as "yellow pine" to northern markets is Loblolly pine, the other half being *P. echinata*. The timber is very variable in quality under different conditions of growth. Sargent says that very large and fine masts were formerly made of this tree, and used in the United States as well as shipped to Europe; but were not distinguished by Laslett from those made of *P. Strobus*.

In England this tree has been grown for nearly two centuries, having been introduced⁵ by Bishop Compton before 1713, but though it has attained a considerable size in some instances, it cannot be said to thrive in this country, requiring a much greater degree of heat than our climate affords.

Loudon figures a tree 75 ft. high, growing at Syon in 1838, and mentions others at Kew, Dropmore, Whitton, and Pains Hill, the latter being then 60 to 70 ft. high, and, as he said, the handsomest tree in Europe. All these are now dead,

¹ Cf. Curtis, *Trees and Shrubs, N. Carolina*, 23 (1860).

² Cf. Chapman, in *U.S. Forestry Bulletin* 56, pp. 8-10 (1905).

³ Pinchot, in *U.S. Forestry Bulletin* 77, p. 18 (1906), says:—Most of the pine cut in Virginia and North and South Carolina is *P. Tæda*, which is widely known in commerce in the United States as North Carolina pine.

⁴ Mohr says the best qualities are equal to true pitch pine, and are used by house carpenters. Large amounts of inferior stuff are shipped as firewood from the coasts of Virginia and North Carolina.

⁵ Aiton, *Hort. Kew.* iii. 368 (1789).

and the only tree¹ which we have found is one growing at Bicton which Mr. H. Clinton-Baker measured in 1908, as 50 ft. in height, and 6 ft. 9 in. in girth at 3 ft. from the ground. This tree bears cones;² but the seed does not seem to be fertile. The leaves are $4\frac{1}{2}$ to 5 in. in length, much shorter than is usual in American trees of this species.

At Geneste, near Bordeaux, I saw several large trees of this pine in 1909 growing near the pitch pines, which they much exceeded in size. The largest was 92 ft. by $9\frac{1}{2}$ ft., and bore abundant cones, which produce fertile seed, and natural reproduction is here common. Another was 95 ft. by 9 ft., a third about 85 ft. by $9\frac{1}{2}$ ft. Mademoiselle Ivoy informed me that the resin of this tree was much more aromatic than that of the native *P. Pinaster*.

Mr. Weale sends us the following note:—"Loblolly pine is not imported into this country in steady quantities and is often sold as Carolina pine. When pitch pine is imported in the form of sawn boards, this wood is frequently observed amongst them. It is not comparable with pitch pine in strength and durability, and cannot hope to find a market upon any other considerations than those of price."

Though the wood of this species contains but little less resin than that of *P. palustris*, and the composition and the distribution of the resin in the log are the same in both species, yet for some unexplained reason the resin of the Loblolly pine does not flow freely, and hardens so rapidly on exposure that it cannot be worked. The statements frequently made³ as regards the use of this tree for resin are erroneous and can only be explained by a confusion of names, and it is most likely that the Cuban pine (*P. caribæa*) was referred to.⁴

(H. J. E.)

PINUS CANARIENSIS, CANARY PINE

Pinus canariensis, Ch. Smith, in Buch, *Phys. Besch. Canar. Ins.* 159 (1825); De Candolle, *Pl. Rar. Jard. Genève*, i. tt. 1, 2 (1829); Loudon, *Arb. et Frut. Brit.* iv. 2261 (1838); Webb et Berthelot, *Phyt. Canar.* iii. 280, Atlas, t. 6 (1845-50); Christ, in Engler, *Bot. Jahrb.* vi. 486 (1885); Masters, in *Gard. Chron.* iii. 723, f. 94 (1888), and in *Journ. Linn. Soc. (Bot.)* xxxv. 593 (1904); Clinton-Baker, *Illust. Conif.* i. 13 (1909).

A tree, attaining 80 ft. in height and 10 ft. or more in girth. Bark thick, reddish, slightly fissured, and separating on the surface into irregular scales. Young branchlets glabrous, yellow, with prominent keeled pulvini. Buds ovoid, acute, $\frac{3}{4}$ in. long, $\frac{1}{2}$ in. broad; scales reddish brown, matted together at the base by their marginal white fimbriæ, spreading, with their tips free and reflexed. The apices of the branchlets of the second and third years are each marked with a conspicuous sheath of the persistent reflexed bud-scales.

Leaves in threes, persistent two years, densely crowded on the branchlets, spreading, 7 to 12 in. (averaging 9 in.) long, $\frac{1}{20}$ in. wide, flexible, serrulate, ending in a fine cartilaginous point, with two to four stomatic lines on each of the three sides; marginal canals median; basal sheath $\frac{3}{4}$ in. long.

¹ The tree at Tortworth Court, mentioned as *P. Teda* by Kent in Veitch's *Manual*, p. 383, is *P. rigida*.

² Figured by Clinton-Baker, *Illust. Conif.* i. 54 (1909).

³ As in Bastin and Trimble, *North American Conifera*, 44 (1897).

⁴ Cf. Mohr, *op. cit.* 121.

Cones subterminal, solitary or clustered, deflexed or pendent, on short stout scaly stalks, cylindrical-conic, with a flattened apex, very variable in length, averaging 5 in. long; shining yellowish brown, and closely resembling those of *P. Pinaster* in appearance; scales thick, about $1\frac{3}{4}$ in. long, and $\frac{3}{4}$ inch wide; apophysis rhomboid, slightly elevated, with a transverse sharp ridge, and a dark brown prominent non-prickly umbo. Seed $\frac{1}{2}$ in. long, pointed at both ends, with a pale brown wing $1\frac{1}{4}$ in. long.

The seedlings have six to eight cotyledons, and grow rapidly, attaining 10 in. in their first year. In *Gard. Chron.* xv. 333 (1881), it is stated that Hochstetter had succeeded in fixing the juvenile form of this species and of *P. Pinea* by cuttings, producing beautiful bushes with solitary needles.

This species is endemic in the Canary Islands. It does not occur on some of the dry eastern islands, as Lanzarote and Fuerteventura; and only a single tree exists on Gomera, and a small wood on Ferro. According to Christ, it is called *tea* by the Spaniards, and was formerly widely spread, and descended lower on the mountains, than at present. Large woods still exist in Teneriffe, Palma, and Grand Canary, beginning at 3700 ft. altitude and ascending to where the snow lies in winter, solitary trees being met with on Teneriffe as high as 6600 ft. It grows on dry slopes, exposed to the sun and wind, and appears to prefer basalt, where the soil contains no lime. Its upper elevation is limited not so much by the cold, as by the poverty of the soil, which at high elevations consists of pumice stone, on which no tree growth can exist. Christ saw many beautiful woods, with an undergrowth of *Cistus*, and numerous seedlings growing under the shade of the parent trees. Many of the trunks¹ show the same character as *P. rigida*, as they produce epicormic branches covered with solitary primary leaves.

The trees are conical in shape, often branched to the ground, and somewhat weeping in habit, with pendulous leaves. Most of the famous trees of this species, one of which was mentioned by Loudon as 30 ft. in girth near the ground, were destroyed even in Webb's time; and the largest tree seen by Christ, the *Pino del Paso*, in Teneriffe, is only 10 ft. in girth; but he mentions old trees on Palma twice as thick.

The timber is reported to be remarkably heavy and durable. In the museum at Kew, there is preserved part of the beam of a wine-press, made of the heart-wood, which is quite sound, although the press was over 200 years old and had stood all the time in the open air.

This species is rare in cultivation in England, except as a green-house plant. Loudon states that specimens in the open were killed at Dublin. There is, however, a small tree, at Heligan, Cornwall, which in 1906 was fifteen years old and about 25 ft. high; and another at Carclew about 6 ft. high, which was slightly damaged by frost in 1908-1909.

It succeeds well on the Riviera, even on calcareous soil; and there are fine specimens at La Mortola and Grimaldi.² Elwes measured one at the Villa Thurêt, Antibes, 92 ft. by $5\frac{1}{2}$ ft., which bore fertile cones in January 1910. (A. H.)

¹ Cooley, in *Bot. Gazette*, xxxviii. 441, fig. 1 (1904), describes a tree in the Botanic Garden at Naples, the stem of which is clothed to the ground with shoots like those of *P. rigida*.

² Cf. *Gard. Chron.* iv. 39 (1888).

PINUS ECHINATA, SHORT-LEAF PINE

- Pinus echinata*, Miller, *Dict.* Ed. 8, No. 12 (1768); Sargent, *Silva N. Amer.* xi. 143, t. 587 (1897), and *Trees N. Amer.* 29 (1905); Mohr, *U.S. Forestry Bulletin* No. 13, *Timber Pines of Southern U.S.* 91, plates 13-16 (1897); Masters, in *Journ. Linn. Soc. (Bot.)* xxxv. 624 (1904).
Pinus virginiana, Miller, var. *echinata*, Du Roi, *Obs. Bot.* 44 (1771).
Pinus squarrosa, Walter, *Fl. Carol.* 237 (1788).
Pinus Teda, Linnæus, var. *variabilis*, Aiton, *Hort. Kew.* iii. 368 (1789).
Pinus Teda, Linnæus, var. *echinata*, Castiglioni, *Viag. negli Stati Uniti*, ii. 312 (1790).
Pinus mitis, Michaux, *Fl. Bor. Amer.* ii. 204 (1803); Loudon, *Arb. et Frut. Brit.* iv. 2195 (1838); Kent, Veitch's *Man. Coniferae*, 342 (1900); Mayr, *Fremdländ. Wald- u. Parkbäume*, 358 (1906); Clinton-Baker, *Illust. Conif.* i. 32 (1909).
Pinus variabilis, Lambert, *Genus Pinus*, i. 22, t. 15 (1803).

A tree, attaining in America 120 ft. in height and 12 ft. in girth. Bark about an inch thick, broken into large irregular scaly plates. Young branchlets slender, brittle, glabrous, glaucous; in the third year the bark of the branchlets exfoliates in large flakes. Buds, $\frac{1}{4}$ in. long, cylindrical, sharp-pointed, brownish, shining, with resinous and appressed scales.

Leaves, both in pairs and in threes, deciduous in the second and third years, spreading, about 3 in. long, slender, flexible, curved, slightly twisted, serrulate, sharp-pointed, with stomatic lines on all three surfaces; resin-canals median; basal sheath $\frac{3}{8}$ in. long.

Cones lateral, either sessile and spreading, or short-stalked and pendulous, in pairs or clusters of three or four, ovoid, $1\frac{1}{2}$ to 2 in. long, dull brown; scales about $\frac{3}{4}$ in. long, obovate, cuneate, rounded at the apex, thin and flexible; apophysis slightly thickened, with a transverse ridge and a central umbo, armed with a short, often deciduous, prickle. Seed triangular, brownish-black, $\frac{3}{16}$ in. long; wing $\frac{1}{2}$ in. long, pale, streaked with brown lines; cotyledons 4 to 7.

This species is readily distinguishable by the leaves, both two and three in a cluster, and by the peculiar scaling of the bark on the branchlets in the third year.

A complete account of this pine, with a map of its distribution, is given by Mohr, who states that it is a tree of the plains and foothills, in the south rarely ascending to 2500 ft., and in the north never higher than 1000 ft. East of the Mississippi it is now found scattered amongst the broad-leaved trees; but in the beginning of the nineteenth century it formed a considerable part of the coniferous forest, growing on light sandy soil in the Atlantic states from New York to Virginia. (A. H.)

This tree has much the same distribution as *P. Teda*, occurring from Staten Island, New York, and east Pennsylvania, through the Atlantic states to northern Florida, crossing the Alleghany Mountains to Kentucky and Tennessee, and extending west to north-eastern Texas, north-western Louisiana, Arkansas, southern Missouri and south-west Illinois. It is more abundant inland than on the coast region of the Gulf states, where the pitch pine replaces it; and is most abundant and in the greatest perfection west of the Mississippi river, where it forms large forests and is the most important source of the timber known in the United States as yellow

pine, which is used more largely for ordinary building purposes in the south-western states than any other wood; and as this tree has the power of spreading itself rapidly over abandoned fields, which it soon covers with healthy forest, it is not likely to become scarce. According to Mohr, average trees in Arkansas and Texas range from 95 to 120 ft. high, and 17 to 25 in. in diameter, at ages of 100 to 200 years.

According to Sargent this timber¹ is very variable in quality, but only second to true pitch pine in its class, and being less resinous, softer and more easily worked, is often preferred for cabinet-making, interior finish, doors, window-sashes, etc. It is also largely used for flooring, weather-boarding, railway cars and sleepers.

Though it does not yet seem to be well known in Europe, yet as pitch pine becomes scarcer and dearer, it will no doubt be substituted for it, or for white pine (*P. Strobus*), which is already known in the English market as yellow pine.

This pine is remarkable for its capacity of producing vigorous sprouts² from the stumps, when the tree is felled or injured by fire. These coppice shoots, ten to thirty in number from each stump, remain bushy, attaining no great height, and are of no value for the regeneration of the tree.

P. echinata was introduced into England about 1739, as Miller had it in cultivation in that year; but has proved as unsuitable for this climate as most of the other pines of the Atlantic coast, and is probably short-lived, as it is very rare in collections.³ A tree at Dropmore, which in 1908 measured 50 ft. high and 3 ft. 4 in. in girth, is probably the specimen mentioned by Loudon as being cultivated there under the name *P. variabilis*, which it still bears. Mr. Page says that it occasionally bears a few cones, but that he has not succeeded in raising plants from the seed. Another specimen at Bayfordbury is 34 ft. by 3 ft.; and one in Kew Gardens, which bore a few cones in 1908, measured 32 ft. by 2 ft. 4 in. in 1909.

(H. J. E.)

PINUS HALEPENSIS, ALEPPO PINE

- Pinus halepensis*, Miller, *Dict.* Ed. 8, No. 8 (1768); Loudon, *Arb. et Frut. Brit.* iv. 2231 (1838); Boissier, *Flora Orientalis*, v. 695 (1884); Masters, *Gard. Chron.* xxii. 552, f. 97 (1884), iii. 627, f. 84 (1888), and *Journ. Linn. Soc. (Bot.)* xxxv. 606 (1904); Willkomm, *Forstliche Flora*, 237 (1887); Mathieu, *Flore Forestière*, 607 (1897); Kent, Veitch's *Man. Coniferae*, 332 (1900); Clinton-Baker, *Illust. Conif.* i. 23 (1909).
Pinus alepensis, Poirer, in Lamarck, *Dict.* v. 338 (1804).
Pinus hierosolymitana,⁴ Duhamel, *Traité des Arbres*, ii. 126 (1755).
Pinus maritima, Lambert, *Gen. Pinus*, i. t. 6 (1832) (not Miller).

A tree attaining 80 ft. in height and 12 to 15 ft. in girth, though often, on poor soils, considerably smaller. Bark at first smooth, silvery grey, and shining, becoming

¹ The wood of this pine is indistinguishable from that of *P. Teda*. Cf. Fernow and Roth, in *U.S. Forestry Bulletin* No. 13, pp. 13, 14 (1897).

² Cf. *Garden and Forest*, x. 192, 209 (1907), and Roth, in *U.S. Forestry Bulletin* No. 13, p. 111 (1897), who observed hundreds of acres along the railways in Texas and Arkansas, covered with bushy clusters of vigorous sprouts from the pine stumps. In *Bot. Gaz.* xxviii. 69 (1899), *P. echinata* is said to produce root-suckers, but this seems to be erroneous.

³ A tree at Bicton, of which we have specimens with stunted foliage, doubtfully referable to this species, died recently.

⁴ This name is uncertain, and cannot be adopted; moreover, it would be inconvenient to set aside *halepensis*, which has been in use for over a century. Cf. Graebner, in *Mitt. deut. dend. Ges.*, 1908, p. 68.

on old trunks reddish brown, fissured, and scaly. Young branchlets glabrous, glaucous grey, flexible, with slightly raised pulvini. Buds conical, slender, less than $\frac{1}{2}$ in. long, brownish white; scales interlaced by white fimbriated margins, with the tips free and often reflexed. Base of the shoot girt with a sheath of reflexed bud-scales.

Leaves in pairs, persisting two years, $2\frac{1}{2}$ to 4 in. long, slightly spreading, slender (about $\frac{1}{3}$ in. wide), curved, twisted in the upper third, serrulate, short-pointed, with stomatic lines on both surfaces; resin-canals marginal; basal sheath $\frac{1}{3}$ in. long, persistent.

Cones, solitary or two or three together, lateral, spreading or deflexed, on thick scaly stalks (about $\frac{1}{2}$ in. long), ovoid-conic, 2 to 3 in. long; scales shining, yellowish brown, oblong, flat, about an inch long and $\frac{5}{8}$ in. wide; apophysis rhomboidal, flat, or slightly raised towards the centre, with a transverse linear ridge; umbo greyish, depressed, often with a slight ridge, unarmed. Seed, nearly $\frac{1}{4}$ in. long, light brown on the lower and blackish on the upper surface; wing pale brown with a dark border, nearly an inch in length. The cones are variable in direction, though often directed backwards, and are irregular in the time of opening, some remaining closed till May in the third year, others not letting out the seeds till the fifth or sixth year.

VARIETY

Var. *Brutia*.

Pinus Brutia, Tenore, *Flora Napolitana*, i. Prod. p. lxxii (1811), iv. 136 (1830), and v. 266, f. 200 (1835); Loudon, *Arb. et Frut. Brit.* iv. 2234 (1838); Boissier, *Flora Orientalis*, v. 695 (1884); Masters, in *Journ. Linn. Soc. (Bot.)* xxxv. 608 (1904).

Pinus resinosa, Loiseleur, in *Nouveau Duhamel*, v. 237 (1812) (not Solander).

Pinus Pithyusa,¹ Steven, *Bull. Soc. Nat. Mosc.* i. 49 (1838).

Pinus persica, Strangways, in Loudon, *Gard. Mag.* xv. 130 (1839).

Pinus Loiseleuriana, Carrière, *Conif.* 382 (1855).

Pinus Paroliniana, Webb, ex Carrière, *Conif.* 391 (1855).

Pinus pyrenaica,² Carrière, *Conif.* 391 (1855); Masters, in *Gard. Chron.* iv. 267, f. 32 (1888); Kent, Veitch's *Man. Coniferae*, 368 (1900); Mayr,³ *Fremdländ. Wald- u. Parkbäume*, 360 (1906).

Pinus Parolinii, Visiani, *Mem. Ist. Venet.* vi. 243 (1856).

Pinus Eldarica, Medwejew, in *Act. Hort. Tiflis*, vi. 2, p. 21 (1902), and *Bäume u. Sträucher Kaukasus*, i. 20 (1907); Masters, in *Gard. Chron.* xxxiv. 251 (1903).

This is a geographical variety of *P. halepensis*, distinguished by its longer, darker green, and more rigid leaves, 4 to 6 in. in length. The cones,⁴ which occasionally arise in whorls of three to six, are never deflexed, but always spreading or pointing forwards, and are in rare cases sub-sessile. The staminate flowers are also larger

¹ Referred to *P. Brutia* by Lipsky, in *Act. Hort. Petrop.* xiv. 309 (1898). According to Loudon, *Gard. Mag.* xv. 130 (1839), the cone is like that of *P. halepensis* in the strong woody peduncle.

² Probably not *P. pyrenaica*, Lapeyrouse, *Hist. Abrégée Pl. Pyrén.* Suppl. 146 (1818), occurring in the Pyrenees, and identified by Calas with the Pyrenean variety of *P. Laricio*. Cf. our vol. ii. 407, note 2. The large forests of *P. pyrenaica* in Spain, described by Captain Cook, are *P. Laricio*. Cf. Willkomm, *Pflanzenverb. iberischen Halbinsel*, 109 (1896).

³ Mayr places *P. halepensis* and var. *Brutia* in different sections, though the character on which he relies for this distinction, the position of the cones, is identical in both.

⁴ All the specimens of *P. Brutia* in Parlatore's herbarium at Florence are from cultivated trees, and differ only from *P. halepensis* in their longer leaves and larger cones. So far as I could judge from these, and from a Calabrian specimen, the differences between this variety and typical *P. halepensis* simply depend on the greater vigour of the former, due to better soil and climate.

than in the type. The differences observable, due to the influence of soil and climate, are similar to those seen in the Austrian and Corsican varieties of *P. Laricio*.

DISTRIBUTION

The Aleppo pine is a Mediterranean species, occurring in almost all the countries bordering on its shores, from Spain to Asia Minor, and from France and Dalmatia to Morocco and Algeria.

In France this species occurs in Provence, in the region of the olive, from the foot of the Alps westward to Sommières, Gard, never extending far from the sea-coast, and not extending above 2700 ft. altitude. It grows mainly on limestone, occupying dry rocky slopes, where scarcely any other tree will grow, but is also common on the porphyry of the Estérel, and is met with on gneiss near Cannes.¹ On Mount Ventoux it ascends to 1300 ft., but at this elevation and distance from the sea is liable to suffer from frost. Large forests occur, as that of Mérindol on Mount Luberon, which covers 4000 acres, and is composed of a mixture of Aleppo pine and *Quercus Ilex*.

Here the trees are usually small in size and stunted in growth, with crooked stems, as the soil is arid and shallow limestone; but in a ravine, where there was some moisture and a growth of ferns, I measured a tree 80 ft. in height, with a straight stem, free of branches to 50 ft., and 8 ft. in girth. In Spain² this species is a native of all the provinces bordering on the Mediterranean, and extends inland as far as Huesca, Saragossa, Teruel, Cuenca, and Guadalajara, growing in the lower regions of the mountains up to 3300 ft., and somewhat rare on the coast itself, though there is a remarkable wood, covering the greater part of the Dehesa de Valencia, a sandy spit of land, about 8 miles long, separated from the sea by the Albufera lagoon. There are small woods on limestone east of Gaucin, north of Gibraltar, where I measured a tree at 900 ft. elevation, 65 ft. in height, and 10 ft. 8 in. in girth.

It is common in the Balearic Isles, where it ascends in Majorca as a tree to 3200 ft., becoming a mere bush at 3900 ft. On Iviza there is a forest 16,000 acres in extent, consisting of *P. halepensis*, partly pure and partly mixed with deciduous trees.

In Italy it is not found north of the Apennines, but it is fairly common on the west and east coasts. It grows,³ though in much less abundance than in the Riviera, on serpentine rocks between Savona and Genoa, and occurs in the mountains of Umbria between Spoleto and Terni, ascending on Somma to about 2000 ft. About the falls of the Velino, and in the defile through which the Nar flows below Narni, it is pretty frequent, growing on limestone amidst the woods of *Quercus Ilex*. On the eastern side of the Adriatic⁴ it succeeds as a planted tree in Dalmatia, but is only wild south of latitude 43°, occurring in small quantity about Ragusa and in the Meleda and Curzola islands. It has also been observed by Baldacci in Albania.

It is common in Greece, except in southern Peloponnesus, and also occurs in Crete and most of the islands, often forming extensive forests near the sea-coast, and

¹ Bunbury, *Bot. Fragments*, 8 (1883).

² Willkomm, *Pflanzenverb. iberischen Halbinsel*, 95, 190 (1896).

³ Cf. Bunbury, *Bot. Fragments*, 8 (1883). Sprenger, in *Mitt. deut. dendr. Ges.*, 1905, p. 182, says there are fine trees on the heights of Posilippo, near Naples, and notes the great quantity of its cones, even when the trees are very young. The pollen is so abundant that people who suffer from hay fever avoid it.

⁴ Cf. Beck, *Veget. illyrischen Länder*, 135 (1901).

occasionally ascending to 3000 ft. Prof. Samios of Athens informs us that a tree at Chalcis, which Elwes saw many years ago, is 130 ft. in height, and 10½ ft. in girth. In Cyprus¹ this is a finer tree than *P. Laricio*, often attaining in the forest 10 ft. in girth, but on dry ground on the hot coast it assumes a bushy form. Mr. A. K. Bovill, Principal Forest Officer in Cyprus, informs us that he has photographed a tree 15 ft. in girth. According to Madon,² it flourishes on all soils up to 5000 ft., mixing above 4500 ft. with *P. Laricio*.

This species also occurs in west and south Asia Minor, covering the sand dunes of the Cilician coast westwards from Mersina; and on the coast of Syria and the lower ranges of the Lebanon is a handsome tree, judging from a photograph (Plate 287) sent us by Dr. Day of Beyrout.

In Algeria *P. halepensis*, pure or mixed with *Quercus Ilex*, forms the greater part of the forests, where the rainfall is less than 12 in. annually, and extends from the sea-coast to about 5000 ft. altitude. It grows mainly on limestone, but is occasionally seen on clay, sandstone, and conglomerate. It is remarkable for its reproductive power, as seedlings are very numerous, and regeneration is certain to ensue after the destruction of the forests by axe or fire. In the dry regions of Algeria, where forest fires are common, it is apparently adapted for natural regeneration on burnt areas, as cones with fertile seed are always present on the trees. Young trees bear cones when only 5 or 6 ft. high, while older trees retain many of the cones closed for six or eight years; and these, when scorched by fire, burst and scatter the seed to a distance of 10 or 20 yards.³ This is well seen in a forest near Affreville, where *P. halepensis* is the predominant species, mixed with a small proportion of *Callitris quadrivalvis* and *Quercus coccifera*. Here the trees are of no great size, but I measured one in the open 70 ft. high and 14 ft. 11 in. in girth.

In Morocco it apparently does not occur near the coast, but is reported by Ball⁴ to grow in the mountains to the south at 4000 to 5500 ft. altitude. It is met with in Egypt, near Alexandria, but is probably planted there.⁵

Var. *Brutia* has a more restricted and a more easterly distribution than the type. It is met with in Calabria in Italy, where it was discovered by Tenore in the Aspromonte mountains between 2400 and 3600 ft. altitude. According to Sprenger,⁶ it grows here on limestone, ascending to 5000 ft., and attaining about 80 ft. in height and 250 years in age. He says that the wood is white and free from resin. According to Halacsy,⁷ it is absent from the mainland of Greece, but occurs at high elevations in Crete. It grows on the shores of the Sea of Marmora, where it is known as *kara jcham* or black pine.⁸ It seems to be the mountain form in Asia Minor, occurring in Pamphylia, Cilicia, and on the Taurus and Lebanon, the tree near the coast being typical *P. halepensis*. Specimens collected in 1874 by Elwes in Lycia, and noted as growing on

¹ Cf. Hartmann, in *Mitt. deut. dend. Ges.*, 1905, p. 169.

² *Forests of Cyprus*, in *Cyprus, Parliament. Paper No. 366*, of 1881.

³ Cf. Lefebvre, *Les Forêts de l'Algérie*, 421 seq. (1900). The part which the persistent closed cones play in the regeneration has not been understood by local observers, who assert that the cones on very young trees produce unfertile seed. This requires further investigation.

⁴ In *Journ. Linn. Soc. (Bot.)* xvi. 669 (1878).

⁵ In *Mitt. deut. dend. Ges.*, 1904, p. 191.

⁶ Specimens procured for Mr. H. Clinton-Baker by Mr. Stuart Hogg.

⁷ Boissier, *Flora Orientalis*, v. 695 (1884).

⁸ *Consp. Fl. Graecae*, iii. 453 (1904).

limestone, are var. *Brutia*. This variety¹ also grows sparingly on the north-east coast of the Black Sea near Pizunda,² and a small forest, about 4 miles in length, of trees not exceeding 40 ft. in height, occurs in the centre of Transcaucasia, at the foot of the great Caucasus, on the west edge of the Eldar Steppe, between 1400 and 2000 ft. elevation.³

This variety is cultivated in Afghanistan, where it was collected by Aitchison, and in Persia where, Dr. Stapf informs us, it is a tall tree, resembling *P. sylvestris* in habit, and very hardy, as it bears without injury severe winters and a heavy snow-fall. Two plants raised at Vienna from seed brought home by Dr. Stapf from Shiraz were at first indistinguishable from seedlings of typical *P. halepensis*, but as they grew older bore the longer foliage of var. *Brutia*. (A. H.)

CULTIVATION

Though this tree was introduced by Bishop Compton in 1683, and has been often planted since, it is not hardy enough to endure severe winters;⁴ and the trees mentioned by Loudon⁵ at White Knights, Berks, and Croome, Worcester, which in 1838 were 57 and 40 ft. high, are no longer living. The only trees⁶ of considerable size which we have seen are one at Margam, Glamorganshire (Plate 288), which in 1907, when I saw it, was a healthy tree, measuring 72 ft. by 10 ft., and bearing many cones, which are conspicuous from their green colour, and another in the Botanic Garden, Bath, which was 46 ft. by 4 ft. 6 in. in 1909, and is a healthy tree with smoother and greyer bark than *P. Pinaster*. There are small trees at Kew and Bicton.

Seedlings which I raised from Spanish seed in 1907 were, with three exceptions, killed by the frost of January 1909, though protected by boughs laid over them, and it seems useless to attempt to grow this tree except in very dry, warm, and sheltered situations near the sea in the south of England.

According to Loudon,⁷ var. *Brutia* was introduced in 1836, when it was raised from seed by the Earl of Mountnorris. Strangways, in 1839, obtained seeds from Persia, plants from which were raised in the garden of the Horticultural Society, and were known as *P. persica*. No trees of this variety are now in cultivation in this country, so far as we know, except a small specimen at Kew.

In February 1910 I saw the tree in the Botanic Garden at Naples, on which Tenore founded his description of *P. Brutia*. It is very vigorous, with a wide-spreading crown of foliage, and measured 82 ft. by 10 ft. A branch sent to Cambridge by the director, M. Cavara, bears seven young cones in a whorl, and two mature cones in a second whorl, which scarcely differ from those of *P. halepensis*.

¹ Lipsky, in *Act. Hort. Petrop.* xiv. 309 (1898), denies the occurrence of *P. halepensis* in Russian territory bordering on the Black Sea, all the specimens being *P. Brutia*.

² Radde, *Pflanzenverbreit. Kaukasus*, 147 (1899).

³ This is supposed to be a distinct species, *P. eldarica* of Medwejew, who refers the tree on the Black Sea to *P. pithyusa*, Strangways. Cf. *Derezya Kavkasa*, 12, 14 (1905), and *Moniteur Jardin Bot. Tiflis*, ii. 26 (1906).

⁴ Mouillefert, *Essences Forestières*, 386 (1903), says that it is killed by 14 or 15 degrees of frost, and that it grows rapidly in youth, and is very intolerant of shade.

⁵ Lambert says that he saw a flourishing tree of this species bearing cones abundantly at 17 years after planting in the garden of Stoke Park, Wilts, on sandy soil; but Lady Lushington informs me that when she first lived, in 1881, at this place, now called Stokke, there was no such tree there.

⁶ The tree at Penrhyn, a cone of which was figured in *Gard. Chron.* xxii. 552, fig. 97 (1884), no longer exists. Webster in *Woods and Forests*, 19th November 1884, says it was 45 ft. high and 4 ft. in girth.

⁷ *Trees and Shrubs*, 968 (1842), and *Gard. Mag.*, 1839, p. 267.

The leaves are longer than is usually the case in var. *Brutia*, measuring about 7 in. in length, which is probably due to the rich volcanic soil in which the tree is growing. Henry sees no reason for supposing that the tree is a hybrid, though from its vigour M. Cavara thinks that it differs from the wild trees in Calabria, which are ascribed to var. *Brutia*.

There is a fine tree, under the name *P. pyrenaica*, in the grounds of the Villa Thurêt, Antibes, which was 70 ft. by 6 ft. 2 in. when I saw it in 1910, and bore cones larger than those of typical *P. halepensis*.

The timber¹ is considered in France inferior to that of *P. Pinaster*, and is characterised by large resin-canals, which often cause infiltrations of resin in the wood, rendering it hard, heavy, and difficult to saw. It is little used, except for making packing-cases, though sometimes it is suitable for telegraph poles and sleepers. Tapping for resin, formerly practised in Provence, is now little in vogue; but in 1906, an experiment was made in the forest of Slisser, in western Algeria, when about a million trees were tapped. The resin produces a turpentine of good quality. The bark contains a considerable amount of tannin, and in Provence is occasionally ground into powder, which is used for dyeing fishing nets, and for mixing with the tanning material obtained from the bark of *Quercus coccifera*.

(H. J. E.)

PINUS MURICATA, BISHOP'S PINE

Pinus muricata, Don, in *Trans. Linn. Soc.* xvii. 441 (1836); Lambert, *Genus Pinus*, iii. t. 84 (1837); Loudon, *Arb. et Frut. Brit.* iv. 2269 (1838); Masters, in *Gard. Chron.* xxi. 49, tt. 7-9 (1884), and *Journ. Linn. Soc. (Bot.)* xxxv. 620 (1904); Sargent, *Silva N. Amer.* xi. 139, tt. 585, 586 (1897), and *Trees N. Amer.* 32 (1905); Kent, Veitch's *Man. Conif.* 350 (1900); Clinton-Baker, *Illust. Conif.* i. 37 (1909); Bean, in *Gard. Chron.* xlv. 260, figs. 112, 113 (1909).
Pinus Edgariana, Hartweg, in *Journ. Hort. Soc.* iii. 217, 226 (1848).

A tree, usually 40 to 50, occasionally 90 ft. high, and 6 to 10 ft. in girth. Bark reddish brown, fissuring into long narrow rounded scaly ridges, becoming very thick,² 4 to 6 in., towards the base of old trunks. Young branchlets glabrous, stout, reddish brown, with projecting pulvini, separated by linear grooves. Buds conic or cylindrical, pointed, $\frac{3}{4}$ to 1 in. long, encrusted with white resin. Scale-leaves persistent at the base of the leaf-clusters.

Leaves³ in pairs, persistent for three or four years, spreading, crowded on the branchlets, 4 to 6 in. long, yellowish green, rigid, slightly curved and twisted, serrulate, marked with numerous stomatic lines on both surfaces, ending in a short callous tip; resin-canals median; basal sheath $\frac{1}{2}$ in. long.

Cones, both sub-terminal and lateral, in clusters of 3 to 7, deflexed, sessile, asymmetrical, oblique at the base, ovoid, about 3 in. long, shining brown, very prickly: scales transversely keeled; on the inner side of the cone with flattened apophyses and slender prickles; on the outer side of the cone with elevated

¹ Mr. Hutchins, however, informs me that in Cyprus it is of better quality, and is used for all purposes for which deal is used here.

² In *Garden and Forest*, x. 232, fig. 30 (1897), a figure of the tree is given, showing the remarkable thickness of the bark.

³ The leaves have a strong peculiar odour.

pyramidal apophyses, armed with stout sharp spines, in the basal scales directed downwards, in the apical scales recurved and pointing upwards. Seed triangular, $\frac{1}{4}$ in. long, roughened, grooved, and blackish; wing nearly 1 in. long.

The cones often remain closed for many years, persisting on the stem and branches of the tree, without becoming embedded in the bark. As in the case of other pines, with late-opening cones, this is a provision for the germination of the seeds, which retain their vitality for a long period, until forest fires cause the scales to gape asunder.

This species, in the absence of cones, is readily distinguished amongst the two-leaved pines with persistent sheaths, by its long yellowish green leaves, and its long buds whitened in a peculiar manner by resin. On a vigorous branch two whorls of buds, branchlets, and cones are usually produced.

This species is one of the four coast trees¹ of California, only growing near the sea within the range of the sea-fogs, and occasionally rising to 2000 ft. altitude. It occurs in Mendocino County, where it attains its largest size, southwards, usually in widely separated localities, to Tornaes Point, north of San Francisco Bay; and from Monterey to San Luis Obispo County. It is also met with in Lower California, on Cedros island, and on the coast between Ensenado and San Quintin.

This pine, like *P. contorta*, which replaces it northward, grows on ocean bluffs, and sometimes is common over considerable tracts of poor sandy soil. In Sonoma County,² it reaches its most vigorous development in peat-bogs, the trees attaining a height of 80 to 150 ft. It is remarkable in its native habitat for its flattened crown of foliage. Jepson mentions a very fine forest of this species on Point Reyes, within a few miles of Olema. (A. H.)

P. muricata was first discovered in 1832 by Dr. Coulter at San Luis Obispo, and is sometimes known as Bishop's pine, from its occurrence in this locality, named after Bishop St. Louis. It was introduced into England in 1846 by Hartweg, who found it near Monterey, and who named it *P. Edgariana*, after Mr. T. Edgar, Secretary of the Horticultural Society.

It is perfectly hardy in most parts of England, and though seldom planted is perhaps suitable as a shelter tree on the sea-coast, though it is much surpassed in growth in such situations by *P. radiata*. Mr. Bean says that it thrives very well in Scilly and in the Channel Isles in very exposed situations.

Probably the finest specimen of this species in England is a tree, growing at Claremont, which has a tall straight stem, and measured in 1907, 71 ft. high by 7 ft. in girth. In Kew Gardens there is a tree of no great height, but of considerable age, remarkable for the old cones, which are borne unopened on the stem; and another,³ near the Pagoda, prostrate and bushy in habit, is very peculiar in its appearance. In the wilderness at White Knights, a fine healthy tree, 57 ft. by 7 ft., was measured by Henry in 1904. At Pitt House, Chudleigh, there is a large spreading tree, about 50 ft. high, with many stems, and covered with old persistent cones, of

¹ The others are *Pinus radiata*, *P. contorta*, and *Cupressus macrocarpa*.

² Jepson in *Flora W. Mid. California*, 23 (1901). Engelmann, in Brewer and Watson, *Botany of California*, ii. 128 (1880), says it is also found of large size growing in peat-bogs in Mendocino County.

³ Figured in *Gard. Chron.* xlv. 260, fig. 111 (1909). Mr. Bean attributes its prostrate habit to the attacks of a boring beetle in early life, which killed many buds and prevented the formation of leading shoots.

which I counted about sixty whorls, the oldest of which were nearly buried in the bark. At Eastnor Castle, a tree was about 40 ft. by 6 ft. in 1907, with large bunches of cones, no less than thirty-seven of which were counted in one cluster.

At The Heath, Leighton Buzzard, a large but ill-shaped tree measured 55 ft. by 7 ft. 2 in. in 1908. At Flitwick Manor, Bedford, Mr. H. Clinton-Baker measured in 1908, a tree 64 ft. by 8 ft. 8 in. At Essendon Place, Herts, there is a fine wide-spreading tree,¹ 49 ft. by 7 ft. 3 in. in 1906. At Garston Manor, Watford, Sir Hugh Beevor found one which measured 64 ft. by 6 ft. 3 in. in 1909. At Brickendon Grange, in the same county, there is a tree, about 25 ft. high, from the seed of which, obtained by heating in an oven an old cone from a main branch, Mr. J. Trotter raised seedlings in 1907. At Bayfordbury, a tree planted in 1850 measures 45 ft. by 4 ft. 7 in.; and numerous seedlings were raised in 1906 from the seed in its old cones.

A healthy wide-spreading tree at Enville Hall, Stourbridge, measured 56 ft. by 8 ft. 9 in. in 1904. At Highnam, Gloucestershire, there is a tree with a divided stem about 60 ft. high. At Hafodunos, North Wales, a wide-spreading tree, densely clothed to the ground, was 56 ft. by 7 ft. 3 in. in 1905.

In Scotland, Sir Herbert Maxwell reports a tree of this species at Stonefield, Argyllshire; and Mr. Austin Mackenzie measured a tree at Carradale, in the same county, 43 ft. by 4 ft. 9 in. in 1906. At Castle Kennedy, a spreading tree, bearing numerous cones, was 35 ft. by 5 ft. 7 in. in 1904.

In Ireland,² the finest specimens, five in number, are growing in Lauragh churchyard, near Derreen, one of which in 1907 measured 66 ft. by 6 ft. There is also a tree about 50 ft. high in the grounds of Derreen. At Coolattin, Co. Wicklow, a tree, very vigorous in growth and coning freely, was 42 ft. by 4 ft. 8 in. in 1906. At Castlemacgarrett, Co. Mayo, another measured 49 ft. by 5 ft. 9 in. in 1904.

(H. J. E.)

PINUS PUNGENS

Pinus pungens, Lambert, in König and Sims, *Ann. Botany*, ii. 198 (1806); Michaux f., *Hist. Arb. Amer.* i. 61, t. 5 (1810); Loudon, *Arb. et Frut. Brit.* iv. 2197 (1838); Sargent, *Silva N. Amer.* xi. 135, t. 584 (1897), and *Trees N. Amer.* 33 (1905); Kent, Veitch's *Man. Conifera*, 367 (1900); Masters, in *Journ. Linn. Soc. (Bot.)* xxxv. 623 (1904); Clinton-Baker, *Illust. Conif.* i. 47 (1909).

A tree, attaining 60 ft. in height and 9 ft. in girth; but usually smaller with a short thick trunk, frequently clothed to the ground, and forming a flat-topped or rounded head of foliage. Bark 1 in. thick, broken into irregular reddish brown scaly plates. Young branchlets glabrous, shining brown, with projecting pulvini, separated by linear grooves. Buds cylindrical, pointed, about $\frac{3}{4}$ in. long, resinous.

Leaves in pairs, deciduous in the second and third years, crowded on the branchlets, spreading, dark green, stout, rigid, curved, twisted, 2 to $2\frac{1}{2}$ in. long, serrulate, ending in a sharp cartilaginous point, marked with numerous stomatic lines on both surfaces; resin-canals median; basal sheath $\frac{1}{4}$ in. long.

¹ According to an account of the pinetum at Essendon in *Gard. Chron.*, 1866, p. 950, this tree was, in 1866, 35 ft. high, and bore cones twenty years old on the branches.

² In *Gard. Chron.*, 1869, p. 193, a tree, 20 ft. high, was reported as growing at Somerville, near Navan, Co. Meath, which had branches with seven to nine whorls of cones.

Cones lateral, usually in clusters of three or four, rarely seven or eight; sessile, spreading or deflexed, oblique at the base by the greater development of the scales on the upper side, light brown and shining, ovoid-conical, about $2\frac{1}{2}$ in. long; scales thin and tough, about 1 in. long and $\frac{1}{2}$ in. broad; apophysis pyramidate divided by a sharp transverse ridge into a narrow upper and a broad lower part, umbo produced into a long sharp-curved spine. Seed nearly triangular, $\frac{1}{5}$ in. long, light brown; wing $\frac{3}{4}$ to 1 in. long; cotyledons 7 or 8.

This pine is readily distinguished from the other species with short leaves in pairs, by the stout sharp-pointed rigid leaves, and the shining reddish brown branchlets, which, when vigorous, develop buds, branchlets, or young cones about their middle point.

This species occurs in the Alleghany mountains, from Pennsylvania to North Carolina and eastern Tennessee, ascending to 3000 ft., and growing mainly on dry gravelly table-lands and slopes. To the northward it is local in its distribution, and generally scattered among other trees, as *Pinus echinata*, *P. rigida*, and *P. virginiana*, oaks and hickories; but in the southern Alleghanies it forms nearly pure forests of considerable extent. It is also found¹ in three isolated stations, distant from its mountain home: in Virginia, between Fredericksburg and Washington city; in Lancaster County, Pennsylvania; and near Rosemount, in New Jersey. It is hardy and thrives well when planted in the middle and eastern states, as far north as New England; but according to Sargent, has little to recommend it but its large abundant cones, which often, after opening, remain persistent on the branches for many years. The wood² is light, soft, brittle, and coarse-grained, and is little used except for fuel and charcoal.

This pine was introduced³ into England in 1804, by Sir W. Strickland,⁴ but has never become common. The only trees which we have found, besides one or two specimens of no great size in Kew Gardens, are two at Bayfordbury, planted in 1851, and now about 30 ft. high and a foot in diameter, which bear cones profusely; a tree at Bicton, 42 ft. by 3 ft. 7 in.; and another at Grayswood, Haslemere, 35 ft. by 2 ft. 7 in. There is also one about 30 ft. high at Menablyly. (A. H.)

PINUS VIRGINIANA, JERSEY PINE, SCRUB PINE

Pinus virginiana, Miller, *Dict.* Ed. 8, No. 9 (1768); Sargent, *Silva N. America*, xi. 123, t. 581 (1897), and *Trees N. America*, 30 (1905); Masters, in *Journ. Linn. Soc. (Bot.)* xxxv. 623 (1904). *Pinus inops*, Solander, in Aiton, *Hort. Kew.* iii. 367 (1789); Loudon, *Arb. et Frut. Brit.* iv. 2192 (1838); Kent, Veitch's *Man. Conifera*, 333 (1900); Clinton-Baker, *Illust. Conif.* i. 25 (1909). *Pinus Royleana*,⁵ Jamieson, ex Lindley in *Journ. Hort. Soc.* ix. 52 *cum icone* (1855).

A tree, attaining 40 ft. in height, with a short trunk rarely more than 5 ft. in girth. Bark $\frac{1}{4}$ to $\frac{1}{2}$ in. thick, broken by shallow fissures into scaly

¹ Cf. T. C. Porter, in *Garden and Forest*, 1893, p. 204.

² Hough, *Trees U. States and Canada*, 19 (1907).

³ Aiton, *Hort. Kew.* v. 314 (1813).

⁴ The late Sir C. Strickland informed us that he remembered the tree at Boynton, 10 or 12 ft. high, and bearing prickly cones, which never produced good seed, and died many years ago.

⁵ The specimen described under this name, was a tree 30 ft. high, cultivated in the Residency Garden at Kathmandoo, India. According to Gordon, quoted by Lindley, in *Gard. Chron.*, 1855, p. 612, this is *P. inops* (*P. virginiana*), with which the figure of the cone and leaves agrees. Seeds were sent to the Horticultural Society from India, and only a few germinated.

plates. Young branchlets slender, tough, flexible, glabrous, glaucous, violet in colour. Buds about $\frac{3}{8}$ in. long, cylindrical, pointed, coated with resin.

Leaves in pairs, deciduous¹ in the third and fourth year, slightly spreading, $1\frac{1}{2}$ to 3 in. long, curved, slightly twisted, serrulate, sharp-pointed, marked by numerous stomatic lines on both surfaces; resin-canals median; basal sheath $\frac{3}{16}$ in. long.

Cones lateral, spreading, solitary or in pairs, shortly stalked, ripening and opening the scales in the autumn of the second year, ovoid-conic, 2 to $2\frac{1}{2}$ in. long, reddish brown, prickly; scales, $\frac{3}{4}$ in. long, $\frac{3}{8}$ to $\frac{1}{2}$ in. broad, thin, nearly flat, oblong-cuneate; apophysis rhomboidal, elevated, crenate in the upper margin, with a sharp transverse ridge, and a convex umbo, tipped by a slender spreading prickle. Seed nearly oval, pale brown, $\frac{1}{4}$ in. long; wing $\frac{1}{3}$ in. long; cotyledons 4 to 6.

This species is readily distinguishable from the other species with short leaves in pairs, by the glaucous violet branchlets, which, when vigorous, develop about their middle either buds or young cones.

*P. virginiana*² occurs from New York and Long Island, southward, generally near the sea-coast to the Savannah river in Georgia, usually growing on sandy soil, never in great abundance, and often spreading over lands gone out of cultivation, branching in habit and of small size. It extends inland to north-eastern Alabama, central Tennessee, Kentucky, and southern Indiana, in the latter state sometimes attaining³ on low hills as much as 100 ft. in height and 10 ft. in girth. It is of little economic value in any part of its range, the wood⁴ being brittle and soft with abundant sapwood, and mostly used for firewood. It is often planted as a shade tree.

This species was introduced into England before 1739, when Philip Miller had it in cultivation at Chelsea; but, having neither useful nor ornamental qualities to recommend it, it has remained very scarce in cultivation. The trees mentioned by Loudon as existing in 1838 at Pains Hill, Dropmore, White Knights,⁵ and Syon, have died or disappeared; indicating that this species is usually short-lived in England.

The largest specimen known to us is at Bayfordbury. Planted in 1842, it is now 47 ft. high, with a short butt, dividing at 2 ft. from the ground into four stems, the largest of which is 4 ft. in girth, with wide-spreading branches and sparse foliage. It bears cones freely. A tree probably planted in 1845 in the Queen's Cottage grounds at Kew is about 20 ft. high with a trunk 1 ft. in diameter, and dividing at 3 ft. up into two wide-spreading limbs. There are smaller specimens at Kew on the mound near the Lily House.

(A. H.)

¹ Galloway, in *Bot. Gaz.* xxii. 437 (1896), states that in young trees the needles fall in the second year, whereas on old trees, growing on good soil, they persist for three to five years.

² *Pinus clausa*, Sargent, *Forest Trees*, 199 (1884), a closely allied species, growing on the coasts of Florida and Alabama, differs mainly in the ashy grey, usually clustered and reflexed cones, which remain closed on the tree for several years, before opening their scales to let out the seeds. This species is not introduced, and probably would not be hardy in our climate.

³ Galloway, who, in *Bot. Gaz.* xxii. 433 (1896), gives an account of the ravages on this pine of a fungus, *Coleosporium Pini*, says that it attains 100 ft. high and $2\frac{1}{2}$ ft. in diameter, and is the most common species around Washington, D.C., many of the abandoned fields being covered with trees 10 to 15 ft. in height.

⁴ Hough, *Trees of U. States and Canada*, 17 (1907).

⁵ A tree at White Knights, supposed to be this species, is *P. montana*; and a tree long labelled *P. inops* at Kew, and referred to by John Smith, in *Records of Kew Gardens*, 286 (1880), has been recognised for several years to be *P. montana*. The species cultivated on the sand-dunes of east Prussia and Denmark, sometimes known as *P. inops*, is also *P. montana*. Cf. Mayr, *Fremdländ. Wald- u. Parkbäume*, 357 (1906).

PINUS BANKSIANA, JACK PINE¹

Pinus Banksiana,² Lambert, *Genus Pinus*, i. t. 3 (1803); Loudon, *Arb. et Frut. Brit.* iv. 2190 (1838); Kent, Veitch's *Man. Conifere*, 315 (1900); Mayr, *Fremdländ. Wald- u. Parkbäume*, 353 (1906); Sargent, in *Bot. Gazette*, xlv. 226 (1906); Clinton-Baker, *Illust. Conif.* i. 9 (1909).

Pinus sylvestris, Linnæus, var. *divaricata*, Aiton, *Hort. Kew.* iii. 366 (1789).

Pinus divaricata, Dumont de Courset, *Bot. Cult.* iii. 760 (1802); Sargent, *Silva N. America*, xi. 147 t. 588 (1897), and *Trees N. America*, 27 (1905); Masters, in *Journ. Linn. Soc. (Bot.)* xxxv. 620 (1904).

Pinus rupestris, Michaux f., *Hist. Arb. Amer. Sept.* i. 49, t. 2 (1810).

Pinus Hudsoni, Poirer, in Lamarck, *Encycl.*, v. 339 (1804).

Pinus Hudsonica, Parlatore, in DC. *Prod.* xvi. 2, p. 380 (1868).

A tree, attaining in America in favourable situations, 90 ft. in height³ and 6 ft. in girth; but usually smaller, and sometimes becoming a mere shrub. Bark thin, dark brown, irregularly divided into narrow connected scaly ridges. Young branchlets slender, flexible, glabrous, greenish, turning purplish brown in the first winter and following year. Buds ovoid, pointed, covered with resin, about $\frac{1}{2}$ in. long.

Leaves in pairs, the clusters not very dense on the branchlets, persistent for two or three years, spreading, 1 to $1\frac{1}{4}$ in. long, more or less curved, slightly twisted, serrulate, ending in a short cartilaginous point, with about ten stomatic lines on each surface; resin-canals median; basal sheath $\frac{1}{8}$ to $\frac{1}{6}$ in. long, lacerated.

Cones lateral, solitary or clustered, shortly stalked, directed towards the apex of the branchlet, much incurved, oblique at the base with the scales on the outer side most developed, ovoid-conic, $1\frac{1}{2}$ to 2 in. long, yellow and shining when ripe, often remaining unopened for several years; scales thin and stiff, about $\frac{3}{4}$ in. long and $\frac{1}{4}$ to $\frac{3}{8}$ in. broad; apophysis raised, pyramidal; umbo depressed or projecting, the minute incurved prickles of the first year usually becoming obsolete. Seeds only developed on the large scales of the outer side of the cone, triangular, blackish, $\frac{1}{8}$ in. long; wing $\frac{1}{3}$ in. long, broadest at the middle, full and rounded at the apex.

This species is readily distinguished by the short needles, and the occurrence of a whorl of buds, branchlets, or cones in the middle of each year's shoot when this is well-developed. The cones are peculiar in colour, shape, and direction.

This species has the most northerly range of all the pines of eastern North America, extending in Canada over a vast territory, bounded on the north by a line drawn in a north-westerly direction from northern Nova Scotia, lat. 45° , to near the southern end of Great Bear Lake, lat. 65° , not touching Hudson Bay or James

¹ The tree is commonly known by this name in Michigan, Minnesota, and Canada. Scrub pine, Grey pine, and Black pine are also used in New England and Canada. From Quebec to Hudson Bay it is called Cypress. Banksian pine is often used in books on forestry.

² This is the correct name, according to the rules for botanical nomenclature adopted by the Vienna Congress. Cf. Graebner, in *Mitt. deut. dend. Ges.*, 1908, p. 68, who points out that the name *divaricata* was not accompanied by a sufficient description. Sargent now accepts *P. Banksiana* as the correct name.

³ This is the maximum size given in *U.S. Forest Service Circ.* 57 (1907). According to Mayr, *op. cit.* 356, Macoun gives 115 ft. (35 metres) as the height which the tree sometimes attains in Canada. I have seen no exact measurements quoted, higher than those taken by me in Minnesota.

Bay; and reaching on the west the valley of the Mackenzie river and the Rocky Mountains. This pine extends southwards in the United States to Maine,¹ northern New Hampshire, Vermont, and northern New York, where it is rare and local and stunted; becoming common and of large size in Michigan, Wisconsin, and central Minnesota, and reaching its most southerly point in the northern parts of Indiana and Illinois.

In Canada, it attains its maximum size and is most abundant west of Lake Winnipeg and north of the Saskatchewan river, where it spreads over great areas of poor sandy soil, and is common and large in size in the regions north of Lake Superior.²

Mr. J. C. Langelier,³ in his description of the immense forests of the province of Quebec, north of lat. 48°, where this tree is only second in importance to black and white spruce as a source of supply of sawn timber, says:—"Botanists describe Banksian pine as a stunted, short, and branchy tree. This description certainly applies not to the Banksian pine of the Lake St. John and Saguenay district, where these trees grow to a considerable height, and attain a diameter which renders them fit for saw-logs. On the Rivière au Rat in 1898, a jobber cut a tree of this kind, which gave 91 ft. of usable timber, viz. five saw-logs and two ties. This tree measured 15 in. across the stump and over 7 in. at the top. At the Escoumains Mills, they sawed for many years Banksian pine logs, turning out good boards which were exported to the United States. Banksian pine ties are from year to year coming to the front, and are transported by railway from Roberval to Quebec, a distance of 190 miles. When there will be no more cedar (*Thuja occidentalis*) to supply the enormous quantities of ties required yearly by railroads, one of its most valuable substitutes will unquestionably be found in the Banksian pine, which the northern region is in a position to supply for a very long period."

In the province of Quebec, south of lat. 48°, Banksian pine grows nearly everywhere on the poor rocky and gravelly lands, chiefly in the dry plains which have been formerly laid waste by fire. It is not so tall or so good as in the northern region, but nearly always is large enough to make railway ties. In this part of Quebec province, *P. Strobos* and *P. resinosa* are more important as sources of supply of sawn timber.⁴ This pine never approaches the sea-coast, but it occupies outlying stations in the centre of Nova Scotia and of New Brunswick.⁴

In Michigan, northern Wisconsin, and central Minnesota, immense tracts of poor sandy soil are covered by Banksian pine, either pure or in mixture with red pine (*P. resinosa*). In Michigan⁵ these tracts are known as Jack pine plains or barrens;

¹ Around Lake Umbagog, in Maine, it attains a height of 60 ft.; but is usually in New England a low tree, 15 to 30 ft. high. Cf. Dame and Brooks, *Trees of New England*, 8 (1902).

² Bell saw large groves on Albany river, south-west of James Bay, with trees 70 ft. high and 2 ft. in diameter at the butt. Cf. *Gard. Chron.* xx. 503 (1883).

³ *Canadian Forestry Association, 6th Annual Report*, 1905, pp. 64, 67, 69.

⁴ *Bot. Gazette*, xxiv. 299 (1897).

⁵ Cf. E. J. Hill, in *Garden and Forest*, iv. 278 (1891). In Michigan the trees are usually not more than 30 or 40 ft. high, with short scraggy trunks, and are occasionally mere shrubs. Britton, however, measured trees near Marquette on Lake Superior, 70 ft. high. Cf. *Bull. Torrey Bot. Club*, 1883, p. 82. An account of this tree on the dunes bordering Lake Michigan is given by Cowles, in *Bot. Gaz.* xxvii. 371 (1899).

and the soil, containing little or no vegetable mould, is often nothing but a shifting mass of sand. In Wisconsin, according to Roth,¹ it is always a small tree, generally less than 10 in. in diameter and below 60 ft. in height. In Minnesota, where I saw it on the Cass Lake forest reservation, it is much finer, many groves averaging over 80 ft. in height and 1 ft. in diameter, the largest tree which I actually measured being 87 ft. high and 3 ft. 3 in. in girth. These groves of pure Banksian pine, which in other localities are often many square miles in extent, consist of tall slender trees, all of the same age and very uniform in size and appearance, with a stem clear of branches to 30 or 40 ft., and a narrow crown of foliage, standing very close together on the ground, which is bare of undergrowth. Plate 289 is taken from a photograph for which I am indebted to the U.S. Forestry Bureau.

The Banksian pine not only withstands extreme cold, but even thrives in a severe climate, as is witnessed by its luxuriant development in the northern and western parts of Canada and in Minnesota. It has been successfully cultivated in the Dakotas and Nebraska² for shelter belts, where a better tree will not thrive; and according to Saunders³ has succeeded when transplanted quite young, on the experimental farms at Brandon, Manitoba, and at Indian Head in the North-west Territories.

Barty and Jack say:⁴—"Timber made from it in former times when it was fairly abundant was considered to be of good size if it averaged three-quarters of a ton to a tree. The wood is hard, full of pitch, and free from sap, but apt to be full of streaks. It is much used for ties and railway sleepers, being one of the best woods for this purpose. Certain sections of country on the south-western Miramichi, the forests on which were destroyed by the great fire of 1825, have since become so thickly covered by forests of Banks's pine that it is almost impossible to force one's way through the trees."

It is specially adapted for seeding burnt areas, which have resulted from time immemorial by lightning striking dead trees. It produces cones at an early age, often when only four or five years old; and on adult trees many of the cones⁵ remain for years unopened on the older branches and even on the stem, the seeds retaining their fertility for an indefinite period. These cones open their scales when scorched by fire, and disseminate large quantities of seed, usually in spring and summer, the season of the forest fires, when the seed of other species is not mature. The seedlings⁶ are very rapid in growth, often attaining 1½ ft. in height when only three years old; and once an area is covered with the seedlings of this pine, no other

¹ *Forestry Conditions of Wisconsin*, 21 (1898), published as Bull. 1 of *Wisconsin Geolog. and Nat. Hist. Survey*.

² Cf. *U.S. Forest Service Circ.* 57 (1907), a planting leaflet, which gives hints concerning the cultivation of this species.

³ *Ottawa Exper. Farm Bull.* No. 47, p. 46 (1904).

⁴ *Trans. Scot. Arb. Soc.* xi. p. 11.

⁵ Dr. Bell, in *Canad. Forest. Assoc. 6th Ann. Report*, 1905, p. 59, states that the cones must be scorched before the seeds will escape. Many cones, however, open, like other pines, when two years old. Specimens which I collected, show that the opening of the cones is very irregular; and no explanation is forthcoming as to why some cones open and others do not. Unwin, *Future Forest Trees*, p. 83 (1905), supposes that the cones after opening, close again in damp weather. This is incorrect, as the old unopened cones contain the normal number of seeds, some of which would have escaped if the cones had opened.

⁶ Schwappach, in *Anbauversuche mit fremdländischen Holzarten*, 54 (1901), gives as instances of the very rapid growth of seedlings, the average size of two-year-old plants, 8 in.; five years old, 5 ft.; nine years old, 10 ft. It is incorrectly stated that it makes two or three shoots in a year; the two or three whorls of branches produced are all formed in the winter bud, and appear on the first and only shoot of the season.

species can obtain a footing. This explains the occurrence of dense woods of this species, uniform in age, over large areas. After a time the growth slackens, and at 60 to 80 years ceases, so that other species, attaining a greater age and height, eventually succeed in replacing this species.

(A. H.)

CULTIVATION

The date of introduction of this tree into Great Britain is unknown, though Aiton says that it was in cultivation before 1783.

Lambert described it in 1803 from a tree growing at Pains Hill which had probably been planted by the Hon. Charles Hamilton, who founded that place before 1735,¹ and which he describes as a remarkably fine tree, though he gives no measurements. He also mentioned trees then growing at Kew and at Croome in Worcestershire. All these² had disappeared when Loudon wrote, and he says that a tree at Dropmore, which in 1837 was 27 ft. high and 1½ in. in diameter, was then the finest known to him. There was also one at White Knights 30 ft. high. Neither of these is still alive, and we have found only a few trees now living in England besides those at Kew. One growing at Arley Castle, which is the only survivor of five or six planted there probably about 70 years ago, measured in 1909, according to Mr. Woodward, 45 ft. by 3 ft. 3 in. Another at Nuneham Park, Oxford, covered with cones, and apparently having attained its maximum height, was 44 ft. by 4 ft. 7 in. in 1907. Another at Pencarrow measured by Mr. A. Bartlett in 1906 was 35 ft. by 3½ ft.; and there is a poor stunted tree bearing cones at Menabilly. A specimen at G. Paul's Cheshunt Nursery, is about 30 ft. high by 3 ft. 4 in. in girth. Mr. Paul says it was probably planted in 1845-1850, and remembers it in 1860 nearly as tall as it is now.

All these facts show that this species is likely, from an economic point of view, to be worthless in this country, as might be expected, considering that the tree inhabits a climate unlike that of any part of Britain. Nevertheless, several writers have strongly recommended this tree for planting in England on the strength of a very short experience on the barren sands of northern Germany,³ where the tree, growing very rapidly from seed, has been widely puffed by enterprising nurserymen, and where it may possibly be useful for shelter in places where nothing better will grow. I was seriously advised by an expert in forestry to plant it on a large scale, and might have done so if I had not previously known the tree in its own country.

Dr. Mayr of Munich, whom I consulted before utterly condemning the tree, and who is second to none in his knowledge of the trees of the northern hemisphere, agrees with me that, if planted at all, it is only fit for the worst class of sandy soil; but as young plants can now be procured at a cheap rate in Germany, there will

¹ Loudon, *op. cit.* i. 70.

² Loudon, in *Gard. Mag.* xviii. 585 (1842), mentions a *P. Banksiana*, 14 ft. high, at Dalhousie Castle, where many American trees had been introduced by the Earl of Dalhousie when he was Governor of Canada.

³ In Bavaria, according to Mayr, over 500,000 have been planted in the State forests, and one firm in Germany sold 6,000,000 plants in 1905. The tree has also been planted extensively at Römershof, near Riga, and experiments are now being made with it on the sand dunes of Jutland.

be no harm in trying a few as an experiment on dry poor soils on the mountains of eastern Scotland. Mayr's account, in his recent work, of the favourable results obtained by the cultivation of this tree in Germany should be studied by those who wish to try it; but he recommends it only as a sheltering and improving crop for the worst kinds of sand and gravel soil in places which suffer severely from spring frost, and where nothing better will grow. He does not expect it to produce valuable timber. Its growth is remarkably fast when young, and it produces good seed when only fifteen years old.

Of these recent introductions, Dr. Mayr showed me, in May 1905, a tree growing at Grafrath, near Munich, from seed brought from Wisconsin in 1885. It was 20 ft. high, and bore fertile cones.

(H. J. E.)

PINUS PINASTER, MARITIME PINE

- Pinus Pinaster*,¹ Solander, in Aiton, *Hort. Kew.* iii. 367 (1789); Loudon, *Arb. et Frut. Brit.* iv. 2213 (1838); Lawson, *Pinet. Brit.* i. 71 (1884); Willkomm, *Forstliche Flora*, 233 (1887); Mathieu, *Flore Forestière*, 610 (1897); Kent, Veitch's *Man. Coniferæ*, 358 (1900); Kirchner, *Lebensgesch. Blütenpfl. Mitteleuropas*, 238 (1905); Clinton-Baker, *Illust. Conif.* i. 43 (1909).
Pinus maritima, Lamarck, *Flore Franç.* ii. 201 (1778); Poirer, in Lamarck, *Encycl.* v. 337 (1804); Masters, in *Journ. Linn. Soc. (Bot.)* xxxv. 621 (1904).
Pinus syrtica, Thore, *Prom. Gascogne*, 161 (1810).
Pinus Lemoniana, Bentham, in *Trans. Hort. Soc.* i. 512 (1835).
Pinus Hamiltoni, Tenore, *Cat. Hort. Neap.* 90 (1845).

A tree attaining 120 ft. in height and 14 ft. in girth. Bark soon becoming scaly and furrowed; on old trees deeply fissured and broken up into scaly plates, dark-brown externally, and reddish internally. Young branchlets brown, glabrous, with raised keeled pulvini; older branchlets, from which the leaves have fallen, roughened by the pulvini, bearing at their apices the reflexed bases of the scale-leaves; the bases of the shoots surrounded by a sheath of reflexed bud-scales. Buds ¾ to 1 in. or more, stout, spindle-shaped, pointed; scales brown, interlaced by their white fimbriated margins, and with free and reflexed points.

Leaves in pairs,² persistent usually for three years, slightly spreading, 5 to 6 in. long, stout, rigid, curved, ending in a callous point, serrulate, with numerous stomatic lines on both surfaces; resin-canals marginal; basal sheath an inch long, persistent.

Staminate flowers in a dense spike. Young cones ¾ in. long, brownish red, with non-prickly scales, on a scaly peduncle, about ½ in. long. Mature cones,³ sub-terminal, in a whorl⁴ of 2 to 8, shortly stalked, spreading or much deflexed, ovoid-

¹ This is the oldest certain name, and the one almost universally adopted. *P. maritima*, Miller, *Gard. Dict.* Ed. 8, No. 7 (1768), is insufficiently described, and has been referred to both *P. Pinaster* and *P. Laricio*. Cf. Graebner, in *Mitt. d. dend. Ges.*, 1908, p. 68.

² They sometimes occur in clusters of threes on young trees.

³ The cones in France usually open and let out the seed in the spring of the third year; but in Corsica and Spain I observed many trees, with cones unopened and five to twelve years old. Here also trees begin to bear cones very early, which remain unopened in numerous whorls on the main stem, resembling exactly the trees of *P. tuberculata* in the Siskiyou mountains. One tree, 10 ft. high, had seven whorls of cones, the upper five of which, two to six years old, were unopened. Another tree twenty-two years old bore cones in twelve whorls on the stem, all unopened. This is undoubtedly an adaptation for regeneration on burnt areas, due to the frequent fires in these dry regions.

⁴ Mr. H. Clinton-Baker obtained in 1908 from a tree at Boldre Grange, Lympington, a branch with sixty-one small cones in a cluster.

conic, 3 to 7 in. long, $1\frac{1}{2}$ to $2\frac{1}{2}$ in. in diameter near the oblique base, shining reddish yellow; scales oblong, about $1\frac{1}{2}$ in. long and $\frac{3}{4}$ in. broad, flat; apophysis rhomboidal, convex and slightly raised in the centre, or pyramidal and much elevated, with a linear transverse ridge, and a dull grey elevated sharp-pointed or blunt umbo. Seed $\frac{1}{3}$ in. or more, shining black above and dull mottled grey below, with a detachable brown wing, 1 to $1\frac{1}{2}$ in. in length.

The seedling has seven or eight cotyledons, entire in margin and dull green in colour; and the stem is clothed during the first two years with solitary sharply serrate primary needles, the adult geminate foliage only appearing in the third year. Seedlings thrive only in full sunlight, and grow fast, attaining often a foot in height in the first year, and 10 to 12 ft. at the end of the tenth year. This pine¹ has a strong tap-root, but speedily develops in addition lateral roots which either spread horizontally or descend into the soil.

VARIETIES

This species varies, in the wild state, in the length of the leaves and in the size of the cones,² the scales of which show considerable differences in the amount of prominence of the apophyses. The following varieties have been distinguished.

1. Var. *Aberdoniae*, Loudon, *Gard. Mag.* xv. 128 (1839). Leaves pale green. Cones shorter and more ovoid than in the type. Introduced in 1825 from Nice by the Earl of Aberdeen, who raised plants, one of which was presented to Lord Granville, and was reported by Loudon to have been 17 ft. high at Dropmore in 1837. Reported trees of this variety, labelled *P. Escarena*,³ are now growing at Dropmore, and only differ from the type in having a thinner and less fissured bark.

2. Var. *Hamiltoni*, Gordon, *Pinetum*, 178 (1858) (*Pinus Hamiltoni*,⁴ Tenore, *Cat. Ort. Bot. Nap.* 90 (1845)), is supposed⁵ to be identical with the preceding variety; but a tree at Kew, named var. *Hamiltoni*, only differs from the type in having more slender branchlets. It has not borne cones.

3. Var. *minor*, Loiseleur, in *Nouv. Duhamel*, v. 242, t. 72 (1812), found on barren sands near Le Mans, France, was said to bear small cones, and to be hardier than the type.

4. Var. *Lemoniana*, Loudon. *P. Lemoniana*, Bentham, in *Trans. Hort. Soc.* i. 512 (1835). Cone solitary and erect at the end of the branchlet, the terminal bud not

¹ After felling, the stools occasionally grow, like those of the silver fir, and for the same reason, because their roots are connected with those of adjacent living trees. The annual rings of wood continue to be formed on the stump after the trunk has been felled, as illustrated by a specimen from Gordon Castle; and this new formation in the amputated stump owes its origin to inoculation of the roots. A remarkable example of the fusion of the roots of two trees of *P. Pinaster*, discovered in a Portuguese forest, and now preserved in the Museum at Coimbra, is illustrated in *Gard. Chron.* xxii. 300, fig. 58 (1884).

² Cones of this species, differing in the arrangement of the scales, are described and figured by Dickson, in *Trans. Roy. Soc. Edin.* xxvi. 505, Pl. 19-22 (1871). At Woburn the cones of old trees growing close together vary considerably in the prominence of the apophyses, and in the size of the seeds; but seedlings raised from the two kinds of seed are indistinguishable in appearance at present.

³ *P. Escarena*, Risso, *Hist. Nat. Europ. Mérid.* ii. 340 (1826), is a doubtful plant; and according to the Duke of Bedford, ex Loudon, *Gard. Mag.* xv. 127 (1839), is a variety of *P. sylvestris*. The seeds brought home by the Earl of Aberdeen from trees near Nice were erroneously supposed by him to be Risso's species, which was named *P. Escarena* in honour of the Count d'Escarène, who discovered it wild in the mountains near Nice. Gordon, in *Gard. Chron.*, 1841, p. 564, gives an inaccurate account of this, which he calls *P. ascarena*, from a village named Ascaren in Italy.

⁴ A tree labelled *P. Hamiltoni* still exists in the Botanic Garden at Naples, of which Prof. Cavara has kindly sent us a branch with cones, which are indistinguishable from those of typical *P. Pinaster*.

⁵ By Gordon, and by Koch (*Dendrologie*, ii. 2, p. 292 (1873)).

developing.¹ This variety was first observed by Sir C. Lemon; and in Loudon's time there were numerous examples at Carclew, the largest being about 30 ft. high in 1837. It was reported to come true from seed. When Elwes visited Carclew in 1905 there was only one survivor to be found, a poor scrubby tree in a hedgerow, and covered with ivy, a specimen from which shows the peculiarity in the position of the cone.

5. Hybrids² between this species and *P. halepensis*, twenty to forty years old, obtained by sowing seed of trees of the former species at Mirabeau, Vaucluse, show a grey bark like that of *P. halepensis*, and leaves 4 in. long, thinner than those of *P. Pinaster*.

DISTRIBUTION

The maritime pine is a native of the Mediterranean region, extending as far eastward as Greece, and reaching the shores of the Atlantic in France and Portugal. *P. Pinaster* and *P. halepensis* have a somewhat similar distribution, but they occur on different soils, the former usually occupying siliceous sands, and the latter occurring on limestone. The maritime pine is usually confined to the coast regions and islands, seldom extending far inland.

It forms extensive woods in western Portugal; and in Spain, occurs in Galicia, Estremadura, and the eastern parts of Granada. North of Gibraltar it grows in mixture with *A. Pinsapo* on the Sierra de Bermeja, elsewhere forming scattered pure woods of no great extent, the largest trees which I saw being about 10 ft. in girth.

In France it is a native of Gascony, where small woods, called *pignadas*, undoubtedly occur in the wild state; but its natural area has been much increased by plantations, the artificial forest of this species in the Landes between Bordeaux and Bayonne being perhaps the most extensive ever created by the hand of man. The total extent of the *Pignada Landaise* amounted in 1892 to 1,715,000 acres, of which 1,600,000 acres belong to communes and private owners, the remainder comprising the dunes on the coast, which cost the government immense sums in various works. The total expenses of planting, road-making, etc., of the 1,600,000 acres is estimated to have been £2,100,000. The value of this forest was £8,200,000 in 1877, which had increased, according to Mr. Huffer,³ to £18,000,000 in 1904, the annual revenue obtained by the sale of timber, turpentine, and resin being £560,000, or 7s. per acre. Recent improvements in transport, such as the construction of light railways, have raised the annual returns considerably. The greater part of this immense area has been planted subsequently to 1855, as in that year the total area under *P. Pinaster* was only 50,000 acres.

This species is also found⁴ in the Mediterranean region of France, in the

¹ Masters, in *Journ. Roy. Hort. Soc.* xiv. 237 (1892), says that he twice met with a similar condition in *P. sylvestris*.

² *Pinus halepensis-Pinaster*, Saporta, in *Comptes Rend. Acad. Sc. Paris*, cix. 656 (1889). Cf. Ascherson and Graebner, *Syn. mitteleurop. Flora*, i. 232 (1896).

³ *Économie Forestière*, i. 177 (1904).

⁴ Fliche and Grandeau, in *Ann. Chimie et Physique*, 383 (1873), found that in Champagne it only thrives on sand, loam, or clay containing less than 0.35 per cent of carbonate of lime, and became stunted and died on chalk soils. Yet it is frequent near Nice on limestone, according to Bunbury, *Bot. Fragments*, 7 (1883); and Mr. Tansley has lately found it on the Riviera flourishing in mixture with *P. halepensis*, in soil which effervesced freely when acid was applied close to the roots.

mountains of the Maures and Estérel, and in the Albères, but here it rarely occurs pure, and is a smaller tree than in the Landes. It has also been planted in France far to the north of its natural habitat, up to latitude 49° in Brittany. Nearly 200,000 acres were planted with this species in Sologne in the centre of France, but most of the trees here were killed by the severe winter of 1879, and *P. sylvestris* has been planted in its place.

In Corsica it occurs from the sea-coast up to 2700 ft. on northern aspects, and to 4000 ft. on southern slopes, mixing in its upper level with *P. Laricio*, and often becoming a fine tree, the largest which I measured in the mountains near Calvi, at 3000 ft. altitude, being 100 ft. high and 10 ft. 10 in. in girth, with a stem clear of branches to 50 ft.

(A. H.)

In Portugal this is perhaps the most abundant tree in all the coast region; and on poor sandy soil unfit for agriculture, covers immense areas, mixed to a small extent with oaks on the better land, but generally pure, and reproducing itself freely everywhere. The trees are seldom allowed to grow very large, the tallest that I saw on deep sand near the Oporto coast being about 100 ft. high and 5 or 6 ft. in girth. But in the Royal forest near Leiria a tree, in 1843, measured 39 metres by 4.48 metres; and in the same forest in the Canton d'Alvenha two trees then existed, of which the first was 40 metres by 3 metres, with a clean bole 27 metres long; the second 38 metres by 4.20 metres. In the forest of Busaco on granite soil there are a few trees scattered among the oaks, of which the largest that I measured was 80 ft. by 9 ft. 4 in. The bark was here not so red and shining as on old trees in England, but quite easy to distinguish from the greyer bark of *P. Pinea*. *P. Pinaster* is known in Portugal as *Pino bravo* or wild pine, whilst *P. Pinea* is called *Pino manzo* or cultivated pine. It grows wild up to about 2500 ft., and was being sown on the hills above Caldas do Gerez, in the Gerez mountains north-east of Oporto, up to about 3000 ft. on dry slopes, where the soil was not good enough for oak.

In Italy this species appears to be limited to the west of the Apennines, on the sandy plains and in the lower hills, from Savona and Genoa¹ to Mount Argentaro. On the eastern side of the Adriatic it occurs on the islands of Lussin, Brazza, Lesina, and Curzola, where it is a tree of moderate height, resembling the Austrian pine in habit. It occurs also in Greece. In Algeria² it is only known on the hills overlooking the coast, between Bougie and Cape Bougarone, where it covers an area of about 4000 acres.

In Cape Colony, where it has been introduced, it grows like a weed along the southern coast, where there are winter rains, and is now largely planted for railway sleepers and firewood by the Forestry Department.³ At Port Phillip, in Victoria, Australia, it averages 40 ft. high in 20 years.⁴ It is also largely planted in the Madeiras and Canaries.

¹ According to Bunbury, *loc. cit.*, it grows on serpentine in the hills between Savona and Genoa, and between Sestri and Spezia.

² Lefebvre, *Les Forêts de l'Algérie*, 432 (1900).

³ Hutchins, in Flint and Gilchrist, *Science in S. Africa*, 393 (1905).

⁴ Von Mueller, *Select Extratropical Plants*, 360 (1891).

CULTIVATION

The maritime pine was introduced by Gerard more than three centuries ago, and though it has at various times been very largely planted in some parts of England, it has never taken the place of a forest tree, and has no qualities which will justify its being considered as such, except in a few places.

It seems, however, so much at home¹ on the warm sands of south-east Dorsetshire, where it reproduces itself freely by seed, that it might perhaps take the place of Scots pine for pit props in places where sea carriage is available. On the road from Christchurch to Heron Court it attains a very large size. The best I measured was about 85 ft. by 9½ ft. on almost pure sand among rhododendrons and tall bracken. I could not learn, however, that the timber was valued here, and was unable to find out the age of the trees.

Though the tree is a native of the Mediterranean region, it seems able to endure great extremes of wet and cold in this country, as I have seen it growing well in the damp climate of Wigtownshire and on the sandhills of Norfolk.

We have measured a great many adult trees in various parts of England, among which a tree (Plate 290) near the house at Foxley Hall, near Hereford, is one of the finest, measuring, in 1907, 95 ft. by 11 ft. 8 in. with a bole clean to 50 or 60 ft. This was remarkable, because the soil and climate at Foxley seem to be more suitable to oaks than to maritime pines, though the situation is well drained and sheltered.

In the grounds of the Earl of Mount Edgcumbe at Mount Edgcumbe, Cornwall, Mr. A. B. Jackson measured an immense old tree, which in 1909 was 18 ft. in girth.

In the kitchen garden at Penrhyn Castle, there is a remarkable tree 80 ft. high and forked close to the ground, forming two huge trunks 11½ ft. and 8 ft. 10 in. in girth, between which a large aviary is fixed.

Other large trees are as follows:—

	Height.	Girth.	Year.	By whom measured.
Arno's Grove, Middlesex	90 ft.	8 ft. 10 in.	1906	A. Henry.
Buxsted Park	96 ft.	12 ft. 5 in.	1908	H. J. Elwes.
Burwood House, Surrey	75 ft.	8 ft. 10 in.	1909	Col. H. Thynne.
" " " "	78 ft.	7 ft. 10 in.	"	" "
Ashburnham Park, Sussex	80 ft.	10 ft. (about)	"	H. A. James.
Holwood, Kent	85 ft.	8 ft. 7 in.	1890	A. D. Webster.
Stackpole Court, Pembroke	80 ft.	7 ft. 6 in.	1906	H. J. Elwes.
Dropmore, Bucks ²	75 ft.	10 ft. 9 in.	1910	C. Page.
High Canons, Herts	69 ft.	7 ft.	1908	H. Clinton-Baker.
Hatfield Park, Herts	65 ft.	11 ft. 5 in.	1905	A. Henry.

At Westwick, Norfolk, according to Loudon, who quotes the *Trans. Soc. Arts*, xxviii. 37 (1811), J. B. Petre, Esq., planted in 1809, on upwards of 500 acres, over 200,000 trees raised from his own seed from trees planted about 1702. I am informed by Mr. M. P. Price that in March 1909 he measured roughly some of the largest surviving trees, and found them to be from 75 to 80 ft. high by 9 to 10 ft. in girth,

¹ Cf. Clement Reid, *Origin British Flora*, 12 (1899). Boswell Syme, *Eng. Bot.* viii. 270 (1868), erroneously states that it is a native of the south of Ireland.

² A tree labelled *P. Escarena*, planted in 1841, measured 66 ft. by 8 ft. 3 in. in 1909.



the boles having very thick bark, and tapering considerably. The tallest tree was found by Henry in 1910 to be 93 ft. by 5 ft. Most of the trees were blown down in the gale of March 24, 1895, the survivors being now scattered among Scots pines which were planted with them. There is no natural reproduction, as the squirrels eat every seed as soon as it is ripe. The present owner, Major B. J. Petre, states that the timber is inferior to that of Scots pine, rarely selling for more than 4d. per foot, while the latter is readily saleable at 6d.

On the sandhills at Holkham this pine has been planted to some extent, and reproduces itself from seed, but does not grow so well as *P. Laricio*.

In Scotland, the finest tree we know is one¹ growing in a wood at Monreith, Wigtownshire, which measured 82 ft. by 9½ ft. in 1905. At Smeaton-Hepburn, East Lothian, there are three trees in a wood, about 70 ft. high by 6 ft. in girth.

In Ireland the best tree which we have seen is at Curraghmore, Waterford, and measured 91 ft. by 7 ft. 10 in. in 1907. At Castlemartyr, Cork, there is a good tree, 70 ft. by 9 ft. At Powerscourt, Wicklow, a tree 67 ft. by 9 ft. 11 in. was bearing cones profusely in 1906. Capt. John Campbell reports that in an exposed position on peat bog, near Moycullen, Galway, this species is thriving; and it appears to have been the only tree that survived in the disastrous experiment of planting on peat bog at Knockboy. At Shelton Abbey, Co. Wicklow, there are four trees, growing in a sheltered situation on a gravelly bank, the dimensions of which, as given by Mr. Shivas in 1910, are 60 ft. by 10 ft., 80 ft. by 8 ft. 9 in., 50 ft. by 9 ft. 8 in., and 60 ft. by 7 ft. 9 in. At Tullymore, Co. Down, there is a fine old tree in the same valley where the Silver firs (Plate 211) grow. Being crowded among other trees, I could not measure its height, which I estimated at 75 ft.; the bole, 10½ ft. in girth, was clean to 40 or 50 ft. up.

TIMBER

The timber of this tree is one of the most important articles of export from the south-west of France. Of late years great quantities of pit props have also been exported from Portugal to South Wales, and as their local value is very small, and the cost of transport to the shipping ports low, this source of supply cannot be overlooked in considering the probable future value of pit props in our southern counties.

An account of the uses of this tree, quoted from a French author, was given by Loudon in 1838, which is worth reading, though perhaps rather out of date. Resin seems then to have been the most valuable product of the tree, but lamp-black was also an important item, and the methods of extracting both are fully described. Now, however, a great quantity of the trees after having been tapped until their resin is exhausted, are shipped in the form of pit props to the South Wales coal ports at a very low rate of freight, in the coal ships, which would otherwise return empty from Bordeaux; and are delivered on the wharf in suitable lengths, in such quantities, and at such a low price, now 20s. to 21s. per ton, that they govern the price of home-grown mining timber. It has been pointed out by Mr. R. Anderson of Cirencester in a

¹ Figured in *Woods and Forests*, 1884, p. 737.

paper on the conversion of home-grown timber,¹ that British timber is further handicapped by the railway companies' practice of giving lower rates for carriage of pit props to the collieries from these landing ports, than they do for English timber over the same lines of railway from inland stations. He calculates that this preferential rate may mean a disadvantage of £12 : 10s. per acre as compared with foreign timber. Mr. Anderson tells me that in consequence, as he believes, of these disadvantages, he has seen no home-grown pit props or English timber in the Derbyshire collieries; and on more than one occasion when I have tried to sell timber to coal owners in that district, I have found that Norwegian timber from the north-east ports was delivered at a price which, after paying haulage and railway charges over about the same distance, would make it impossible for me to grow such wood profitably.

(H. J. E.)

PINUS PINEA, STONE PINE

Pinus Pinea, Linnæus, *Sp. Pl.* 1000 (1753); Loudon, *Arb. et Frut. Brit.* iv. 2224 (1838); Schouw, in *Ann. Sci. Nat.* iii. 236 (1845), and *Journ. Hort. Soc.* iii. 120, 130 (1848); Willkomm et Lange, *Prod. Fl. Hispanica*, i. 20 (1861); Laguna, *Fl. Forestal Española*, 49 (1883); Boissier, *Fl. Orientalis*, v. 694 (1884); Fliche, *Assoc. Franç. Avance. Sciences, Nancy* (1886); Willkomm, *Forstliche Flora*, 240 (1887); Mathieu, *Flore Forestière*, 620 (1897); Kent, Veitch's *Man. Conifera*, 360 (1900); Masters, in *Journ. Linn. Soc. (Bot.)* xxxv. 613 (1904); Clinton-Baker, *Illust. Conif.* i. 44 (1909).

Pinus fastuosa, Salisbury, *Prod.* 398 (1796).

Pinus maderiensis,² Tenore, *Ind. Sem. Hort. Neap.* in *Ann. Nat. Sci.* 379 (1854).

A tree, attaining 100 ft. or more in height, with a trunk rarely 20 ft. in girth, and a broad rounded head of ascending branches and very dense foliage. Bark at first smooth and brown, ultimately deeply furrowed and scaly. Young branchlets glabrous, yellowish green, with raised keeled imbricated pulvini, terminating in lanceolate fringed reflexed scale-leaves, which persist during the first year. Buds ¼ to ⅓ in. long, ovoid, pointed; scales brown, matted together by the long white fimbriæ on their margins, free and reflexed at their apices.

Leaves in pairs,³ persistent two years, densely crowded on the branchlets, spreading, 4 to 5 in. long, curved, serrulate, sharp-pointed, marked with about twelve stomatic lines on the outer and six on the inner surface; resin-canals marginal, numerous; basal sheath whitish, ¼ in. long.

Cones sub-terminal, solitary or two or three together, on stout stalks, which are clothed with scale-leaves and ½ in. to ¾ in. long; erect, ovoid or nearly globular, 4 to 6 in. long, and 4 in. broad, symmetrical, shining and light brown; scales 1½ in. or more in length, ¾ in. wide, hollowed at the base for the seeds; apophysis much thickened, pyramidal, four to five angled, and marked with four or five radial linear ridges; umbo rhomboidal, ⅓ in. wide, dark coloured, showing in its centre an inner umbo, which is often tipped with a triangular reflexed process. Seeds⁴ numerous,

¹ *Journ. Roy. Agr. Soc. England*, lxiv. 50 (1903).

² Cf. *Gard. Chron.*, 1855, p. 334.

³ On well-developed vigorous branches, a few of the leaves are sometimes in clusters of threes.

⁴ Seeds kept in the cones apparently retain their germinating power indefinitely, an instance being recorded in *Gard. Chron.*, 1856, p. 39, where seedlings were raised from cones said to be forty years old.

nearly 100 in a cone, one or two on each scale, $\frac{5}{8}$ in. to $\frac{3}{4}$ in. long, dark purplish brown, convex on the inner and flattened on the outer surface, with a thick shell and an edible kernel; wing $\frac{1}{8}$ in. to $\frac{1}{4}$ in. long, surrounding the apex and part of the sides of the seed, remaining on the scale when the cone opens.

The cones of this species are remarkable in taking three years to ripen, the seeds usually falling out in the spring of the fourth year; and each scale shows distinctly the growth of three seasons, the inner and outer umbo indicating the growth of the first and second year, while the rest of the apophysis is formed in the third year.

The seedling¹ has ten to thirteen cotyledons, nearly 2 in. long, triangular in section, sharp-pointed and stomatiferous on the upper two sides. The primary leaves, solitary, $\frac{1}{2}$ to 1 in. long, linear, flattened, serrate, and stomatiferous on both surfaces, are produced for several years, in mixture, after the first season, with the adult geminate leaves. Seedlings are very vigorous in growth, often attaining a foot in length in six months, and develop lateral branches and a long tap-root.

In this species,² adult trees frequently produce branches, which bear solitary glaucous flat linear leaves, similar to the primary leaves on the seedling plant. Hochstetter³ has succeeded in fixing the juvenile form by cuttings, producing beautiful shrubs with solitary needles.

The Comte de Paris sent in 1894, from his estate near Seville in Spain, to the Museum at Kew,⁴ a cone, from the apex of which a stout leafy shoot had sprung, a foot in length and with three branches. It died after it had exhausted all the nourishment from the cone, which had been severed from the tree when the shoot was about 6 in. in length.

The stone pine shows little or no tendency to vary; but there is a form in cultivation in Italy, var. *fragilis*, with a very thin shell to the seed.

DISTRIBUTION

The stone pine is a native of the Mediterranean region, and undoubtedly occurs wild,⁵ as well as planted, in the Iberian peninsula, south-eastern France, Corsica, Italy, Greece, and Asia Minor, extending a little distance into Russian territory on the south-east of the Black Sea. It has been recorded as a native of the Canaries and Algeria, but there is no doubt that it has been introduced into these regions. It has been extensively planted for centuries, and it is difficult to ascertain whether existing woods are natural or artificial in many localities; while on the other hand, owing to the advance of agriculture, it has probably disappeared in historic times from many places.

It is more widely distributed in Spain and Portugal than elsewhere, its northern limit, according to Willkomm,⁶ being a line following the Douro from its mouth to its source, continued through southern Aragon to the coast of Catalonia. Remark-

¹ Excellent figures representing different stages in the germination are given by Sachs, *Text-book Bot.* 508 (1882).

² Cf. Masters, in *Gard. Chron.* xx. 48, fig. 9 (1883), and *Journ. Linn. Soc. (Bot.)* xxvii. 259, fig. 8 (1891).

³ *Gard. Chron.* xv. 333 (1881).

⁴ Thiselton-Dyer, in *Ann. Bot.* xvii. 779, t. 40 (1903), and *Kew Bulletin*, 1894, p. 226.

⁵ Nymán, *Sylog. Fl. Europ.* 347 (1854-5), doubts the spontaneity of this tree in Europe; but this opinion is contrary to that of most botanists.

⁶ *Pflanzenverbr. iber. Halbinsel*, 96 (1896).

able woods occur at Albufeira in Algarve, and on the shores of the Bay of Cadiz. It ascends in the mountains of the coast region of Granada to 3000 ft., an elevation unattained elsewhere, as it is usually a native of the plains and low hills near the sea.

(A. H.)

In Portugal the stone pine is not nearly so common a tree as the maritime pine, and is usually seen on dry hill-sides and exposed places, where its umbrella-shaped crown makes it a very conspicuous tree. The finest that I saw was a very remarkable tree near Covilha in the province of Beira Baixa, growing at an elevation of about 2000 ft. Padre J. de Silva Tavares lent me a splendid negative of this tree, reproduced on Plate 291, and informed me that its height was 31.25 metres, the girth of the trunk, which is 14½ metres high, being 5.36 metres at the base. He said that an old man, who remembered the French invasion, stated that it was then about the same size as at present, so the tree must be a very long-lived one. On the Pena Verde, near Cintra, I measured another fine old tree of very gnarled and rugged habit, owing to its exposed situation. It was about 75 ft. high, with a trunk of about 30 ft. by 12 ft., the bark divided into very broad reddish plates, which do not become smooth and shining like those of *P. Pinaster*. Both of these are exceeded in size by a tree said to have been cut down at Curto,¹ which measured 40 metres by 6.40 metres. A section of this tree, 4.77 metres in girth, showed 300 annual rings.

(H. J. E.)

In France isolated trees are met with in the forests of Aleppo and maritime pines in the extreme south of Provence and Languedoc; and nearly pure woods, which are undoubtedly wild, occur on several points of the Mediterranean, from Aigues Mortes to Cannes. The largest of these, 750 acres in extent, lies between Aigues Mortes and Les Saintes. Another wood at La Plage, near Hyères, is 160 acres in area. Others occur at Vidauban, Saint Raphael, and between Cannes and Napoule. The most northerly station in France is the remarkable forest of Bigourdin near Fonscolombe, which consists of a mixture of *P. Pinea* and *P. halepensis*, and is undoubtedly natural. Here the mean annual temperature is 58°, the same as at Ravenna, the northern limit of the tree on the Adriatic. The most remarkable specimen is the *Pin de Bertaud*,² growing in the department of Var, two miles from Saint-Tropez, on the main road to Toulon. It is 53 ft. high, well shaped, and with a perfectly sound trunk 20 ft. in girth, the spread of foliage being 85 ft. in diameter. In France the stone pine is cultivated as far north as Angers, which has a western mild climate.

In Corsica there is a wood of this species, about 25 acres in area, near Porte Vecchio.

In Italy *P. Pinea* is wild at intervals on the west coast, from Genoa, where it occurs on the low hills, to Ostia, mainly growing on sandy plains in mixture with *P. Pinaster*. The natural forest of San Rossore, between Leghorn and Pisa, in which *P. Pinea* predominates amidst *P. Pinaster* and broad-leaved trees, like *Quercus pedunculata* and *Q. Ilex*, with an undergrowth of *Erica scoparia* and grasses, occurs on soil containing very little lime, less than $\frac{1}{2}$ per cent. The pines

¹ Gebhart, in *Rev. des Eaux et Forêts*.

² *Journ. Soc. Nat. Hort. France*, 1888, p. 367, fig. 1.

attain a height of about 70 ft. There is also a wood of this species at Castel Fusano near Rome. The most celebrated forest¹ of *P. Pinca* in Italy, the *Pinete di Ravenna*, in which Dante, according to tradition, composed the *Divina Commedia* whilst he walked amidst its glades, is situated east of Ravenna, forming a band 2 miles distant from the Adriatic coast, about 16 miles in length and a mile in width; and in 1866 covered about 10,500 acres, according to Balestreri,² who visited it in that year, when the pines were about 60 ft. in height and 8 ft. in girth. There are three distinct sections,—the *Pineto di S. Vitale*, about 5000 acres, and the *Pineto di Classe*, about 2500 acres, which belong to the city of Ravenna; while the third, the *Pineto di Cervia*, about 3000 acres, is owned by the commune of Cervia. This forest was greatly damaged³ by the long and severe winter of 1879, when the thermometer fell to -10° or -12° C., all the young pines, less than twenty-five to thirty years old, being killed outright. The older trees, with their foliage brown and withered in the spring of 1880, were believed to be dead; and orders were given to fell them and sell the timber. A large area was at once completely cut down. Later in the season, the trees were observed to be still living, and the destruction was stopped. About 2700 acres remained untouched, and the old trees here are now thriving. About 5000 acres of the area which had been felled, was subsequently sown with seed; and the young pines are now flourishing and about 15 to 25 ft. in height. For the preceding information we are indebted to M. Bandi, the forester in charge, whom I saw in 1909, when I visited the *Pineto di Classe*, which lies about 5 miles south-east of Ravenna. The soil is sandy, but is said to contain a notable quantity of lime, nearly five per cent. The forest is an open one, mainly composed of pines with a few scattered oaks (*Q. pedunculata*), and an undergrowth of *Cratægus Pyracantha*, *Rosa sempervirens*, clematis, juniper, and bracken. Towards the margin, where the soil improves, the pines become fewer, and are replaced by oak and *Fraxinus oxycarpa*. The largest pines which I saw measured 70 to 80 ft. in height and 5 to 7 ft. in girth.

In Italy the tree is cultivated for its edible seeds from the foot of the Alps to Sicily, and is planted from sea-level up to 1000 ft. in the north and 2000 ft. elevation in the south. The timber, which was formerly used for shipbuilding, is no longer employed.

According to Beck v. Mannagetta⁴ it is scarcely wild on the eastern shore of the Adriatic, and is even rarely planted, and only for ornament. Boué's observation that it occurs in Herzegovina near the sea has not been confirmed; and Poscharsky's statement that it forms woods at Ragusa is erroneous.

In Greece it is recorded⁵ at many stations on sandy soil in the plains and on the low hills, in Attica, Peloponnesus, and in the islands of the Cyclades, Crete, Cephalonia, Zante and Corfu. It is common⁶ in the islands in the Sea of Marmora, and the seeds are called *fistik* by the Turks.⁷

¹ It was described by Ginanni, in a large book published at Rome in 1774, entitled *Istoria Civile et Naturale delle Pinete Ravennati*.

² *Pinete di Ravenna*. (Florence, 1866.)

³ In *Gard. Chron.* xv. 736 (1881), and *Woods and Forests*, i. 146 (1884), there are accounts of this calamity.

⁴ *Veget. illyrischen Länd.* 185 (1901).

⁵ Halacsy, *Consp. Fl. Græca*, iii. 451 (1904).

⁶ Walsh, in *Trans. Hort. Soc.* vi. 47 (1826).

⁷ In Cyprus it is sometimes planted, but Mr. Hutchins thinks that it is not indigenous.

Boissier records it in the littoral region of Anatolia and Syria; and it reaches its most easterly point as a wild tree on the left bank of the Tschoroch river, near Artun, south of Batoum, where it forms an open wood in mixture with *Arbutus Andrachne*.¹

It does not appear to be wild in northern Africa, and forms no part of the flora of Egypt, though two cones were found in a tomb of the 12th dynasty (2200-2400 B.C.), which are now preserved in the museum at Boulac.

A cone has been found in a turf-bog in Alsace, lying beside the skull of a bison, but this is supposed to have been brought there by early traders. A fossil species, resembling *P. Pinca*, was discovered by Saporta in a miocene deposit at Ardèche.

(A. H.)

CULTIVATION

The tree is now widely cultivated in warm countries; and, according to Bunbury,² there were in his day extensive groves of it on the lower slope of Table Mountain and on the sandy flats to the east of Cape Town,³ where it flourished as well as in Italy.

It was early introduced into England, being mentioned in Turner's *Names of Herbes*, published in 1548. It grows very slowly, and is somewhat tender, though trees may be seen in all the southern counties. According to Bunbury,² the trees at Hardwicke, in Suffolk, were all killed by the severe winter of 1860, those at Barton being injured and not doing well afterwards. In the woods at Addington Park all the trees of this species, which were forty to fifty years old, were dead or dying in 1890. Trees, however, at Kew and Richmond seem to have been unaffected by the severe frosts of exceptional years, and bear fruit in abundance.

The seeds⁴ may be liberated by knocking the cone with a mallet, or by placing it in water hot enough to soften the resin which keeps the scales together. The scales will also come asunder if the cones are placed in a warm oven. Seeds should be soaked in water before sowing, and the seedlings should be kept in a cool frame for at least two years.

REMARKABLE TREES

If I had not seen the remarkable plantation of this pine at Matchams, near Ringwood, I should have supposed that it was incapable of developing its normal character in any part of England, but here it seems so much at home that the conditions under which it grows are of interest. Hamilton Leigh, Esq., owner of this place, informs me that the trees were raised from seed sent by Lord Nelson from the Mediterranean about one hundred years ago, to the then owner of the estate. They grow close to the road and railway, at the foot of a great sandhill on the open barren heath, two or three miles south-west of Ringwood, in sand which is apparently never dried up in summer, owing to the percolation from the hill above;

¹ Radde, *Pflanzenverb. Kaukasuslând.* 126 (1899).

² *Arboretum Notes*, 125 (1889).

³ According to Hutchins, *Science in South Africa*, 395 (1905), there are some noble specimens still on the old farms; but about thirty years ago this species was attacked by a fungus (*Peronospora sp.*), and the tree is now likely to become extinct in Cape Colony.

⁴ *Gard. Chron.* xxxvii. 240 (1905).

the trees being well sheltered from the south-west and drawn up by maritime pines which grow around them. They have the umbrella-shaped head of the true Roman pine, and are from 50 to 60 ft. high by 4 to 5 ft. in girth. They produce cones abundantly, which are attractive to squirrels, which eat the seed before it falls. By their bark, their cones, and their habit they are easily distinguished from the maritime pines.

Another place where the stone pine may be seen of some size, though in a climate evidently too moist to suit it, is at Killerton, where, on the top of the hill above the house, there are several old trees about 50 ft. by 7 to 8 ft., but they have an unsightly appearance owing to numerous half-dead branches. At the foot of this hill, on Taverner's farm there is another tree of the same kind, which is healthier.

At Saltram,¹ Devonshire, there are several trees, the largest of which is 60 ft. high and 8½ ft. in girth. The late Lord Morley sent me a photograph of this tree, which, however, is by no means typical in habit. At Mount Edgcumbe, Plymouth, there is another tree 54 ft. high, and 9½ ft. in girth at 3 ft. from the ground, with a spread of foliage 46 ft. in diameter. This tree has not borne cones, though two smaller trees at the same place produce fruit freely.

At Heron Court, in Dorsetshire, the seat of the Earl of Malmesbury, there are several stone pines, the largest of which is no less than 13 ft. in girth at 2½ ft., where it divides into large branches, but does not exceed 40 to 45 ft. high. There are two groups in the park of smaller size, all of which seemed to bear ripe seed in 1906.

At Melbury, Dorsetshire, there is a well-shaped tree about 50 ft. by 7 ft., showing bark rather like that of *P. Pinaster*, with broad flat plates, but duller and not so shining, and marked at intervals of about a foot, with irregular transverse rings, which seemed to show its annual growth.

At Kew the old tree near the Director's office measured,² in 1903, 31 ft. high and 7 ft. 7 in. in girth, with a spread of foliage 46 ft. in diameter.

A large tree³ in the Red Lodge Nursery, Southampton, was blown down in 1903. It measured 61 ft. in height, and 8 ft. 7 in. in girth at 3 ft. from the ground, and was said to have been seventy-five years old.

At Eastnor Castle there is a group of stone pines which are curiously distorted by irregular concentric swellings round their trunks. They are only about 30 to 35 ft. high; but one, which forks very low, is no less than 8 ft. 10 in. in girth at 1½ ft. from the ground.

Sir Hugh Beavor reports a good tree at Chorley Wood Cedars, 50 ft. high by 9 ft. 11 in. in girth. At Burwood House, Surrey, Mr. R. Woodward reports a tree 50 ft. high and 8½ ft. in girth.

At Stackpole Court, Pembrokeshire, there is a tree about 30 ft. by 6½ ft. bearing cones which seem fertile, though here the climate seems too damp for this tree. There are two trees near the Orangery at Margam, about 40 ft. by 7½ ft., from which seedlings have been raised. At Penrhyn, North Wales, a tall slender tree was, in 1905, 53 ft. high by 4 ft. 10 in. in girth.

¹ *Gard. Chron.* xxxiv. 413 (1903).

² Cf. *Kew Handlist of Conifera*, xxiii. (1903). This tree is figured in *Gard. Chron.* iv. 602, fig. 85 (1888).

³ *Gard. Chron.* xxxiv. 285, figs. 121, 122 (1903).

A remarkable instance of the hardiness of this tree in Scotland was given by Captain Norman, R.N., at a meeting of the Berwickshire Naturalists' Club, in September 1905. He states that a group of six trees of this species are growing at the foot of a railway embankment close to the post road at Dunglass, East Lothian. They were identified at Kew, and bear cones annually, the largest being about 30 ft. high. These trees are said to have been planted by an Edinburgh firm soon after the railway was made in 1846. But though there are many parts of Scotland where the climate would seem to be much more suitable for this pine, we have seen none worth mentioning.

In Ireland, there is a fair-sized tree in the Trinity College Botanic Garden, Dublin; and at Hamwood, Co. Meath, a tree, planted in 1844, had attained, in 1904, 50 ft. in height and 6½ ft. in girth.

Mouillefert¹ says that the wood of *P. Pinea* is like that of *P. Pinaster*, but is less resinous, and the sapwood is abundant at a considerable age. At the Cape of Good Hope he thought that the lignification was quicker and more complete than in Europe. As to the comparative value of the wood of this pine and *P. Pinaster*, opinions differ in Portugal, but most people consider the stone pine the best.

(H. J. E.)

PINUS DENSIFLORA, JAPANESE RED PINE

Pinus densiflora, Siebold et Zuccarini, *Fl. Jap.* ii. 22, t. 112 (1844); Masters, in *Journ. Linn. Soc. (Bot.)* xviii. 503 (1881), and xxxv. 619 (1904); Mayr, *Abiet. jap. Reiches*, 72 (1890), and *Fremdländ. Wald- u. Parkbäume*, 343 (1906); Shirasawa, *Icon. For. Japon.* text 10, t. 1, ff. 1-14 (1899); Kent, Veitch's *Man. Conifera*, 326 (1900); Clinton-Baker, *Illust. Conif.* i. 18 (1909).

A tree attaining in Japan 120 ft. in height and 12 ft. in girth. Bark of branches and young trees, and of the upper half of the stem of old trees, reddish, and peeling off in thin scales, resembling that of *P. sylvestris*; towards the base of old trees rugged and dividing into small plates. Young branchlets glabrous, glaucous, with raised pulvini, separated by linear grooves. Buds cylindrical, sharp-pointed, dark-brown, ½ in. long, slightly resinous; scales free at their apices, but not reflexed.

Leaves in pairs, persistent about three years, spreading, 3 to 4 in. long, soft in texture, twisted, dull green, with eight to ten stomatic lines on each surface, ending in a short callous tip, serrulate; resin-canals marginal; basal sheath ⅜ in. long, often ending above in two long narrow filaments.

Cones subterminal, spreading, two or three together, sub-sessile, ovoid-conic, 2 to 2½ in. long, dull grey in colour; scales about 1 in. long and ⅔ in. wide, oblong, thin, with the concealed part pale brown above and reddish below, flat or slightly convex from side to side; apophysis rhomboidal, slightly raised, transversely ridged, upper margin irregularly sinuate, dull grey, with an elliptical dark brown umbo tipped with a minute mucro. Seed ¼ in. long, bright brown; wing narrow, pale brown, ½ to ⅔ in. long.

¹ *Essences Forestières*, 395 (1903).

This species,¹ which closely resembles *P. sylvestris* in the bark and buds, is readily distinguishable by the dull green longer leaves and the glaucous branchlets.

Numerous varieties of *P. densiflora* are in cultivation in Japan, no less than twenty-two being enumerated by Mayr. Some are dwarf, pendulous, globose, or otherwise peculiar in habit; whilst others have variously coloured foliage, golden, striped, variegated, etc. These are apparently unknown² in England. The hybrids between *P. densiflora* and *P. Thunbergii* are mentioned under the latter species.

P. densiflora appears to be confined to Japan, as the herbarium specimens from Korea and the Shantung hills³ in China, supposed to belong to this species, are different in appearance, though undoubtedly closely allied. The representative of this species in central China is *P. Henryi*,⁴ Masters, not yet introduced into cultivation.

(A. H.)

This species, which is known by the Japanese as *aka-matsu*, red pine, or *me-matsu*, female pine, is the commonest conifer in Japan; but in most cases is planted, as it has been cultivated from ancient times, usually on poor dry soil, where other trees will not thrive. It is considered to be a native of the hilly mountainous district, generally between 500 and 3000 ft. elevation, scarcely ever ascending into the higher region, which is occupied by the silver firs and spruces, and being absent⁵ from the sea-coast, where it is replaced by *P. Thunbergii*. According to Mayr it is rare in the subtropical forests at low elevations in the southern islands; but occurs as far north as south-western Yezo. In the wild state, I found the tree scattered here and there through the mixed forests, up to about 2000 ft., generally on dry ridges or sandy stony river banks. In the forest near Koyasan, it was larger than elsewhere, up to 12 ft. in girth; and one tree standing alone in a dense forest of *Cupressus obtusa* and *Sciadopitys* had a clear trunk of 60 ft. high or more, and measured about 100 ft. by 11 ft. 9 in. The best planted trees which I saw, were near the foot of the low pass between Shimonosuwa and Shiojiri in Shinshu, in private grounds by the roadside. These were over 100 ft. high and 8 or 9 ft. in girth, clean to 70 ft., and though not so straight in the stem as *P. sylvestris*, were very fine trees. More often, however, this pine has a crooked unsightly stem, and does not grow to any great size, being usually crowded, and cut when young; and it is only rarely that it has a chance of showing its full development, and becomes a

¹ It is often known in cultivation, both in Europe and in the United States, as *P. Massoniana*, a species of southern China, not in cultivation.

² The varieties mentioned in *Kew Handlist Coniferae*, 111 (1903), are not in cultivation in Kew Gardens.

³ Mayr brought home from Korea living plants, which he considered to be this species. The Shantung tree, which grows on the hills near Chefoo, is imperfectly known, and has been mentioned by Masters in *Journ. Linn. Soc. (Bot.)* xxvi. 551 (1902), as *Pinus Massoniana*, Lambert, var. *planiceps*, Murray, MS. in Mus. Brit. It bears cones different in colour from those of *P. densiflora*; and is certainly quite distinct from *P. Massoniana*, a long-leaved species, inhabiting the plains of central China and the low hills of southern China. The Korean pine is *P. funebris*, Komarov, referred to on p. 1144, note 2.

⁴ *Pinus Henryi*, Masters, in *Journ. Linn. Soc. (Bot.)* xxvi. 550 (1902) and xxxv. 618 (1904). This species, discovered by me in 1888, is a small tree, rarely exceeding 40 ft. in height, forming open woods, at 4000 to 6000 ft., in the mountains of Hupeh, Szechwan, and Shensi. The cones are subterminal, shortly-stalked, ovoid, 1½ in. long, shining reddish brown; scales oblong, ⅝ in. long, ⅜ in. wide; apophysis rhomboidal, slightly raised, with four radial ridges, and a depressed umbo, tipped by a minute prickle. Seeds light brown, with short, broad, dark brown wings. The foliage resembles that of *P. densiflora*.

⁵ Mayr says that it is occasionally planted near the coast, and is sometimes found on the second range of hills near the coast, *P. Thunbergii* occupying the strand and the first range. The largest trees, up to 120 ft. in height, which he saw, were in the warm valleys of the central mountains of Hondo.

fine tree; and then, with its reddish yellow bark on the upper half of the stem, and spreading crown, it reminds one much of *P. sylvestris*.

CULTIVATION

This species was introduced¹ by Siebold in 1854, into the Botanic Garden at Leyden; but was not generally distributed until 1861, when seeds were sent home from Japan by J. Gould Veitch. It is, however, very rare in cultivation,² except in botanic gardens, as at Kew, where it is a handsome tree, ripening its cones perfectly, and displaying the characteristic bark. We have also seen specimens, of no great size, at Brocklesby, Lincolnshire; Bagshot, Surrey; High Canons, Herts; and Murthly, Perthshire.

At Grafrath, near Munich, it has proved perfectly hardy during the last twenty-five years; but is easily injured by snow. Young plants are liable to the attacks of the leaf-shedding disease.

According to Sargent,³ it is hardy in New England, where it produces fertile cones in abundance, and is already beginning to assume its mature picturesque habit. So far as can be judged from an experience of twenty-five years, it appears to be the most promising of the two-leaved pines introduced into the eastern states from foreign countries.

The wood is usually coarse and knotty, but being the cheapest building timber in Japan, is largely used there. Mayr says it is very similar to that of *P. sylvestris*, and, as in that species, the amount of heartwood depends on the situation and age.

(H. J. E.)

PINUS MONTANA, MOUNTAIN PINE

Pinus montana, Miller, *Gard. Dict.* Ed. 8, No. 5 (1768); Willkomm, *Forstliche Flora*, 209 (1887); Mathieu, *Flore Forestière*, 593 (1897); Kent, Veitch's *Man. Coniferae*, 343 (1900); Masters, in *Journ. Linn. Soc. (Bot.)* xxxv. 611 (1904); Schröter, *Pflanzenleben der Alpen*, 74 (1904); Kirchner and Schröter, *Lebensgesch. Blütenpfl. Mitteleuropas*, 202 (1906); Clinton-Baker, *Illust. Conif.* i. 34 (1909).

Pinus mugus,⁴ Scopoli, *Fl. Carniol.* ii. 247 (1772).

Pinus pumilio, Haenke, *Beob. Reis. Riesengeb.* 68 (1791); Loudon, *Arb. et Frut. Brit.* iv. 2186 (1838).

Pinus uncinata, Ramond, in De Candolle, *Flor. Franç.* iii. 726 (1805); Cook, *Sketches in Spain*, ii. 230 (1834).

Pinus humilis, Link, in *Abhand. Berl. Akad.* 171 (1827); Kerner, *Nat. Hist. Pl. Eng.* Trans. i. 548, fig. 135 (1898).

Pinus obliqua, Sauter, in Reichenbach, *Flora Germ. Exc.* 159 (1831).

Pinus uliginosa, Neumann, *Schles. Ges.* 95 (1837).

Variable in habit, a tree or prostrate shrub, with greyish black scaly bark. Young branchlets brown, glabrous, with raised keeled pulvini. Buds ovoid or cylindrical, short-pointed, ¼ to ½ in. long, covered with resin.

¹ A plant, 18 in. high, in cultivation at Woburn in 1839, is named *Pinus japonica*, Forbes, in *Pin. Woburnense*, 33 (1840); but it is impossible to say from the description whether it was *P. densiflora* or *P. Thunbergii*.

² A thousand plants, imported from Japan, were planted in 1907 at Ampton Park, Suffolk; and about a hundred were living in 1910.

³ *Garden and Forest*, x. 471 (1897).

⁴ This name occurs in Scopoli as *mugus*, but *mughus* is adopted by all later writers. It is derived from the Italian name of the tree, *mugo*, used in south Tyrol.

Leaves in pairs,¹ persisting five to ten years, $1\frac{1}{2}$ to $2\frac{1}{2}$ in. long, rigid, curved, dark green,² ending in a short blunt cartilaginous point, serrulate, with stomatic lines on both surfaces; resin-canals marginal; basal sheath $\frac{1}{2}$ to $\frac{6}{10}$ in. long.

Cones subterminal, solitary or two or three together, sessile or sub-sessile, 1 to 2 in. long, conical, ovoid or sub-globose; scales with shining dark brown apophyses, the ashy grey or light brown umbo being surrounded by a darker coloured ring. The variations in the size and shape of the cones and of the apophyses will be dealt with under the varieties. Seed similar to that of *P. sylvestris*, but slightly larger in the body and shorter in the wing. Seedling with two to eight, usually four to six cotyledons, about $\frac{1}{8}$ in. long, entire in margin; primary needles shorter than the cotyledons, serrate, clothing the first year's shoot, and gradually replaced in the second year by the adult geminate leaves. The seedlings grow very slowly, attaining about an average height of an inch in the first year, and 2 to 3 ft. high in the tenth year. No well-developed tap-root is formed.

VARIETIES

This species consists of numerous geographical races, which are difficult to define, as the variations in habit are not exactly coincident with the variations in the characters of the cones. In certain cases peculiarities in habit appear to be fixed and hereditary, whilst in other cases these are due to soil, climate, and exposure, and are not transmitted by seed. The cones are not constant in the various races; in rare cases they vary even on the same tree, and are often different in trees from the same locality. There is great difference of opinion amongst foresters and botanists as to the varieties, the number described being very great, but for practical purposes the following arrangement is convenient:—

1. Var. *uncinata*, Willkomm, *Forstliche Flora*, 171 (1875); Masters, in *Gard. Chron.* xxii. 208, fig. 42 (1884).

Usually a tall tree, with a single undivided stem, 60 to 80 ft. in height. Cones asymmetrical, very oblique at the base, ovoid-conical, 2 to $2\frac{1}{2}$ in. long, directed downwards or pendulous, with the scales on the outer side strongly developed, their much raised and pyramidal apophyses ending in hook-like processes, which are directed towards the base of the cone. This variety, which has been called by Sir John Stirling Maxwell³ the upright mountain pine, is the only form met with in Spain, in the eastern and central Pyrenees, and in the French Alps, and is of rare occurrence in Switzerland. It forms extensive woods in sub-alpine regions up to timber line.

With this variety must also be classed a shorter tree, 30 to 50 ft. high, which is met with in pure woods on some of the high-lying peat mosses in the Vosges, Jura, Switzerland, lower Austria, and Bohemia. Isolated trees of this form are also occasionally seen amongst the dwarf *P. montana* in the Alps of Switzerland and

¹ Occasionally the needles are in threes, as in var. *mughus* in the Raxalp. Cf. Kronfield, in *Verhand. zool. bot. Ges. Wien*, xxxviii. 96 (1888).

² Koehne, *Deut. Dendrologie*, 39 (1893), states that in all forms of *P. montana*, the epidermal cells are twice as thick as in all other species, and have only linear cavities.

³ In *Trans. Roy. Scot. Arb. Soc.* xxi. 10 (1908).

in the Tyrol; but it is not known to occur in the dwarf pine belt of the Silesian and Carpathian ranges. Dwarf pines with cones of this type are sometimes seen in exposed and barren spots in the western Alps, but these are supposed to be stunted by the nature of the situation where they grow.

2. Var. *rotundata*, Willkomm, *Forstliche Flora*, 174 (1875).

Cones asymmetrical and oblique, as in the preceding variety, conical or ovoid, $1\frac{1}{2}$ to 2 in. long, spreading or bent downwards, sessile, with the lower and occasionally the middle scales on the outer side ending in a short four-sided blunt pyramid, directed slightly downwards. Usually a tree, scarcely exceeding 30 ft. in height, with several stems arising close to the ground, due to the rapid development of the lateral branches which turn upwards, and becoming erect, grow as fast as the leader. This, which Sir John Stirling Maxwell calls the intermediate form¹ of the mountain pine, is found on sunny precipices, rocky slopes, and high peat-mosses, and is common in the whole of the Alps, except in France. The dwarf mountain pine in the Swiss Alps often bears cones of this type.

3. Var. *pumilio*, Willkomm, *Forstliche Flora*, 175 (1875).

A shrub, rarely over 6 ft. in height, prostrate in habit, with the branches tending to lie flat on the ground, only turning up at the ends. No definite leader is formed. Cones symmetrical, usually sub-sessile, ovoid or globose, smaller than in the preceding varieties, 1 to $1\frac{1}{2}$ in. in diameter, spreading, tinged with violet before ripening; scales uniform in size; apophysis unequally divided with the umbo placed near the lower edge. This, one of the forms of the dwarf mountain pine, which comes true from seed, occurs in the Jura, Switzerland, Black Forest, Fichtel mountains, Bohemian and Bavarian forests, Riesen and Iser mountains, extending southward to Bosnia, Herzegovina, and Montenegro.

4. Var. *mughus*, Willkomm, *Forstliche Flora*, 177 (1875).

Similar to the last in habit, and in size, shape, and direction of the cones, and only distinguishable by the apophysis of the scale being very flattened with the umbo in the centre. This form is common in the eastern Alps and in the Balkan States, and is very rare in Switzerland.

Several hybrids between this species and *P. sylvestris* have been described, which are arranged by Ascherson and Graebner² as follows:—

(a) *P. sylvestris*, var. *engadinensis* × *P. montana*, var. *uncinata*. Found in the Upper Engadine, near Samaden, at 6000 ft. altitude.

(b) *P. sylvestris* × *P. montana*, var. *rotundata*. Found in peat-mosses on the boundary between Lower Austria and Bohemia and in southern Bohemia.

(c) *P. sylvestris* × *P. montana*, var. *pumilio*. Found in the southern Bohemian forest and in the Tyrol.

¹ This form was introduced into Denmark in 1798 from Eisenach, in Thuringia, and has kept true from seed. Occasionally one of the stems takes the lead and suppresses the others, but in such cases the stem is always bent near the ground.

² *Syn. mitteleurop. Flora*, i. 229 (1896-98). These authors (*op. cit.* 232) state that a tree in the Botanic Garden at Vienna, supposed by Wettstein to be a hybrid between *P. Laricio*, var. *austriaca*, and *P. montana*, has been shown by Beck to be a pure Austrian pine.

DISTRIBUTION

This species is widely spread in the mountainous regions of central and southern Europe,¹ extending from Spain in the west to Bukovina in the east, and from the Vosges and Lausitz (Saxony) in the north to the Abruzzi mountains in Italy and Perim Dagh in Macedonia, its most southerly stations.² The distribution of the mountain pine and of its varieties appears to depend mainly on the encroachment and competition of other species of conifers. In the west and south-west, where the spruce, its greatest rival, is rare or absent, it descends to comparatively low levels, and is a fine tree forming extensive forests; whereas in the central, eastern, and south-eastern parts of its range it has to contend with the spruce or larch, and occasionally with *P. Cembra*, and driven to high altitudes, it has become a mere shrub. In many parts it also forms woods on peat-mosses at moderate elevations in the mountains, where it grows better than either *P. sylvestris* or the spruce.

In Spain it occurs from the Sierra de Cuença through Aragon and Catalonia to the central³ and eastern Pyrenees, forming vast forests, which were first described by Capt. Cook (Widdrington).⁴ In the Pyrenees the spruce is a rare tree, found sparsely mixed with silver fir, and the larch is totally absent. In consequence the mountain pine reigns alone in this range at high elevations, occurring between 5000 and 8000 ft., and attaining its maximum development, trees 100 ft. in height and 9 ft. in girth having been measured by the French forest officers. Sir J. Stirling-Maxwell,⁵ who visited this region in winter, says that the finest forests were then inaccessible, but he obtained excellent photographs of woods of this species at lower levels, where trees about seventy years old averaged 55 ft. in height and 3 ft. in girth. He notes the straight cylindrical stems of the Pyrenean variety, with grey coloured bark, and a narrow crown of foliage, and compares the tree in all its stages of growth to the Corsican pine. On account of its narrow pyramidal habit and tough elastic wood it scarcely suffers from heavy snowfall, and is in marked contrast in this respect to *P. sylvestris*, which grows from lower levels up to where the mountain pine begins. Up to forty years old it is relatively fast in growth, being a slender and regular tree, but after this age there is a marked diminution in height growth, accompanied by increase in thickness of the stem and by a rounder crown. Still at seventy years it preserves its narrow pyramidal habit, the stout cylindrical stem carrying branches which are remarkably short and light. Its root system is shallower than that of *P. sylvestris*, which can only keep pace with it in growth in the Pyrenees on the better soils. The mountain pine is the least exacting of trees, whether as regards soil, aspect, or climate.

¹ C. Reid, in *Journ. Linn. Soc. (Bot.)* xxxviii. 220 (1908), doubts the occurrence of this species in British pre-glacial deposits, where it had been identified by Heer and Saporta.

² Judging from the description, *P. Kochiana*, Klotsch, and *P. armena*, Koch, both in *Linnaea*, xxii. 297 (1849) are incorrectly referred to *P. montana* by Medwejew in *Bäume u. Sträucher Kaukasus*, i. 14 (1907). This peculiar pine occurring in the Caucasus around Ardahan, near Kars, and in Daghestan, has hooked cone-scales, and is *P. sylvestris*, var. *hamata*. Steven, in *Bull. Soc. Nat. Mosc.* xi. 52 (1838).

³ The forests in the central part of the Pyrenees (departments of Ariège and Haute-Garonne) are nearly all destroyed; those in the eastern part (Pyrénées Orientales and Hautes-Pyrénées) are still of considerable extent.—Mathieu, *op. cit.* 596.

⁴ Cf. Loudon, *op. cit.* 2188.

⁵ In *Trans. Roy. Scot. Arb. Soc.* xxi. 10-15, figs. 1-9 (1908).

In France the tall upright variety also occurs on Mt. Ventoux and throughout the Alps of Provence, Dauphiné, and Savoy, where it grows at high elevations from 4800 to 8000 ft., on dry, poor, and rocky soils. At Briançon it does not attain so large a size as in the Pyrenees, and, according to Sir J. Stirling-Maxwell, at forty years scarcely attains 40 ft. in height, averaging 20½ in. in girth, while Scots pine alongside it is about the same height, but 27 in. in girth. The finest trees of this variety in the French Alps occur in the wild forest of Villarodin-Bourget, near Modane, which I visited in 1903. Here it forms a dense wood on the sides of a dry ravine between 5000 and 7000 ft. elevation, mixing at the lower level with *P. sylvestris*, the trees being about 60 to 70 ft. in height and 1 to 1½ ft. in diameter, and remarkable for their narrow pyramidal habit and their number on the ground, casting a dense shade. Higher up on the side of the ravine there are many isolated trees, very old, and of great size, up to 80 ft. in height and 9 ft. in girth. The stems of some of the smaller trees are marked with ring-like swellings, one above another, and full of resin, which are caused by the larva of a beetle. Seedlings are common here, and Elwes, who visited this locality in 1907, brought home some alive, which are now growing at Colesborne.

In the Jura, near Pontarlier, on peat-mosses, the shorter upright form, characteristic of this situation, occurs in small open woods. Here the trees rarely exceed 40 ft. in height, and are much more widely branched than those at Modane.

The upright form is also found sparingly in several localities in the Swiss Alps, Swabia, Oberpfalz, Silesia, Bohemia, and the Erz mountains. An extensive forest, with an area of 6000 acres, occurs on dolomite in the Lower Engadine, near Zernetz, at 5800 to 7000 ft. elevation, extending through the Ofen Pass to the Münster valley. Here the trees, many of which are of the intermediate form, gradually mix at the lower edge of the forest, with spruce, larch, and *P. sylvestris*. This forest is illustrated in *Les Arbres de la Suisse*, pl. xvii., which shows trees like those of Modane, but smaller, the largest depicted being 47 ft. high and 3 ft. 4 in. in girth. Another is recorded as 50 ft. by 5 ft. 3 in.

The intermediate form is common, mixed with the upright form, in all the localities of the latter, except in the Pyrenees and French Alps, and is usually met with on sunny precipices, rocky slopes, and high-lying peat-mosses.

The dwarf form (vars. *pumilio* and *mughus*) is widely spread throughout the Swiss, Italian, Austrian, and Bavarian Alps, ranging in the latter from 2000 to 4800 ft. elevation; and it extends through the Black, Bohemian, and Bavarian forests; in the Fichtel, Reise, Glatzer, and Iser mountains, occurring in the latter from 2000 to 2700 ft. altitude; in the Carpathians between 4200 and 6500 ft.; in the Bihar mountains of Hungary; in the mountainous regions of Carinthia, Carniola, Dalmatia, Bosnia, Herzegovina, Roumania,¹ Bulgaria, reaching its southernmost point in Perim Dagh in Macedonia. In Italy it is only known, outside of the Alps, on Mount Amaro in the Majella group of the central Apennines, where

¹ Golesco, in *Bull. Soc. Dend. France*, 1907, p. 176, gives a good description of the dwarf pine in the mountains of the Muscel district in Roumania, which comprise the highest summits of the Transylvanian ranges.

it¹ occurs between 6000 and 8700 ft., the latter being the highest elevation known for the species.

The dwarf mountain pine,² known as the *Legföhre*, is one of the most characteristic shrubs of the Alps and Carpathians, in some places covering large areas with a dense, almost impenetrable thicket, composed of decumbent stems, whose branches are so interlaced that though one may pass through it with difficulty in a lateral direction, and slide downwards over it on a steep hill-side, yet to ascend it is practically impossible. These thickets are well described by Kerner,³ who says that the stems, even when of great thickness, assume a horizontal position, with their growing ends always directed on mountain slopes towards the valley. The branches are remarkably elastic, and in winter are pressed downwards upon the soil by the heavy snow-fall; and in summer rise up again, often plastered with earth and small stones, and take a curved ascending position.

P. montana is remarkable for its different behaviour in regard to the chemical elements in the soil in different parts of its area. In the French Alps the extensive woods of this species cease to grow when the Jurassic chalk comes to the surface. Near the Aiguilles the tree is absent from slate formations, but immediately appears wherever the soil is composed of lime or chalk. At Grächen in Nicolai valley it grows on slate, and at Davos on serpentine. In the Engadine it occurs mainly on dolomite, but is not entirely absent from the gneiss formation. In the Carpathians it is indifferent to the nature of the soil. Christ says that in the Swiss Alps generally it is decidedly a lover of lime, often growing on rubbly limestone rocks, and alternating markedly with *Alnus viridis*, which clothes the declivities of the primitive non-calcareous rocks.⁴

In the Pyrenees the tree is found to be especially valuable for windy plateaux. It thrives in soils too poor for any other trees to grow, and succeeds better⁵ on peat than *P. sylvestris*. It is extremely hardy, easy to raise from seed, and presents no difficulty in transplanting. It is used now throughout the French Alps for planting at high altitudes and in all difficult situations. It is comparatively free from the attacks of fungi and insects.

(A. H.)

CULTIVATION

This species was first cultivated in England in 1779, at Orford Hall, near Warrington, Lancashire, where the shrub of var. *pumilio* originally introduced was still living, though in a shattered condition, in Loudon's time.

¹ Described as *P. majellensis*, Schouw, in *Ann. Sc. Nat.* iii. 233 (1845). Referred to *P. Laricio* by Parlato; but as Masters points out, in *Journ. Linn. Soc. (Bot.)* xxxv. 613 (1904), the resin-canals are marginal, and not median as in *P. Laricio*.

² At Innsbruck, according to Beissner, in *Mitt. d. dendr. Ges.*, 1905, p. 69, the tall, intermediate, and dwarf pines are distinguished by different names, Spirke, Latsche, and Zunder or Knieholz; but these names are not current everywhere with the same signification.

³ *Nat. Hist. Plants*, Eng. trans., i. 548, fig. 135 (1898).

⁴ Cf. Schimper, *Plant Geography*, 100, 104 (1903).

⁵ In the high peat-moors of the Hertogenwald, in Belgium, at 2000 ft. altitude, a few plants of the intermediate variety were doing better on deep peat than any other tree when I saw these plantations in 1909.

The Pyrenean form was apparently introduced by Captain Cook, as young plants were raised in the garden of the Horticultural Society from seed procured by him. Apparently this variety has been entirely neglected since, and we are scarcely in a position to judge concerning its capabilities as a forest tree in mountainous districts and on peat-mosses in this country; but recently some experimental planting has been done by Sir John Stirling Maxwell¹ at Corrou, Inverness-shire, with seeds obtained from the government seed-establishment at Mont Louis, in the Pyrénées Orientales. The finest examples of this form that we have seen is a tree at Essendon Place, Hertford, which measured, in 1907, 51 ft. in height, with a stem clear of branches to 30 ft., and 5 ft. 5 in. in girth. A good specimen in the Cambridge Botanic Garden measures 41 ft. by 3 ft. 5 in. At Sir H. Farquhar's seat, Gilmanscroft, Ayr, there is a tree of this variety. At Glasnevin a slender tree measures 35 ft. high by 2½ ft. in girth.

When Henry was at Annecy in 1904 the late Mr. Guinier, Inspecteur des Forêts, showed him a plantation of *P. montana*, twelve years old, raised from Pyrenean seed. He considered that this race is quite distinct and much finer than the race in the French Alps. Its growth is only slightly less vigorous than that of *P. sylvestris*, over which it has certain advantages, as it is the sole species in France available for planting peat-mosses, and, moreover, thrives on arid soils, where *P. sylvestris* grows very slowly. It has a dense cover, but always lets a little sun fall on the ground, even in the thick forests of the Pyrenees. The two races, that of the French Alps and that of the Pyrenees, planted in the Forêt du Crêt du Maure, near Annecy, retain their characteristic differences.

The intermediate form seems to be the one most general in cultivation, not only in this country, but also in Denmark, where it has been extensively used for planting the dunes and barren tracts in Jutland. It was introduced into Denmark from Eisenach in Thuringia in 1786, and has come true from seed. It attains on poor soil about 20 ft. in thirty or forty years, and then ceases to grow; and can scarcely be looked upon as of any economic value, though the improvement of the soil may prepare the way for other species. In Denmark² it is usually planted on the dunes pure at first, and afterwards the common spruce is introduced, which is a more valuable species, but one impossible to start by itself on poor soil covered with heather. Müller, who is the greatest authority on this species of pine, introduced the upright variety³ of the French Alps in 1886; but it is said to be more liable to the attacks of fungi. It is remarkable in this, as in many other cases of introduction of a species, that the seed from the best form (from the Pyrenees) should not have been selected.

In England the best specimen we have seen of the intermediate variety is a tree at The Wilderness, White Knights, near Reading, which consists of six stems, arising from a very short butt 6 ft. in girth, and rising to 60 ft. in height. There

¹ *Trans. Roy. Scot. Arb. Soc.* xx. 7 (1907). The seed of the Pyrenean variety, which can be obtained through the British Embassy at Paris, has been regularly supplied to the Norwegian Government for the last three years.

² Cf. *Quarterly Journ. Forestry*, iii. 74 (1909), where a full account of the heath plantations in Denmark is given by Mr. A. C. Forbes.

³ Known as the *Pin de Briançonnais*, or in seed catalogues as *P. montana gallica*.

are also four trees at Bayfordbury, which are about 40 ft. high, each with three to five stems from near the base, where they curve and turn upwards. Another at Arley was 32 ft. by 3 ft. 2 in. in 1904.

My father some fifty years ago planted some thousands of this tree at Colesborne in ignorance of their habit, and though they will live on the poorest and thinnest oolite, yet not one of the survivors would repay the trouble of cutting down, except for burning in closed stoves or for charcoal; for which it is said to be very well adapted. Here and there a tree drawn up among others has grown to be 20 to 30 ft. high, but the majority form straggling bushes, which produce cones abundantly, but have no beauty; and I cannot honestly recommend any one to plant this species at present.

Of the shrubby form, var. *pumilio*, the most remarkable specimen is probably one at Burwood House, Surrey, of which Col. Thynne has taken a photograph. It measures about 11 ft. high, and is 156 ft. in circumference around the prostrate ends of the branches. At Belton Park, Grantham, a large shrub of this kind is about 15 ft. high, and spreads on all sides for about 30 ft. There is a large spreading bush, about 30 ft. high and 45 paces round, at Spetchley Park, near Worcester, the seat of R. V. Berkley, Esq.

(H. J. E.)

PINUS CONTORTA

Pinus contorta, Loudon, *Arb. et Frut. Brit.* iv. 2292 (1838); Sargent, *Silva N. Amer.* xi. 89, t. 567 (1897), and *Trees N. Amer.* 26 (1905); Kent, Veitch's *Man. Coniferae*, 323 (1900); Masters, in *Journ. Linn. Soc. (Bot.)* xxxv. 630 (1904); Clinton-Baker, *Illust. Conif.* i. 16 (1909); Shaw, *Pines of Mexico*, 29 (1909).

Pinus inops, Bongard, in *Mem. Phys. Math.* pt. ii. *Acad. Sc. St. Petersb.* ii. 163 (1831) (not Solander).

Pinus Boursieri, Carrière, in *Rev. Hort.* 1854, p. 225.

Pinus Mackintoshiana, Lawson, *Cat.* (1855).

Pinus Bolanderi, Parlatore, in *DC. Prod.* xvi. 2, p. 379 (1868).

This species is very variable in habit and size, constituting a series of geographical races, which require further study in the field. It may be described as follows:—A tree or shrub, with either thin or thick bark. Young branches glabrous, with slightly raised keeled pulvini. Buds cylindrical, acute at the apex, about $\frac{1}{2}$ in. long, encrusted with white resin. Leaves in pairs, persistent three to eight years, curved, twisted, 1 to 3 in. long, serrulate, ending in a callous point, with numerous stomatic lines on both surfaces; resin-canals median; basal sheath $\frac{1}{4}$ in. long.

Cones sub-terminal, on short stout scaly stalks, in pairs or clustered, opening when ripe or remaining closed¹ for many years, ovoid or conical, $\frac{3}{4}$ to $2\frac{1}{2}$ in. long,

¹ Sargent, in *Bot. Gazette*, v. 54 (1880), says that he sowed in 1879, seed from closed cones collected by Engelmann in Colorado in 1874. Seeds of cones thirteen and ten years old did not germinate, but the seeds of some cones of nine, eight, and seven years old did germinate. This shows according to Engelmann, *Bot. Gazette*, v. 62 (1880), that the object of the tree keeping the cones closed, is to preserve the vitality of the seeds for a number of years beyond their maturity.

unequal and oblique at the base, spreading or deflexed. Scales thin, variable in size, up to $\frac{3}{4}$ in. long and $\frac{3}{8}$ in. wide; those on the outer side near the base with elevated pyramidal apophyses; the others with a rhomboidal transversely ridged apophysis and an elevated umbo, which is armed with a minute recurved, often deciduous prickle. Seed $\frac{1}{8}$ to $\frac{1}{6}$ in., triangular, blackish, furrowed; wing variable in length; cotyledons,¹ three to five, usually four.

This species is only liable to be confused with *P. montana*, from which it is readily distinguishable by the short basal sheaths of the leaves and the median resin-canals. Two main varieties, considered by many botanists and foresters to be distinct species, are recognizable:—

1. SHORE PINE, typical *P. contorta*.—Usually a small tree, 10 to 30 ft. high, though attaining 60 to 70 ft. when sheltered and on good soil. Bark $\frac{3}{4}$ to 1 in. thick, deeply divided into oblong scaly plates. Leaves dark green, 1 to $1\frac{1}{2}$ in. long, slender, $\frac{1}{4}$ to $\frac{1}{8}$ in. wide. Cones ovoid, very variable in size, $\frac{3}{4}$ to $1\frac{1}{2}$ in. long, some opening their scales when ripe, others remaining closed on the tree for many years.

Typical *P. contorta* occurs on the Pacific Coast from Alaska² to Mendocino County,³ in California, usually inhabiting sand-dunes or barrens or growing on ocean bluffs. In western Vancouver island it is a low twisted shrub when growing along the edges of the forest next the ocean; but on peat-mosses⁴ in the forest it is a small irregular flat-topped slow-growing tree. It begins to flower and fruit when only a few feet high; and the ripe cones remain unopened on the older branches and on the stem of the tree. On the high mountains opposite Vancouver I saw this tree growing in the forest in small glades on rocky poor soil, at 500 to 750 ft. altitude, not far from the sea; and it did not exceed 20 ft. in height, producing small ovoid cones, $\frac{3}{4}$ in. in diameter, most of which opened as soon as ripe.

On the seashore close to Crescent city in northern California, this species occurs on the ocean bluffs and on the barren gravelly flat to about a mile inland, and is very variable in size, in exposed situations dwindling to a picturesque shrub, but where sheltered attaining a considerable size, one tree which I measured being 65 ft. high and 7 ft. in girth. This tree had dark grey thin unfurrowed bark, covered with small scales, and resembling exactly that of var. *Murrayana*. A slightly smaller tree, beside it, which I took in the same photograph, had the thick coarsely fissured bark of typical *P. contorta*. Most of the cones were persistent.

2. LODGE-POLE PINE.

Var. *Murrayana*, Engelmann, in Brewer and Watson, *Bot. California*, ii. 126

¹ The seedling is described by Hill and de Fraine, in *Ann. Bot.* xx. 472 (1906) and xxiii. 203 (1909).

² Gorman, in *Pittonia*, iii. 69 (1896), says it is confined to lake borders and margins of sphagnum marshes in Alaska, where it is comparatively rare and little used, except for fuel. The inner bark is eaten by the natives. He adds that he saw one specimen on Square Island 100 ft. in height and 18 in. in diameter.

³ Jepson, in *Flora W. Mid. California*, 23 (1901), says it is frequent on the Mendocino coast, northward of Pt. Arena, as a low tree, 5 to 20 ft. in height.

⁴ Cf. Butters, in *Postelsia*, 157, plate xii. (1906), where a picture is given of this tree growing in a sphagnum swamp.

(1880); Sargent, *Silva N. Amer.* xi. 90, t. 568 (1897), and *Trees N. Amer.* 27 (1905); Kent, Veitch's *Man. Coniferæ*, 324 (1900).

Pinus contorta, Loudon, var. *latifolia*, Watson, in King's *Rep. U.S. Geol. Survey 40th Parallel*, v. 330 (1871).

Pinus Murrayana,¹ Balfour, *Rep. Oregon Expedition*, 2, t. 3 (1853); Mayr, *Fremdländ. Wald- u. Parkbäume*, 358 (1906).

Pinus inops, Bentham, *Fl. Hartweg*, 337 (1857) (not Solander).

Pinus contorta, Newberry, in *Pacific R. R. Rep.* vi. pt. iii. 34, 90 (1857) (not Loudon).

Pinus Tamrac, A. Murray, in *Gard. Chron.*, 1869, p. 191.

Pinus tenuis, Lemmon, in *Erythea*, vi. 77 (1898).

A tall tree, varying from 70 to 200 ft. in height; bark rarely more than $\frac{1}{4}$ in. thick, covered with small loosely appressed scales. Leaves $1\frac{1}{2}$ to 3 in. long, $\frac{1}{16}$ to $\frac{1}{8}$ in. broad, yellowish green. Cones very variable: in specimens which I gathered in the Siskiyou mountains, Oregon, from small trees occupying burnt areas, an inch in length, very oblique, deflexed, and remaining closed for an indefinite period; in specimens collected in Montana, slightly larger, but many opening when ripe; in the Sierra Nevada, usually larger, up to 2 in. in length, and apparently always opening when ripe, and falling from the tree in the following season. Probably three distinct forms of this variety can be distinguished:—

1. Rocky Mountain form, occurring from Alaska to Montana. A slender tree, rarely over a foot in diameter, and 100 ft. in height in its best development. Cones late in opening. The form in Colorado, distinguished as *P. Murrayana*, var. *Sargentii*, Mayr, in *Waldungen Nord-Amer.* 350 (1890), seems to be similar to the tree in Montana, and like it has long leaves (3 in. in length).

2. Sierra Nevada form. A large stout tree, attaining 150 ft. in height and 9 ft. in girth. Cones usually opening when ripe.

3. Intermediate forms between var. *Murrayana* and typical *P. contorta* occur as small trees, 40 ft. or less in height, in the Cascades and the Siskiyou mountains; and have slender foliage and closed cones.

The lodge-pole pine has an exceedingly wide distribution in western North America, extending from the hills in the valley of the Yukon river, Alaska, through the interior plateau of British Columbia, where it occurs at 2000 to 4000 ft. It crosses the Rocky Mountains in the valley of the Peace river, lat. 56° , its eastern boundary in Alberta being the meridian of 114° longitude, west of Edmonton and Calgary. A small isolated forest² of this pine occurs at 3000 ft. altitude, south-east of Medicine Hat, in the Cypress Hills, which take their name from this tree, as both it and *P. Banksiana* were called *cyprès* by the early French voyageurs.

In the United States, it forms extensive forests on both sides of the Rocky

¹ The type specimen of *P. Murrayana* is preserved in the herbarium of the Royal Botanic Garden at Edinburgh, and is labelled in Jeffrey's handwriting as follows:—"Pinus sp. No. 740. Found in the Siskiyou mountains in lat. $43^{\circ} 30'$, elevation 7500 ft., growing on moist, deep, loamy soil, Oct. 21st. This, all the cones I could procure. Tree 40 ft. high, of a conical form." Lat. $43^{\circ} 30'$, far to the northward of the Siskiyou mountains, is evidently a mistake for lat. $41^{\circ} 30'$, as we know from Jeffrey's type specimen of *P. Jeffreyi*, which was collected three days later (Oct. 24, 1852) in lat. $41^{\circ} 30'$ in the Shasta valley. Another specimen at Edinburgh, of which there is a duplicate at Kew, is labelled:—"740. Pinus sp. Same as No. 740 of 1852 collection. Summit of Sierra Nevada mountains near Walker's Pass, Sept. 20, 1853." This specimen did not reach Edinburgh until after the publication of the species by Balfour.

² Macoun, in *Proc. Roy. Soc. Canada*, xii. 4, pp. 13, 15 (1894).

Mountains in Montana; and extends southward, in the Yellowstone Park, at 7000 to 8000 ft., through the mountains of Wyoming and Colorado, to New Mexico and Arizona. Westwards it is common on the ranges of eastern Washington, Idaho, and Oregon, extending through the Siskiyou mountains into California, where it attains its largest size in alpine forests on the Sierra Nevada, at 8000 to 9500 ft.; and in the southern part of the state, forms the timber line on the highest peaks of the San Bernardino and San Jacinto mountains. It is also found¹ on the San Pedro Martir mountain in Lower California.

In Montana, where I saw it in the Lewis and Clark Reserve, it is essentially the tree which occupies burnt areas, its seedlings appearing in profusion in the mixed Douglas and larch forests, when these are destroyed by fire. In consequence, it is usually seen in dense even stands of tall slender trees, which attain about 100 ft. in height and a foot in diameter at 150 years old. Klers Koch,² forester in the Gallatin Reserve, reports on its facility of reproduction, as it bears cones early in life, even at 10 to 15 years old when crowded, and says that fire after fire may sweep over a district, and after each fire a new growth of pine springs up, denser than the preceding one. In a sample plot 10 ft. square, taken in a burnt area, 95 pine seedlings had sprung up. In 1885, a fire completely swept the whole length, 20 miles, of the Gallatin cañon, and there is at present a dense growth of young pines covering the mountain sides. He says that the root system is superficial, and the tree is easily blown down by the wind, as I witnessed myself near Flathead lake, when the tall slender trees came down in a sudden storm like ninepins. The tree appears to grow on most soils, though Koch has noticed that it avoids limestone, and it occurs at a great range of altitude, being met with, according to Leiberg,² in the Bitter-root Reserve in Idaho, at 2000 to 9000 ft. In Gallatin county, above 7000 ft. it mixes with spruce and *Abies lasiocarpa*, being replaced at 8500 ft. by *P. albicaulis*.

In Idaho, though it usually occurs as dense stands on fire-swept areas, it also grows in considerable quantity in swampy tracts, north-east of Grace Peak, and attains a much greater size, up to 200 ft. in height, with trunks 16 in. in diameter, and clear of branches to 140 ft. and showing 275 years' growth. Low branching trees, resembling *P. contorta* in habit, are met with in northern Idaho at elevations below 3000 ft. The tree demands light in order to grow well, but bears a considerable amount of shade, though in that case making little growth, a tree 43 years old that had been suppressed, measuring only $6\frac{1}{2}$ ft. high and $1\frac{1}{2}$ in. in diameter. In Colorado, it appears to be a smaller tree than farther north, averaging 75 ft. in height and 8 to 14 in. in diameter.

Mr. F. R. S. Balfour has kindly supplied us with the following account of the fine form of var. *Murrayana*, which grows in the Sierra Nevada of California:—

"On the main ridge between the valleys of the Kaweah and King's rivers, there are large quantities of fine tall trees 100 to 125 ft. high, and earning for *contorta* the more dignified name of *Murrayana*. I camped for two nights in a grove of these trees where there were many 12 ft. in circumference and over 100 ft.

¹ Shaw, *Pines of Mexico*, 29 (1909).

² From notes supplied by the U.S. Forestry Department, Washington.

high. The whole character of the tree differs utterly from the little lodge-pole pine usually growing elsewhere. These had bark of a warm pinky brown in small flat flakes pressing closely to the stem. They were for the most part over 200 years old, and indeed I counted over 300 rings in one tree not 2 ft. in diameter. The altitude was about 8500 to 9500 ft., and therefore covered with deep snow for about eight months in the year. Many dead trees stood among the living ones, white and bleached, but showing uniformly that the fibre of the timber grows with a twist. This twist in the wood saves it from the lumbermen. In their opinion it would be a first-rate timber of great hardness and lasting quality, were it not for this peculiarity. The older trees have fine open crowns with perfectly straight stems, and no large branches. Where the bark has been bruised off from any cause, the sap-wood shows bright saffron yellow till healed over. I never saw this variety of *Pinus contorta* lower down than 8500 ft., and it grew immediately above the *Abies magnifica* belt."

HISTORY AND CULTIVATION

P. contorta was discovered in 1825 by Douglas, near Cape Disappointment in Washington, at the mouth of the Columbia river; but it does not appear to have been introduced until 1855, when it appeared in Lawson's Catalogue under the name *P. Macintoshiana*.¹

Var. *Murrayana* was discovered in 1852 by Jeffrey, who sent specimens and seed, which reached Edinburgh in the following year. A further supply, which he collected on 20th September 1853, on the summit of the Sierra Nevada in California, near Walker's Pass, arrived in 1854.

The characters, which separate *P. contorta* and its variety *Murrayana* in the wild state, are not entirely preserved under cultivation. Trees labelled *P. contorta* in Kew Gardens, show vigorous branchlets with broad leaves; and owing to the occurrence of spring shoots, the cones are often pseudo-lateral in position. These trees have furrowed bark, as in their native home, and are widely branched, with peculiarly curved branchlets.² Trees of var. *Murrayana* in cultivation show a narrow pyramidal habit, with fine scaly bark; but their leaves are scarcely as broad as in wild specimens. Coming from the interior of the continent, they are not so vigorous in growth as the typical form from the Pacific coast. At the nursery of the Arboretum at Tervueren in Belgium, there are batches of seedlings of both forms, those of typical *contorta* having vigorous shoots with short needles, those of var. *Murrayana* with shorter shoots and longer bright green needles.

(A. H.)

The finest specimens of var. *Murrayana* which we have seen, are growing in the pinetum at Westonbirt, where there are two trees narrowly pyramidal in habit

¹ Cf. Masters, in *Journ. Linn. Soc. (Bot.)* xxxv. 647 (1904). Fowler, in *Gard. Chron.*, 1872, p. 1070, states that it was often grown then under this name; but he is in error in stating that *P. contorta* was introduced by Douglas, as there is no record of this in Loudon, who first described the species.

² This is well shown in *Gard. Chron.* xix. 45, fig. 5 (1883), where a branch of typical *contorta* from Barron's nursery at Borrowash is figured. Engelmann, in *Gard. Chron.* xix. 351, erroneously supposes, on account of the broad needles, that the figure represents var. *Murrayana*.

and with scaly bark, 59 ft. by 4 ft. 7 in., and 50 ft. by 3 ft. 3 in. Both were bearing cones in 1909. In addition, there are about twenty trees, smaller in size, about 30 ft. high and twenty-five years old. At Westonbirt this species becomes yellow in foliage, and does not thrive on limestone. It is said to be a bad rooter, and easily blown down by the wind. At Merton Hall, Norfolk, there is a tree 47 ft. by 4 ft. 5 in. (Plate 292).

At Bayfordbury, a tree with a straight stem and scaly bark, measured in 1905, 49 ft. high by 4 ft. 9 in. in girth. There are two specimens at Pampisford, Cambridge, drawn up in a wood, which measure about 40 ft. in height and 2 ft. in girth. At Highclere, where there are six trees, one growing in a plantation measures 50 ft. by 3 ft. 5 in., and one in the open is 40 ft. by 5 ft. There are also smaller trees at Nuneham Park, Oxford, and at Ochertyre, Perthshire. The best we know in Scotland is at Castle Menzies, which I found in 1908 to be 51 ft. by 5 ft. 10 in. A tree of typical *contorta*, planted in 1886 at Grayswood, Haslemere, as *P. Bolanderi*, measured, in 1906, 28 ft. by 3 ft. 1 in.

Mayr considers var. *Murrayana* to be close to *P. Banksiana*, both from a botanical and a biological point of view, and recommends it for planting in cold situations on high-lying moors. When planted closely, it cleans its stem readily, and at Grafrath, near Munich, where it has been planted in a cold peaty soil, it has endured a minimum temperature of -22° Fahr. But at Nürnberg, where 65,000 young trees were planted in a moist situation, they are reported to be tender to frost. At Grafrath this species grows even faster than *P. Banksiana*.

The lodge-pole pine, introduced¹ from Colorado into the Arnold Aboretum about 1877, has proved hardy in New England and produced cones; but it suffers from fungi and gives no promise of permanent success.

TIMBER²

The wood of the lodge-pole pine is coarse in grain, full of knots; and warps and cracks badly. It is soft, white, light, and not very strong, with little sapwood. It has been little used hitherto, except for mining purposes, the Amalgamated Copper Company having purchased, for example, fifty million feet (board measure) in 1906 from the Hellgate Reserve in Montana. It is coming into use, however, of late, for railway sleepers, for which it is suitable when creosoted, and the Burlington and Missouri Railway Company has begun to make extensive experiments in the preservation of this timber. It is in considerable use for fencing, but cannot be used for posts or telegraph poles, as it rots quickly when placed in contact with the ground.

(H. J. E.)

¹ Sargent in *Garden and Forest*, x. 471 (1897).

² Notes taken by forest officers, in the U.S. Bureau of Forestry, Washington, are here summarised.

PINUS RESINOSA, RED PINE

Pinus resinosa, Solander, in Aiton, *Hort. Kew.* iii. 367 (1789); Loudon, *Arb. et Frut. Brit.* iv. 2210 (1838); Sargent, *Silva N. Amer.* xi. 67, tt. 555, 556 (1897), and *Trees N. Amer.* 25 (1905); Kent, *Veitch's Man. Coniferae*, 372 (1900); Masters, in *Journ. Linn. Soc. (Bot.)* xxxv. 614 (1904); Mayr, *Waldungen Nord-Amer.* 211-214 (1890), and *Fremdländ. Wald- u. Parkbäume*, 346 (1906); Clinton-Baker, *Illust. Conif.* i. 48 (1909).

Pinus sylvestris, Linnæus, var. *norvegica*, Castiglioni, *Viag. Negli Stati Uniti*, ii. 313 (1790).

Pinus rubra, Michaux f., *Hist. Arb. Amer.* i. 45, t. 1 (1810) (not Miller).

A tree, usually attaining in America a height of 70 to 90 ft., and a girth of 6 to 9 ft.; occasionally, under most favourable conditions, reaching 150 ft. high and 15 ft. in girth. Bark about an inch thick, divided by shallow fissures into broad flat scaly ridges. Young branchlets orange-brown, glabrous, with raised rounded imbricated pulvini, which persist as rough protuberances on the older branchlets, from which the leaves have fallen. Buds elongated, conical, pale-brown, $\frac{1}{2}$ to $\frac{3}{4}$ in. long, coated partly with white resin, with a few of the appressed scales free at their acuminate tips.

Leaves in pairs, deciduous in the fourth year, densely crowded on the branchlets, forming cup-like tufts at their apices, more or less spreading below, 5 to 6 in. long, dark green, shining, soft and flexible, sharp-pointed, serrulate, obscurely stomatic on the inner and outer surfaces; resin-canals marginal; basal sheath $\frac{7}{8}$ in. long.

Cones¹ sub-terminal, solitary or in pairs, sub-sessile, spreading, ovoid-conic, about 2 in. long, light brown, shining; scales $\frac{7}{8}$ in. long, $\frac{1}{2}$ in. wide; apophysis thickened, rhomboidal, with a transverse ridge, and a central depression, in which lies the rounded shining dark brown unarmed umbo. Seed ovoid, compressed, mottled brown, about $\frac{1}{5}$ in. long; wing pale brown, $\frac{3}{4}$ in. long; cotyledons six or seven.

This species is only liable to be confused with *P. Laricio*, which it resembles in the branchlets and general appearance of the foliage; but is readily distinguished by the long basal sheaths of the leaves, the resin-canals of the latter being marginal and not median as in *P. Laricio*.

DISTRIBUTION

The red pine is the representative of *P. sylvestris* in Canada, and the northern border of the United States, where it is often called "Norway Pine," its northern limit extending from Lake St. John in Quebec, lat. 48°, westwards through central Ottawa to the southern end of Lake Winnipeg. In Quebec it forms thick groves on sandy and gravelly hills, and the forests still uncut contain an immense quantity of lumber of this species.² On dry ridges near Toronto, Elwes saw trees over 90 ft. high, with clean stems to 50 or 60 ft.

¹ The cones in falling, as I have observed in Minnesota and on cultivated trees at Bayfordbury, leave some of the basal scales and the short stalk on the branchlet.

² J. C. Langelier, in *Canadian Forestry Association, Sixth Ann. Report*, 69 (1905), estimates the timber of this pine still standing in Quebec, at 7500 million feet board measure.

The tree extends southwards through Nova Scotia, New Brunswick, Maine,¹ New Hampshire, and Vermont, becoming very rare and local in Massachusetts, and reaching its most southern limit in the mountains of Chester County, Pennsylvania. In New Hampshire² it occurs mainly in the low sandy country in the Saco river basin, where it either grows pure or in mixture with *P. Strobus*. In the Pisgah forest, near Hinsdale, in this state, I saw in 1906 a few trees growing on rocky ridges, one of which measured 94 ft. by $7\frac{1}{2}$ ft.

It extends westwards, through north-eastern Ohio, north of Cleveland; and in central Michigan, northern Wisconsin, and north-eastern Minnesota, attains its greatest abundance and largest size. In northern Wisconsin,³ it grows mixed with *P. Strobus* on loamy sands; and either pure or mixed with *P. Banksiana*, occupies the poorer lands, which are known as pine barrens. It is occasionally met with on clay soils on the slopes along Lake Superior. It grows rapidly when young, about as fast as *P. Strobus* up to the age of 100 years; but afterwards increases very slowly in diameter. In the Cass Lake Forest Reserve in Minnesota, it occurs in similar situations, and is the timber chiefly valued for beams, that of *P. Strobus* being almost entirely used for indoor finish. *P. resinosa*, in pure stands in this state, has very straight stems, free of branches to a great height. Tables that I obtained in Washington show that in Itasca County, Minnesota, and in Bayfield County, Wisconsin, trees occur 120 ft. in height and 30 in. in diameter; and at 200 years old, they average 26 in. in diameter.

This species is very intolerant of shade at all ages; and in America,⁴ where it is occasionally planted, is either used pure, or in mixture with *P. Strobus*. Measurements made of plantations near Lake Winnepesaukee in New Hampshire, show that at twenty-seven years old the red pine averages 35 ft. high, and is taller than white pine of the same age.

(A. H.)

Bailey and Jack in a paper "In the Woods of New Brunswick,"⁵ say of this pine that lumbermen recognise two varieties, which they call "Sapling" and "Old Red Pine." The former has an inferior timber, which, however, was largely used in Maine for hogshead heading. The latter, nearly extinct in 1887, sometimes attained a height of 90 ft., and a diameter of 3 ft., clean to 40 or 50 ft. up. The wood is strong and durable, resembling that of pitch pine, but with less resin, and was formerly largely employed for the decking of vessels and for beams, having a fine compact grain with few knots. It grew best on dry and sandy soil, in the granite boulder country fifty miles north of St. Andrews, and also on the Tobique river, where in some places the trees were so thick that there was hardly room to turn a sled between the stumps.

In *Canadian Forestry Journal*, 1905, p. 172, two illustrations are given of a remarkable instance of a tree of this species, from which a ring of bark 1 ft. wide was removed all round the tree nine years previously. The tree was still alive,

¹ It is common in Maine, generally on dry ridges, but in Greenbush and Passadumkeag grows abundantly on peat bog with black spruce. Dame and Brooks, *Trees of New England*, 10 (1902).

² Chittenden, *Forest Conditions of New Hampshire*, U.S. Forestry Bulletin No. 55, p. 54 (1905).

³ Roth, in *Wisconsin Geol. Survey Bull.* No. 1, *Forestry Conditions of Northern Wisconsin*, 20, 67 (1898).

⁴ U.S. Forest Service Circ. 60 (1907).

⁵ *Trans. Scot. Arb. Soc.* xi. 11 (1887).

and had made an increase in girth of 6 in. above the place where it was girdled. Mr. A. Knechtel, at that time forester to the New York Forest, Fish, and Game Commission, found this tree close to the road from Paul Smith's to M'Colloms' in the Adirondack mountains, and gave the dimensions as follows:—Height, 30 ft.; diameter of girdled part, 5 ft. 3 in.; ditto, just below the girdle, 6 ft. 4 in.; ditto, just above, 8 ft. 3 in. Mr. Knechtel writes me on May 10, 1909, that the tree was still alive when he last saw it in October 1908, and explains the fact as follows:—"The plant food ascends the tree through its interior; the elaborated material descends between wood and bark. Since there is no bark at the girdle, it does not cross it. Hence the tree grows above the girdle and not below it."

CULTIVATION

It was introduced¹ by Hugh, Duke of Northumberland, as long ago as 1756; but it seems unable to live long or to attain timber size in any part of this country. Lambert says that in 1804 he found it in a flourishing state at Pains Hill, at Caen Wood (in a small island), and at Syon, where the first trees were planted, yet from their size he concluded that it would not produce valuable timber. At White Knights a number of trees were planted by the Marquess of Blandford about the end of the eighteenth century, raised by Loddiges from seeds received from America, and some of them existed in Loudon's time. But at these places none are now living; and the only trees we have seen are two specimens at Bayfordbury, planted in 1851, one of which is 54 ft. high and 5 ft. 3 in. in girth, and the other 50 ft. by 3 ft. 10 in.; two trees at Dropmore, 68 ft. by 4 ft. 5 in., and 62 ft. by 4 ft. 3 in. in 1909; and one or two small trees at Kew. In my nursery at Colesborne small imported trees closely resemble the Austrian pine, but are far less vigorous in growth, and have been gradually dying ever since I had them.

TIMBER

The timber of this tree was at one time imported to a considerable extent, and according to Laslett was then known as red pine, and when straight and clean enough for masts was considered superior to the Riga and Dantzic pines for that purpose.

Macoun says that it is neither so tall nor so large as the white pine (*P. Strobus*), and that though the wood is much harder, stronger, more elastic and resinous, is often not separated in commerce from the wood² of that species. It is valuable for piles, masts, and spars, and though formerly worth more than white pine, is not nearly so abundant in Canada.

Mr. Weale writes as follows:—"Canadian red pine (*Pinus resinosa*) is produced in Canada generally, but not largely imported into this country owing to the competition of the Baltic *Pinus sylvestris*. It is harder and not so easily worked as yellow pine (*Pinus Strobus*), and not so hard as pitch pine (*Pinus palustris*). For

¹ Aiton, *Hort. Kew.* iii. 367 (1789).

² Dr. H. T. Bovey, in *Trans. Roy. Soc. Canada*, xii. 3, p. 11 (1894), gives the results of tests on the comparative strength of red pine, white pine, and Douglas fir.

work that needs much application of the tool the yellow pine is therefore preferred. On the other hand, where long lengths, hardness, and durability are required, consumers employ the pitch pine. The Canadian red pine in consequence does not find the ready market in Great Britain it deserves."

Mayr gives a comparison between the wood of a tree of this species felled in Dakota and a tree of *P. sylvestris* felled in Bavaria; the latter had heavier wood with less sapwood, but contained a less percentage of resin. (H. J. E.)

PINUS THUNBERGII, JAPANESE BLACK PINE

Pinus Thunbergii, Parlatore, in DC., *Prod.* xvi. 2, p. 388 (1868); Masters, in *Journ. Linn. Soc. (Bot.)* xviii. 504 (1881), xxvi. 552 (1902), and xxxv. 629 (1904), and in *Gard. Chron.* xxiii. 344, fig. 63 (1885); Mayr, *Abiet. jap. Reiches*, 69, t. v. f. 16, and t. vii. f. 1 (1890), and *Fremdländ. Wald- u. Parkbäume*, 350 (1906); Shirasawa, *Icon. Forest. Japon.* text 11, t. i. ff. 15-29 (1899); Kent, Veitch's *Man. Coniferae*, 383 (1900); Clinton-Baker, *Illust. Conif.* i. 55 (1909).
Pinus Massoniana, Siebold et Zuccarini, *Fl. Jap.* ii. 24, t. 113 (1844) (not Lambert).

A tree, attaining in Japan 130 ft. in height and 20 ft. in girth. Bark greyish brown, deeply fissured. Young branchlets glabrous, brown, with slightly raised pulvini, bearing at their apices long lanceolate-acuminate fimbriated scale-leaves, persisting during the first year, and leaving, when they fall, transverse projecting ridges, roughening the older branchlets. Buds ovoid, cuspidate, $\frac{1}{2}$ to $\frac{3}{4}$ in. long, greyish white; scales appressed and matted together by their fimbriated edges, and ending in long subulate points.

Leaves in pairs, persistent for three years, densely crowded on the branchlets, more or less spreading, 3 to 4 in. long, rigid, twisted half a turn, so that the apices of the two leaves in each cluster face each other by their outer surfaces, serrulate, ending in a spine-like cartilaginous point, marked with numerous stomatic lines on both surfaces; resin-canals median; basal sheath $\frac{1}{2}$ in. long, ending above in two long filaments.

Cones sub-terminal, spreading, clustered, on short stalks, ovoid-conic, about $2\frac{1}{2}$ in. long; scales oblong-cuneate, thin, concave laterally, with the concealed part dark reddish brown on the outer and pale brown on the inner surface; apophysis thickened, rhomboidal, shining brown, upper edge irregular, depressed in the centre, with numerous radial lines, transverse ridge slightly marked, umbo reddish brown or white with resin, armed with a minute, often rudimentary prickle. Seed greyish or brown, mottled with black, $\frac{1}{5}$ to $\frac{1}{4}$ in. long; wing narrow, pale brown, about $\frac{3}{4}$ in. long.

This species, which is the representative of *P. Laricio* in Japan, is readily distinguished by its remarkable white buds and rigid needles. The long filaments of the basal sheaths are peculiar to this species and *P. densiflora*.

Mayr describes ten varieties which are cultivated in Japanese gardens. In var. *monophylla* the two leaves in the cluster coalesce. Forms of peculiar habit are known, globose or pendulous, or with twisted stems. Var. *aurea*, in which the

leaves assume a golden yellow colour during winter, and var. *variegata*, in which the leaves are marked with one or two transverse yellow bands about the middle, were introduced¹ into Kew Gardens in 1897.

According to Mayr, this species forms hybrids with *P. densiflora*.

(A. H.)

DISTRIBUTION

This species is restricted to Japan,² where, according to Shirasawa and Mayr, it is only known in the wild state on the eastern sea-coast, from Kiusiu and Shikoku to the northern part of Hondo. On account of the dark grey bark, uniform in colour to the top of the tree, it is usually called *kuro-matsu* or black pine by the Japanese. Commonly forming a stout trunk, with irregular wide-spreading strong branches, it is also termed *o-matsu*, or male pine, in contradistinction to *P. densiflora*, which, from its more slender stem and more graceful appearance, is named female pine. Varied and picturesque in appearance, the black pine is frequently depicted by Japanese artists.

It is one of the trees which has been planted from a very early period in gardens and about temples. The most celebrated tree of the species grows on the shore of Lake Biwa at Karasaki, which is easily reached in two hours from Kioto, and is well worth a visit. It is certainly a remarkable tree, though nothing like so large as stated in Murray's *Handbook to Japan* (1903).³ The correct measurement, as taken by myself, is as follows:—Girth at ground, 20 ft.; at 5 ft., where a very large limb is already thrown off, 29 ft. The largest limbs are about 12 ft. each in girth, and the main trunk above them about 20 ft. high. The highest branch that I could find on the tree is not over 50 ft. from the ground, but the spread is astonishing. As nearly as I could follow the extremities of the branches, they cover an area 180 paces round, and though the tree is decayed in places and is said to be a thousand years old, it is full of foliage and had many cones which bear fertile seeds.

Another famous tree at the Naniwaga tea-house in Osaka, seen by Siebold, had the branches artificially extended, and formed a circuit of 135 paces.

This pine is also largely planted for timber in Japan, and is of great service near the sea-coast for fixing the dunes and for shelter belts. It will grow in the poorest soil, but then remains dwarf and of no value unless planted wide apart. On good

¹ *Gard. Chron.* xxi. 250 (1897). These varieties cannot now be found.

² A pine, widely spread in the mountains of northern Korea, and of the Manchurian provinces, S. Ussuri, Kirin, and Mukden, has long been confused with *P. Thunbergii*, and has only lately been accurately described as a distinct species—*Pinus funebris*, Komarov, *Flora Manshurica*, i. 177 (1901). The leaves of this species differ in having marginal resin-canals; and the buds are reddish, ovoid, short-pointed, with appressed scales. The cones, similar in size to those of *P. Thunbergii*, differ in the greyish apophyses of the scales, each of which has an elevated umbo, ending in an inflexed short point. The seeds are shining dark brown, with short broad wings. This pine resembles in stature *P. sylvestris*, but has ashy grey coloured bark. It is often planted in Korea and Manchuria, and in the vicinity of Peking, around temples and tombs; but has not yet been introduced into this country. It is erroneously referred to *P. Thunbergii* by Masters in *Journ. Linn. Soc. (Bot.)* xxvi. 553 (1902).

The specimens from Yunnan and eastern Szechwan referred to *P. Thunbergii* by Franchet, in *Journ. de Bot.* xiii. 253 (1899), are certainly not this species.—(A. H.)

³ A photograph of this remarkable specimen, sent by Sir Thomas Hanbury, who considered it to be *P. densiflora*, is reproduced in *Gard. Chron.* xv. 366, fig. 44 (1894). Another remarkable pine, either *P. Thunbergii* or *P. densiflora*, is figured in *Gard. Chron.* xv. 140, fig. 15 (1894). This stands in the Kinkakuji monastery in Kioto, and is trained to represent a junk with a mast and sail. Cf. Kent, Veitch's *Man. Conifera*, 385, fig. (1900).

soils it attains enormous dimensions, Mayr recording a tree 140 ft. in height and 11 ft. in girth. The timber is difficult to work, and inferior in quality to that of *P. densiflora*, but is superior for firewood and yields resin.

CULTIVATION

P. Thunbergii was introduced into Holland by Siebold in 1855, and into England by J. Gould Veitch in 1861. It is often seen in private collections and botanic gardens, as at Kew, Glasnevin, and Bayfordbury; but nowhere has attained considerable dimensions, the finest specimen being one at Dropmore, planted in 1861, which was 52 ft. high by 6 ft. in girth in 1909. There are two trees at Eastnor Castle, the larger of which is 48 ft. by 5 ft., and the smaller 42 ft. by 3 ft. 5 in. Another at Grayswood, near Haslemere, planted in 1881, is a wide-spreading tree, 39 ft. in height and 4 ft. 3 in. girth in 1906. It gives little promise of being a useful tree for planters, though it might be tried near the sea-coast. Lord de Saumarez wrote in 1897 to Kew that he had found this species invaluable for planting in Guernsey on the most exposed points close to the sea, where all other pines, including *P. Pinaster*, had failed. In 1909, trees planted twenty years had attained 25 ft. in height. At Grafrath, near Munich, it is slow in growth and much injured by snow, a tree twenty-five years old being only 13 ft. high. In New England it is perfectly hardy.

(H. J. E.)

CUPRESSUS

- Cupressus*,¹ Linnæus, *Gen. Pl.* 294 (1737); Stark, in *Trans. Roy. Soc. Edin.* xxvii. 651 (1876);
Bentham et Hooker, *Gen. Pl.* iii. 427 (1880); Masters, in *Journ. Linn. Soc. (Bot.)* xxx. 18
(1893), and xxxi. 312-363 (1896).
Chamaecyparis, Spach, *Hist. Vég.* xi. 329 (1842).
Retinispora,² Siebold et Zuccarini, *Fl. Jap.* ii. 36 (1844).
Thuya, section *Chamaecyparis*, Bentham et Hooker, *Gen. Pl.* iii. 427 (1880).

EVERGREEN trees, or rarely shrubs, belonging to the division Cupressineæ of the order Coniferae. Bark³ usually divided into ridges, and separating on the surface into loose or appressed scales. Branches, ascending or spreading, much ramified, and terminating in so-called "branchlet systems" or "herbaceous shoots," which are green in colour, two- or three-pinnately divided, and covered with scale-like leaves; most of the branchlet systems⁴ are deciduous in the third or fourth year, a few developing by their main axes into permanent branches. Ultimate branchlets slender, quadrangular or flattened. Leaves on adult trees, minute, more or less coalesced with the axes, ovate, with spreading or appressed tips, in four rows, in opposite decussate pairs, around the branchlets; either (a) all uniform in size and shape, or (b) of two kinds, a flattened pair on the front and back of the branchlet, and a lateral conduplicate pair. On vigorous leading shoots and on seedling plants the leaves are needle-shaped or linear-lanceolate, spreading, and uniform in four ranks. In certain horticultural varieties, formerly considered to be species of a distinct genus, *Retinispora*, the foliage either resembles that of seedling plants or is intermediate in character between the primordial and the adult foliage.

Flowers monœcious, terminal, solitary, the two sexes on separate branches. Staminate flowers cylindrical, composed of numerous decussate stamens, with short filaments, enlarged into ovate connectives bearing two to six pendulous globose anther-cells. Pistillate flowers, composed of decussate peltate scales, in which no distinction between the "ovuliferous scale" and the "cover-scale" or "bract" is apparent, continuous in series with the leaves at the end of the branchlet, and

¹ We are indebted to Mr. Cecil Hanbury for a fine set of specimens, sent by Mr. Berger from La Mortola on the Italian Riviera, and to Mr. Flahault for a set of all the species cultivated at Montpellier.

² This name was first applied to the Japanese species, which have conspicuous resin-vesicles on their seeds. (*C. Lawsoniana*, discovered afterwards, has the same character.) It is derived from *ρητινῆ*, resin, and *σπορά*, seed. Subsequently it was wrongly spelled *Retinispora*, and was made to comprise the juvenile forms of *Cupressus* and *Thuya*.

³ The bark of *C. Lawsoniana*, q.v., differs remarkably on old trees from that of all the other species.

⁴ A "branchlet system" arises from a bud, and forms in the first year an axis and secondary lateral branchlets; in the second year tertiary branchlets are developed. The branchlet system usually falls off in October of the third year, but in certain species the fall is in the second or in the fourth year; in the latter case the tertiary branchlets develop another set of branchlets.

bearing either (a) in one row, two to five, or (b) in several rows, numerous erect urceolate ovules. Fruit, a globose cone, composed of four to fourteen woody peltate scales, abruptly dilated at the apex, and bearing in the centre of the outer surface a mucro, boss, or knob. Seeds erect on the base of the scale, acutely angled, compressed or rounded, with two thin lateral wings.

The genus consists of about fifteen species,¹ widely distributed throughout the warm temperate region of the northern hemisphere; and is divided into two sections, which are by many authors considered to be two distinct genera. The only constant difference between the sections appears to lie in the margin of the leaves. The different periods of ripening of the cones, the number of seeds on each scale, and the flattened or tetragonal branchlets, are too variable to form any real base of distinction. Penhallow² points out that while the microscopic structure of the wood of *Cupressus* and *Thuya* is distinct, there is no difference in the wood of *Cupressus* and *Chamaecyparis*; and considers that the latter must disappear as a genus.

About fourteen species are in cultivation, which are distinguishable as follows:—

I. EU-CUPRESSUS.

Leaves, fringed with a narrow thin translucent serrated border,³ either uniform in four ranks, or dimorphic with conduplicate lateral pairs and flattened facial pairs. Branchlet systems either flattened with their pinnæ in one plane, or arising at varying angles with their pinnæ in several planes. Cones large,⁴ usually $\frac{1}{2}$ in. or more in diameter, ripening in the second year. Seeds,⁴ usually six to twenty on each scale, in several rows. Cotyledons two to five.

A. Branchlet-systems flattened with the pinnæ in one plane.

* Leaves appressed.

1. *Cupressus torulosa*, Don. Western Himalayas. See p. 1158.

Branchlets equal-sided. Leaves obtuse, uniform in four ranks. Cones, $\frac{1}{2}$ in., globose or ellipsoid, on short usually curved stalks; scales eight or ten, external surface depressed, with a minute process. Seeds six to eight on each scale.

2. *Cupressus funebris*, Endlicher. China. See p. 1162.

Branchlets compressed. Leaves dimorphic, non-glandular, with a mucronate scarcely spreading apex. Cones,⁴ $\frac{1}{3}$ in., globose, on long slender stalks; scales eight, external surface not depressed, with a minute process. Seeds three to five on each scale.

- 2A. *Cupressus lusitanica*, Miller, var. *Benthami*, Carrière. Mexico. See p. 1177.

Branchlets compressed. Leaves dimorphic, usually with a depressed circular gland, apices mucronate and spreading. Cones and seeds as in *C. lusitanica*.

¹ *Dacrydium Franklinoi*, Hooker, the Huon pine, a native of Tasmania, which is occasionally cultivated in the west of Scotland and in Cornwall, is frequently mistaken for a cypress. On close examination the leaves, which are dotted over with white stomata, will be seen to be spirally arranged, and not in opposite decussate pairs, as in *Cupressus*.

² In *Trans. Roy. Soc. Canada*, ii. § 4, p. 43 (1896).

³ This narrow serrated border can only be seen with a lens of considerable magnifying power.

⁴ *C. funebris* is exceptional in its small cones with few seeds on each scale, and is a link between the two sections.

** *Leaves spreading.*

3. *Cupressus cashmeriana*, Royle. Himalayas. See p. 1161.

Branchlets compressed. Leaves glaucous-blue, widely spreading above their decurrent base, subulate, with a mucronate apex. Cones, $\frac{1}{2}$ in., ellipsoidal; scales ten, outer surface depressed, with a minute reflexed process. Seeds ten on each scale.

- B. *Branchlet-systems arising at varying angles, with their pinnæ not in one plane.*

* *Leaves with a conspicuous circular pit, exuding resin.*

4. *Cupressus Macnabiana*, Murray. California. See p. 1174.

Branchlets compressed. Leaves dimorphic, thick, obtuse. Cones globose, $\frac{1}{2}$ to $\frac{3}{4}$ in., reddish brown, often glaucous; scales six, with prominent processes, those on the upper scales thickened, conical, and incurved. Seeds ten to twelve on each scale.

5. *Cupressus arizonica*, Greene. Arizona, Northern Mexico. See p. 1183.

Branchlets equal-sided, glaucous in native specimens. Leaves uniform, acute or acuminate. Cones, $\frac{1}{2}$ to $\frac{3}{4}$ in., glaucous at least in the first year; scales six to eight, with the external surface not depressed, and a prominent process. Seeds eight to ten on each scale.

** *Leaves not conspicuously glandular.*

† *Branchlets equal-sided. Leaves uniform in four ranks, closely appressed.*

6. *Cupressus sempervirens*, Linnæus. Mediterranean region. See p. 1151.

Leaves $\frac{1}{2}$ in. long, obtuse. Cones sub-globose or ovoid, 1 to $1\frac{1}{4}$ in., pale brown or greyish; scales eight to fourteen, either with a central pit overhung by a minute process, or pyramidal ending in a mucronate process. Seeds twenty on each scale.

7. *Cupressus macrocarpa*, Hartweg. Monterey (California) and Guadalupe Island. See p. 1165.

Leaves $\frac{1}{8}$ in. long, obtuse, swollen towards the tip. Cones ellipsoid, 1 to $1\frac{1}{4}$ in. long, shining reddish brown; scales eight to fourteen, with a central depression overhung by a thin-edged ridge-like arcuate process. Seeds twenty on each scale.

8. *Cupressus Goveniana*, Gordon. California. See p. 1171.

Leaves $\frac{1}{2}$ to $\frac{1}{6}$ in. long, swollen near the apex, which is acute and often mucronate. Cones globose, $\frac{1}{2}$ to $\frac{3}{4}$ in., shining dark brown; scales six to ten, projecting in the centre, which bears a prominent process. Seeds ten to twelve on each scale.

‡ *Branchlets compressed. Leaves nearly uniform in four ranks, free at the tips.*

9. *Cupressus lusitanica*, Miller. Mexico, long cultivated in Portugal. See p. 1176.

Leaves $\frac{1}{6}$ in. long, acuminate, often mucronate. Cones remarkably glaucous, at least in the first year, globose, $\frac{1}{2}$ in., on straight stalks; scales eight, with a prominent process. Seeds eight to ten on each scale.

II. CHAMÆCYPARIS.

Leaves entire in margin; always dimorphic, lateral pair conduplicate, facial pair flattened. Branchlet systems usually flattened, with their pinnæ in one plane. Cones small, not more than $\frac{1}{3}$ in. in diameter, usually ripening¹ in one year. Seeds one to five on each scale, in one row. Cotyledons invariably two.

A. *Lateral leaves much larger than the dorsi-ventral leaves, longer than them on the main axes.*

10. *Cupressus obtusa*, Koch. Japan, Formosa. See p. 1185.

Leaves obtuse, non-glandular. Under surface of the foliage marked with x-shaped clearly-defined white markings. Cones $\frac{1}{3}$ in., orange-brown; scales eight or ten. Seeds one to five on each scale, with large conspicuous resin-vesicles.

11. *Cupressus Lawsoniana*, Murray. South-western Oregon, north-western California. See p. 1200.

Leaves acute, usually glandular. Under surface of the foliage green or with ill-defined white markings. Cones $\frac{1}{3}$ in., glaucous; scales eight. Seeds two to five on each scale, with large conspicuous resin-vesicles.

B. *Lateral leaves not much larger than the dorsi-ventral leaves, equal in length with them on the main axes.*

12. *Cupressus pisifera*, Koch. Japan. See p. 1190.

Leaves acuminate, with spreading often mucronate tips, obscurely glandular. Lower surface of the foliage with white markings in hollows of the leaves. Cones $\frac{1}{4}$ in., dark brown; scales ten, wrinkled and deeply depressed in the centre. Seeds one to two on each scale, with large conspicuous resin-vesicles.

13. *Cupressus nootkatensis*, Don. Alaska, British Columbia, Washington, Northern Oregon. See p. 1194.

Leaves acute, mucronate, green, without any white markings. Cones ripening in the second year, $\frac{1}{3}$ in., plum-coloured; scales four or six, with prominent pointed processes. Seeds two on each scale, without resin-vesicles.

14. *Cupressus thyoides*, Linnæus. Near the sea from southern Maine to northern Florida, and westward to Mississippi. See p. 1210.

Leaves acute, green, without white markings, with a conspicuous raised gland on the back. Cones $\frac{1}{4}$ in., glaucous; scales six. Seeds one to two on each scale, without resin-vesicles.

The following species are not yet introduced, and are imperfectly known.

CUPRESSUS FORMOSENSIS, Henry.

Chamæcyparis formosensis, Matsumura, in *Tokyo Bot. Mag.* xv. 137 (1901); Matsumura and Hayata, *Enum. Pl. Formos.* 402 (1906); Beissner, in *Mitt. deut. dendr. Ges.* 1907, p. 115; Hayata, in *Journ. Coll. Sc. Tokyo*, xxv. 208 (1908).

¹ *C. nootkatensis* is an exception. Cf. p. 1196, note 4.

This species, which occurs on Mount Morrison in Formosa, at 7000 to 10,000 feet altitude, appears to be allied to *C. Lawsoniana*, and is reported to attain an enormous size, Beissner having received from A. Unger of Yokohama a photograph of a tree said to be 72 feet in girth.¹ There are herbarium specimens at Berlin, which I have not seen. It is described as having acute green leaves not marked with white lines as in *C. pisifera*; and the cones are intermediate in size between those of that species and those of *C. obtusa*. No seeds of this remarkable species have as yet reached Europe.

CUPRESSUS HODGINSII, Dunn, in *Journ. Linn. Soc. (Bot.)* xxxviii. 367 (1908).

Described² from specimens collected near Foochow, China, consisting of detached foliage and cones. The former resembles the foliage of young trees of *Libocedrus macrolepis* in cultivation at Kew. The cones are very peculiar, resembling those of a cypress, but containing seeds with two very unequal wings, and indicate a new and interesting species, doubtfully referable to *Cupressus*.

CUPRESSUS THURIFERA, Humboldt, Bonpland, and Kunth, *Nov. Sp. et Gen.* ii. 3 (1817); Masters, in *Journ. Linn. Soc. (Bot.)* xxxi. 349, figs. 25-27 (1896); Kent, Veitch's *Man. Conif.* 230 (1900).

Chamaecyparis thurifera, Endlicher, *Syn. Conif.* 62 (1847).

A rare species, recorded for three or four localities in Mexico, and doubtfully referable to *Cupressus*. There are cones in the Kew herbarium collected by Botteri³ at Orizaba which were attributed to this species by Dr. Masters. These cones are globose, composed of six non-peltate scales, decussately arranged, and fitting close together by their margins; each scale bears the scars of attachment of one to three wingless seeds. Kent described this species from specimens, said to have been sent from La Mortola, but which cannot now be found in Messrs. Veitch's museum at Chelsea; and Mr. A. Berger writes⁴ that no tree of this kind now exists at La Mortola. It is doubtful if this species was ever introduced, as Carrière⁵ states that the plant formerly grown under this name was a *Biota*; and seeds of supposed *C. thurifera*, distributed in 1909, by the Dendrological Society of France, differed in no respect from those of *C. lusitanica*. (A. H.)

¹ While these pages were finally going through the press, Mr. H. Clinton-Baker has shown me a photograph, taken by Mr. A. R. Firth, Consul at Tamsui, of an enormous tree of this species, growing on Mt. Ari, which measures 125 ft. in height, with a stem free of branches for 45 ft. and 67 ft. in girth. Capt. L. Clinton-Baker, R.N., has just brought home excellent specimens in fruit, and two living plants, which will be planted at Bayfordbury.

² While these pages were finally going through the press, Mr. H. Clinton-Baker has received from Capt. Hodgins, excellent specimens in fruit. There are now four living plants at Bayfordbury, two sent in 1909, and two brought home in April 1910, by Capt. L. Clinton-Baker, R.N.

³ Lindley, in *Gard. Chron.* 1856, p. 772, states that Botteri sent cones of a cultivated plant, from which very glaucous seedlings like a *Thuja* were raised in the Chiswick Garden.

⁴ Mr. Berger states that two plants formerly cultivated under this name at La Mortola turned out to be *Cupressus sempervirens* and *C. lusitanica*, var. *Benthani*.

⁵ *Conif.* 135 (1867).

CUPRESSUS SEMPERVIRENS, MEDITERRANEAN CYPRESS

Cupressus sempervirens, Linnæus, *Sp. Pl.* 1002 (1753); Pallas, *Fl. Ross.* I. pt. ii. p. 11, t. 53 (1784); Loudon, *Arb. et Frut. Brit.* iv. 2464 (1838); Boissier, *Fl. Orient.* v. 705 (1881); Hooker, *Fl. Brit. Ind.* v. 645 (1888); Masters, in *Journ. Linn. Soc. (Bot.)* xxxi. 325 (1896); Kent, Veitch's *Man. Coniferae*, 228 (1900); Gamble, *Indian Timbers*, 697 (1902); Kirchner, *Lebengesch. Blütenpfl. Mitteleurop.* i. 280 (1906).
Cupressus horizontalis, Miller, *Dict. No. 2* (1768), sphalmate "horizontalibus."
Cupressus lugubris, Salisbury, *Prod.* 397 (1796).
Cupressus fastigiata, De Candolle, *Flor. Franç.* vi. 336 (1815).
Cupressus patula, Spadoni, *Xilog.* i. 193 (1826).
Cupressus Tournefortii, Audibert, *Cat.* (1834).

A tree, attaining in the Mediterranean region an immense age and size. Bark very thin, even on old trees, smooth or slightly fissured longitudinally, greyish brown, with a light brown cortex. Branchlet systems, alternate, not distichous, spreading irregularly at varying angles, tri-pinnate, with the pinnæ not disposed in one plane. Ultimate branchlets tetragonal, equal-sided, $\frac{1}{8}$ in. in diameter. Leaves, in four equal ranks, $\frac{1}{2}$ in. long, rhomboid, obtuse, closely appressed, often marked with a longitudinal furrow.

Staminate flowers, yellow, $\frac{1}{8}$ in. long; stamens about ten pairs, with sub-orbicular dentate connectives, each of which bears four or more anther-cells. Female flowers globose, $\frac{1}{4}$ in. in diameter; scales decussate, three to seven pairs, thick and fleshy with a thin edge, and bearing at the base about twenty urn-shaped ovules.

Cones ripening in the winter of the first year or in the following spring, opening in the succeeding autumn by the separation of the scales at their edges, when the seed falls out; on short stout curved stalks, sub-globose or ovoid, 1 to $1\frac{1}{4}$ in. in length, shining, pale brown or greyish; scales eight to fourteen, very variable in form, either flattened with a central pit overhung by a minute rounded thin process, or pyramidal with a mucronate process. Seeds eight to twenty on each scale, $\frac{1}{8}$ in. long, oblong, rounded or angled, without resin-vesicles; wing very narrow.

The seedling¹ has two opposite cotyledons, $\frac{2}{5}$ in. long, linear, flattened, shining green below, and dull bluish green above with stomata. The primary leaves, $\frac{1}{3}$ in. long, green and spreading, have stomata on their upper surface; the first pair opposite and alternating with the cotyledons, and followed by a series of whorls of four, ultimately being replaced by decussate pairs of adult scale-like leaves.

VARIETIES

The Mediterranean cypress has been known to exist from the most ancient times in two forms.

¹ Cf. Kirchner, *op. cit.* 281, 282.

1. Var. *horizontalis*, Gordon, *Pinetum*, 68 (1858).

Cupressus horizontalis, Miller, *Dict. No. 2* (1768).

Branches spreading, the tree assuming the habit of a cedar. This is the common form in the wild state.

2. Var. *stricta*, Aiton, *Hort. Kew.* iii. 372 (1789).

Var. *pyramidalis*, Nyman, *Consp.* 675 (1881).

Var. *fastigiata*, Hansen, in *Journ. Roy. Hort. Soc.* xiv. 287 (1892).

Cupressus pyramidalis, Targioni-Tozzetti, *Oss. Bot.* iii.-v. 53 (1808).

Cupressus fastigiata, De Candolle, *Fl. Franç.* v. 336 (1815).

Cupressus conoidea, Spadoni, *Xilog.* i. 189 (1826).

Branches erect, nearly parallel to the stem, forming a tree of narrowly pyramidal outline. This is the form most commonly met with in cultivation.

It is doubtful if the varieties, which depend upon the form of the fruit, though distinguished by Parlatore, can be maintained, as he admits that he observed on the same tree cones of different shapes, ovate-oblong, oblong, and globose, with both umbonate and umbilicate scales. The following may be mentioned, although it is extremely doubtful if it can be distinguished in cultivation.

3. Var. *indica*, Parlatore, in De Candolle, *Prod.* xvi. pt. ii. p. 469 (1868).

Cupressus Whiteyana, Carrière, *Conif.* 128 (1855).

Cupressus Doniana, Royleana, and *australis*, Koch, *Dendrologie*, II. pt. ii. p. 146 (1873)

Habit of var. *stricta*, with globose cones and mucronate umbonate scales. This variety as well as the spreading form is cultivated in northern India.

4. Variegated and dwarf varieties, which we have not seen, are mentioned by Carrière.

5. Var. *thujæfolia*, Knight and Perry, *Syn. Conif.* 19 (1850).

A sub-variety of the upright cypress, in which the branchlet systems are regularly arranged in one plane.

DISTRIBUTION

This species is indigenous in the mountains of northern Persia, in Syria, Cilicia, Greece, and the islands of Rhodes, Crete, and Cyprus. Pliny believed that it was introduced from Crete into Italy. Humboldt considered the native home of the cypress to be in the mountains of Buseh, west of Herat, but so far as our present knowledge goes it is now a rare and always a planted tree in Afghanistan. Hehn's¹ supposition that it was in ancient times imported from Persia into the Lebanon and Cyprus is without any foundation.²

Dr. Stapf informs me that this tree is truly wild in the Elburz mountains in northern Persia, where he saw it on rocky slopes opposite Mendjil and Rudbar. Buhse collected it on the sides of the Safed Rud valley.

¹ *Wanderings of Plants and Animals*, 212.

² Mouillefert, *Essences Forestières*, 402 (1903), identifies with this species some pieces of wood found at Carthage, which had been used for coffins by the Carthaginians about 500 B.C. At present the tree only exists in Algeria near houses and in gardens.

In Greece,¹ it is now found wild on Mount Parnassus and forms woods between Messene and Kalamata in Peloponnesus.

In Cyprus,² the spreading form of the cypress, var. *horizontalis*, grows in a wild state throughout the northern range of mountains, which consist mainly of limestone, thriving luxuriantly up to the highest point, 3300 ft. above sea-level. There are no large trees now in the forests of this range, the best being about 35 ft. high and 5 ft. in girth, since in former times, whenever a tree was large enough to make a rafter it was cut by the villagers, and much damage was also done by forest fires. In the southern range, which is mainly composed of volcanic rocks, there are only a few isolated specimens, which ascend to 3500 ft. elevation. The fastigiata variety is commonly planted in gardens in the plains; and the finest specimens are one at the Ayia Nicola church in the Famagusta district, 70 ft. high and 9½ ft. in girth; another of the same height and 12 ft. in girth at the Chrysostomos monastery, Kyrenia district; while a third at the Ayia Katerina mosque, in the Nicosia district, is 78 ft. by 7 ft. 3 in. Attempts to raise cypress from seed on Troodos at 5500 ft. elevation failed, as the plants were killed by the cold.

According to Pliny,³ it grew in the White Mountains of Crete, being in great abundance on the very summits, from which the snow never departs. Evelyn⁴ states that a vast forest of this species in Crete was destroyed by a fire which raged from 1400 to 1407. Mr. A. Trevor Battye found the horizontal form wild in Crete at elevations of about 3000 ft., attaining about 50 ft. high, by 6 ft. in girth. A photograph taken by him in the entrance to the gorge from the plain of Omalu, shows a group of these trees.

According to Boissier⁵ it occurs on the Lebanon between 3500 and 5000 ft., and appears to have been collected in the wild state in northern Syria near Beila, and in the mountains of Cilicia. Post⁶ states that the upright variety is everywhere cultivated in the cemeteries in Syria under the name of *Saru*.

The cypress has been carried by man both eastward and westward of its original home, and is occasionally even planted in China.⁷ It is much cultivated in northern India, the fastigiata variety being the most common and attaining occasionally a height of 100 ft. with a girth of 9 ft.

The cypress is naturalised in many places, as on the eastern shore of the Adriatic,⁸ where, however, it does not thrive at elevations exceeding 1000 ft., and in the Caucasus.⁹ In Italy it is perfectly naturalised in Tuscany, where in a mixed wood of oak and ash, between Castelfiorentino and Montagone, Sprenger¹⁰ noticed thousands of trees of all ages from seedlings to a hundred years old.

The cypress is cultivated on the continent in a few places north of the Alps, as on the island of Mainau¹¹ in Lake Constance, and at Metz; but in France it

¹ Halácsy, *Consp. Fl. Græcæ*, iii. 454 (1904).

² According to a memorandum, prepared by Mr. A. K. Bovill, Principal Forest Officer, kindly sent by the Chief Secretary to Government, Cyprus.

³ Lib. xvi. cap. xxiii.

⁴ *Sylva*, 123 (1679).

⁵ *Flora Orientalis*, v. 705 (1881).

⁶ *Flora of Syria*, 748 (1896).

⁷ Cf. Franchet, *Journ. de Bot.* xiii. 263 (1899).

⁸ Beck, *Veg. illyr. Länd.* 184 (1901), with plate representing a grove on the island of Sabioncello.

⁹ Radde, *Pflanzenverb. Kaukasus*, 184 (1899).

¹⁰ In *Mitt. deut. dend. Ges.* 1904, p. 195.

¹¹ A fine tree on this island is figured by Beissner in *Gart. Zeitung*, November 1891.

is commonly planted in Provence and Languedoc about as far north as Valence, and in the south-west; but is not hardy near Paris. Carrière¹ states that the southern slope, on part of which Montpellier is built, appears to have been formerly occupied by an extensive wood of cypress. The remains of the wooden beams are known as *mélèze*, which is the name still used for the cypress by many of the inhabitants of Montpellier. One of these ancient trees still survived in Carrière's time, and was supposed to be 800 years old. It measured 13 ft. in girth at 3 ft. from the ground, and 4 ft. in girth at 71 ft. up, where it had been broken off by lightning. This remarkable tree belonged to the spreading type, and was situated on a property named Mas-Limasson. (A. H.)

In January 1910 Professor Flahault showed me at the Colline de la Vallette, about two miles north of Montpellier, on a dry limestone hill, a remarkable wood which was planted in 1810 by Pyrame de Candolle, with cypress. The original trees are supposed to have been cut; and M. Flahault thought that the existing ones are seedlings from them. The difference in habit between the two forms is very marked, and is well shown in the photograph reproduced on Plate 293 A. The best trees of the pyramidal form are about 50 ft. by 4 ft., the average about 35 to 40 ft. Of the horizontal form the best are about 35 ft., the average 20 to 30 ft. There are many small seedlings coming up in the more sheltered parts of this wood, though it is regularly grazed by sheep, and one of these seedlings, though only 3 ft. high, bore fruit. The trees growing with the cypresses are *Pinus halepensis*, which seem to be self sown. In the botanic garden at Montpellier there is a fine specimen of the horizontal form measuring 88 ft. by 8½ ft.

There are large and beautiful trees in the Generalife Gardens at Granada, which are called *cipreses de la reina*. These are supposed² to have been planted by the Moors, and are about 500 years old.

The most celebrated cypress in Europe is one at Somma in Lombardy, which is said to have been planted in the year of the Nativity of our Lord. Loudon³ was informed by the Abbé Belèze that a chronicle exists at Milan, proving it to have existed in 42 B.C. But after having visited the tree I cannot believe that this legend is true, as the tree has no appearance of great age, and I should rather suppose that it is a descendant of some old tree which formerly existed here. Somma is a village about four miles north of Galarate on the railroad from Milan to the Alps, and the tree grows in the corner of a walled garden close to the road, which is said to have been diverted by Napoleon to avoid cutting it down. Manetti, who measured the tree for Loudon, said that⁴ it was 121 ft. high and 23 ft. in girth near the ground. I measured it carefully, and found it to be 85 ft. by 17 ft. 3 in. at five feet from the ground. It forks on one side at about 12 ft., and on the other at 15 ft., and then divides into six or seven large trunks. It seemed to be sound, but I could not see into the fork. It is of the *horizontalis* type, and was covered with full-grown but unripe fruit in October 1906.⁵

¹ *Conif.* ii. 149 (1867).

² Willkomm, *Forstl. Flora*, 247 (1887).

³ *Arb. et Frut. Brit.* iv. 2470, fig. 2325. The figure is copied from a drawing sent to London by Manetti.

⁴ Evidently an error, as the Abbé Belèze measured the tree in 1832, and found it to be 70 ft. high and 20 ft. in girth; it had for many years lost its leading shoot. Cf. Loudon, *op. cit.* i. 169 (1838), and *Ann. Soc. d'Hortic.* xii. 76.

⁵ The story in Loudon, p. 2471, about this tree being wounded by Francis I. is erroneous, as Loudon points out in pp. 2589, 2605. The tree struck by this king, in his despair after the loss of the battle of Pavia, was a Lombardy poplar. More details about the age and history of this tree will be found in *Notes and Queries*, for Nov. 17, and Dec. 29, 1894.

Sprenger¹ says that this tree grows larger in Tuscany than in the south of Italy, and that he had seen trees on the Lago Maggiore known to be 620 years old, which were over 10 metres in girth near the ground, but I found no such trees myself.

The cypresses in the court of the Diocletian Museum at Rome are said to have been planted by Michael Angelo; and when measured by M. Simond in 1817 the largest was about 13 ft. in girth. Mr. Victor Ames tells me that these are the most picturesque of the fastigate type that he has seen in Italy. The largest he knows of the *horizontalis* type near Florence are at Marignolle, the tallest at Pozzo Imperiale. Outside the Porta Romana there are some good specimens, which on account of their pendulous growth look like ancient spruce trees. There is a good cypress at Villa d'Este in Tivoli.² A tall very slender cypress at La Mortola measured 33 metres by 1½ metres in 1910.

In the garden of Mr. R. Whittaker near Palermo, I saw a tree in 1910 which measured about 85 ft. by 5 ft., 50 years after planting. Its lateral branches were horizontal, and more regular than usual. On the Isola Bella in Lake Maggiore, I measured a very handsome fastigate tree planted in 1859, which in 1910 was 65 ft. high.

There are very large cypresses at Scutari, where, as generally in Turkey,³ it is planted abundantly in cemeteries, but I can obtain no exact measurements of the size it attains here.

The largest cypress recorded in Greece was one near Mistra, six miles west of the ruins of Sparta, which Lord Aberdeen⁴ found to be 36 ft. in girth at 4 ft. from the ground in 1803. When he saw it again in 1839 it had scarcely gained in girth, and was estimated to be about 150 ft. in height. This immense tree was destroyed⁵ by fire lit by gipsies in 1881. Another large cypress at Patras, which Long⁶ measured in 1820 as 22 ft. 2 in. in girth at 4 ft. from the ground, was destroyed⁷ in the wars of the Greek Revolution. This tree was 18 French ft. in girth in 1676, according to Spon. Prof. Samios of Athens informs us in a letter that the largest specimen he knows of in Greece at the present time is at Oetylos, and measures 50 metres high by 2 metres in girth.

CULTIVATION

It is uncertain when the cypress was first introduced into England. The first mention that we know of it is by Turner, who was physician at Syon in 1548, and says⁸ that it was growing plenteously there. Gerard,⁹ in 1597, says that there are trees of it at "Syon, a place neare London, sometime a house of nunnes. It groweth also at Greenwich, and at other places, and likewise at Hampstead, in the garden of Mr. Wade."

¹ *Mitt. deut. dendr. Ges.* 1904, p. 195.

² In *Gard. Chron.* xiii. 752, fig. 130 (1880), an illustration is given of the cypress trees in the Buena Vista Garden at Verona. Cf. also Karsten and Schenck, *Vegetationsbilder*, iii. tt. 23, 24 (1906), for illustrations of this tree at Gardone on Lake Garda.

³ In *Gard. Chron.* iii. 48, fig. 11 (1875), the cypresses growing in the garden of the Seraglio at Constantinople are figured.

⁴ In Loudon, *Gard. Mag.* xv. 697 (1839), with a figure of the tree, reproduced from a drawing of it made on the spot by Lord Aberdeen.

⁵ Willkomm, *Forstliche Flora*, 246 (1887), who gives its height as 170 ft. and its girth as 36 ft.

⁶ In Loudon, *Gard. Mag.* xiv. 530 (1838).

⁷ Lord Aberdeen, *loc. cit.*

⁸ *Names of Herbes*, 32 (1548).

⁹ *Herball*, 1185 (1597).

Evelyn¹ says: "Within a few years past, reputed so tender, and so nice a plant, that it was cultivated with the greatest care, and to be found only among the curious, whereas now we see it in every garden, rising to as goodly a bulk and stature, as most which you shall see even in Italy itself; for such I remember to have seen once in his late Majesty's gardens at Theobald's before that Princely seat was demolished."

Evelyn and Boutcher both give instructions for raising the cypress from seed in the open ground, but the latter adds that as it is no uncommon thing for a hard winter to destroy whole beds of them, it is better to sow some seeds in pots.

I have always adopted the latter practice, and have raised many from seeds gathered in Rome, not planting out the seedlings till they are two years old, when they should be about a foot high. In good soil, if not exposed to severe frost, they then make rapid growth,² and will be fit to plant out at four years old, though they may be kept in the nursery longer, and successfully transplanted when 5 or 6 ft. high. The seeds will keep good for a very long period; and I have seen at Blackmoor, some trees which were raised from seed collected in the cemetery at Scutari by the present Lord Selborne in 1884. These seeds were sent by him to his father, who kept them in a drawer till 1895, when they were sown, and the young trees in April 1905 were from 10 to 15 ft. high. Though fruit is produced in most parts of England the seed does not always ripen, and I should prefer Italian or French grown seed. The tree should always be planted in well-drained soil, and in the warmest and best-sheltered position that can be found, as it does not thrive and is liable to be killed in severe winters in low-lying or damp situations. A great many trees of considerable size were killed during the severe winters of 1860-61 and 1879-80-81; almost all those in the north and in Scotland, of which Mr. Palmer obtained particulars, having succumbed during the latter period, whilst many old ones in warmer parts of England were injured.

REMARKABLE TREES

Among the finest cypresses that I have seen in England is one on the lawn at Heron Court (Plate 293), which in 1906 I found to be 60 ft. high by 5 ft. in girth.

At Enville Hall, Staffordshire, Henry measured one which in 1904 was 62 ft. by 9 ft.

In the garden at Langley Hall, Norwich, a tree raised from seed gathered in the Garden of Gethsemane in 1870 by Sir R. Beauchamp was 32 ft. high in 1905.

At Dropmore a tree is 42 ft. high by 5 ft. 9 in. at 3 ft. from the ground.

At Killerton some trees planted near the church about 1841 are from 50 to 60 ft. in height by 4 to 5 ft. in girth.

In the Palace gardens at Wells there is a very broad-topped tree in full vigour about 48 ft. high.

There is a remarkable old tree at Crowcombe Court, Somerset, of which one

¹ *Sylva*, 115 (1670).

² Kirchner, *op. cit.* 282, says that the growth on the Riviera of seedlings in the open is rather slow, averaging 12 to 16 in. high at six years old.

half fell down some years ago. The other half, which leans a good deal, is about 50 ft. high, with a clean bole 8 ft. in girth.

At Shedfield House, near Botley, Hants, the residence of Lady Phillimore, Sir Hugh Beevor measured a tree 57 ft. by 6 ft. in 1906. Prof. Phillimore, who has kindly sent a specimen branch and a photograph, says that this tree is believed to be 120 to 200 years old, and to have been planted about the same time as a plane standing near it, which measures 15 ft. in girth at the base.

At Barton, Bury St. Edmunds, there is a tree of the horizontal variety which was 46 ft. by 3 ft. 8 in. in 1904.

On the lawn at White Knights Park, Reading, Mr. A. B. Jackson measured in 1909 a tree 65 ft. high and 6 ft. 11 in. in girth.

In Wales, at Penrhyn Castle, there is a group of very fine trees, supposed to be only about fifty years planted, and of which the tallest tree in the centre in 1906 was 65 ft. high by only 2 ft. 10 in. in girth; another was 55 ft. by 4½ ft.; a third was 55 ft. by 3 ft. 2 in.

In Scotland I have seen no old trees, and but few young ones. A tree at Monreith raised by Sir H. Maxwell from seed gathered at Florence in 1878 was about 25 ft. high in 1906.

At Keir,¹ Perthshire, there are about forty trees of this species trained against the house, the largest of which is 29 ft. high and 21 in. in girth. A lithograph of the house made in 1858 shows that they were then about 10 ft. high.

In Ireland,² a tree at Kilruddery, near Bray, was 38 ft. by 5 ft. 5 in. in 1904; and another at Powerscourt was 36 ft. by 3 ft. 7 in. in 1909.

TIMBER

The timber³ is light brown in colour, hard, and close-grained, with very numerous fine medullary rays, and annual rings usually distinctly marked by a firm line. According to Mathieu,⁴ the wood is easy to work, and gives off a penetrating agreeable odour. It is very durable, lasts indefinitely under water, and longer than oak when used for vine-props. In France and Italy it is considered excellent for furniture; and the doors of St. Peter's at Rome, which lasted from the time of Constantine to that of Pope Eugene IV., nearly 1000 years, were said to be made of cypress.⁵ According to Madon⁶ it yields in Cyprus wood of the first quality for building.

It has been frequently stated that the Egyptians used this wood for mummy cases,⁷ but all the specimens in the Kew Museum have proved to be the wood of *Ficus Sycomorus*.

The large chests which are supposed to have been used for importing silk from

¹ The account of these trees in *Journ. Roy. Hort. Soc.* xiv. 531 (1892), is not accurate. We are indebted to the owner, Archibald Stirling, Esq., for the particulars given above.

² In *Gard. Chron.* 1868, p. 1289, a tree in the Bridgetown garden, Castlemartyr, was reported to be 60 ft. high and 13 ft. in girth in 1868; but neither Henry nor I saw this tree on our visits to Castlemartyr.

³ Gamble, *Indian Timbers*, 697 (1902).

⁴ *Flore Forestière*, 523 (1897).

⁵ Loudon, *Gard. Mag.* xv. 271 (1839). Cf. also *Gard. Chron.* 1843, p. 87.

⁶ *Cyprus Parly. Paper*, No. 366 of 1881, Encl. No. 2. Madon considers it to have been the shittim wood of Scripture, out of which the ark of the covenant was constructed; but Canon Tristram, *Fauna and Flora of Palestine*, 293 (1884), identifies shittim wood with *Acacia seyal*, Delile.

⁷ *Kew Bull.* 1909, pp. 74-6.

the Levant in early times, and which are usually ornamented with carving, and sometimes bear Greek lettering, are believed to be made of this wood. Shakespeare, in *The Taming of the Shrew*, II. i. 353, says:

In ivory coffers I have stuffed my crowns;
In cypress chests my arras counterpoints,
Costly apparel, tents, and canopies.

(H. J. E.)

CUPRESSUS TORULOSA, HIMALAYAN CYPRESS

Cupressus torulosa, Don, *Prodr. Fl. Nepal.* 55 (1825); Lambert, *Genus Pinus*, ii. 18 (1824); Loudon, *Arb. et Frut. Brit.* iv. 2478 (1838); Lawson, *Pinet. Brit.* ii. 201, t. 35 (1867); Hooker, *Fl. Brit. Ind.* v. 645 (1888); Masters, in *Journ. Linn. Soc. (Bot.)* xxxi. 335 (1896); Kent, Veitch's *Man. Conif.* 233 (1900); Gamble, *Indian Timbers*, 696 (1902); Collett, *Fl. Simlensis*, 483 (1902); Brandis, *Indian Trees*, 693 (1906).

Cupressus Tournefortii, Tenore, in *Mem. Soc. Ital. Sc. Modena*, xv. pt. 2, p. 194 (1855) (not Audibert).

Cupressus pendula, Hopf, in Regel, *Gartenflora*, iii. 279 (1854) (not Thunberg).

Cupressus majestica, Knight and Perry, *Syn. Conif.* 20 (1850).

Cupressus Corneyana, Knight and Perry, *Syn. Conif.* 20 (1850).

A tree, attaining in the Himalayas 150 ft. in height and 37 ft. in girth. Bark, $\frac{1}{2}$ in. thick, brown, peeling off in long, narrow fibrous strips. Branches horizontal or ascending, with pendulous tips, forming a broad pyramidal crown. Branchlet systems alternate, distichous, two- or three-pinnate, with the pinnæ disposed more or less in one plane. Ultimate branchlets often curved, tetragonal, equal-sided, $\frac{1}{2}$ in. in diameter. Leaves¹ uniform in four ranks, closely appressed, $\frac{1}{8}$ in. long, ovate, obtuse at the apex, convex on the back, and often with an obscure longitudinal glandular depression. Older branchlets reddish brown, not glaucous, terete, with the leaves completely deciduous in the fifth year.

Staminate flowers $\frac{1}{2}$ in. long, when open, with three to four anthers on each of the twelve to sixteen stamens. Cones, when young, green variously tinged with plum colour, ripening in October and November of the second year, often persistent after the fall of the seeds for one or two years longer; when mature, on short recurved stalks, globose or ellipsoidal, $\frac{1}{2}$ in. in diameter, dark reddish brown; scales, eight to ten, with the outer surface depressed in the centre and giving off a small triangular, rounded or acute, often recurved process. Seeds, six to eight on each scale, pale brown, $\frac{1}{8}$ in. long, flattened on one surface, convex and scarcely ridged on the other, with inconspicuous resin vesicles; wing rather broad, with a narrow translucent border. Cotyledons, three to five.²

¹ Hood, in *Gard. Chron.* 1847, p. 766, states that the foliage gives off a peculiar scent, noticeable on a windy day to leeward of the tree.

² Described by Hill and De Fraine, in *Ann. Bot.* xxii. 699 (1908).

We have not been able to distinguish, in England, var. *majestica*,¹ Carrière, *Conif.* 118 (1855); but the following variety is noteworthy:—

Var. *Corneyana*, Carrière, *Conif.* 151 (1867).

Cupressus Corneyana, Knight and Perry, *Syn. Conif.* 20 (1850).

Cupressus funebris, Koch,² *Dendrologie*, ii. pt. 2, p. 160 (1873) (not Endlicher).

Branches and branchlets pendulous. Branchlet systems irregularly arising at varying angles, and not so distichous as in the type, forming a more diffuse and not flattened mass of foliage. This variety was first put into commerce by Knight and Perry, who stated that: "It is not certain whence it has been introduced, but it is supposed to be a native of either Japan or the north of China," and acting on this belief they named it after Mr. Corney, a merchant in China, who occasionally sent seeds to their nursery at Chelsea; but they never affirmed that it was raised from Chinese or Japanese seed. Doubtless it originated in the Chelsea nursery, as it differs in no respect, except in habit, from the type; and *C. torulosa* is unknown in China and Japan.

DISTRIBUTION

This beautiful tree is a native of the outer ranges of the western Himalayas, from Chamba to Nepal, between 5500 and 9000 ft. elevation. It is rather local in its distribution, and usually grows on limestone. Brandis³ mentions several localities—small patches on the Ravi, parts of Kulu, limestone rocks of the Shali and Tika hills, near Simla;⁴ limestone hills of Lokandi and Moila, and below the Karamba peak in Jaunsar; on the Chinar peak below Naini Tal, where it is found exceptionally on clay slate, but near limestone. It also grows in the Bamsu valley in Tehri-Garhwal, attaining a considerable size. Webber⁵ says that it only grows on sunny slopes over 7000 ft. altitude in isolated localities, and mentions trees on the Chinar peak 150 ft. high with stems clean to near the top, the greatest girth that he measured being 37 ft. Gamble speaks of a tree at the Deota temple in the Tons valley, which is 154 ft. high and 22 ft. in girth.

This species reproduces well from seed, and seedlings are often found in the crevices of vertical precipices, as at Moila, producing trees which grow first outward and then straight up the rock. It succeeds, when planted, at low elevations, even in the plains of India, as at Calcutta, Dehra Dun, Saharanpur, and Chikalda in Berar. Young plants are often attacked by a fungus,⁶ *Gymnosporangium Cunninghamianum*, which occurs as a yellow gelatinous mass. (A. H.)

CULTIVATION

The first description of this tree was based by David Don, in 1825, on specimens collected by Buchanan-Hamilton, in Nepal, in 1802-3; and seeds were first

¹ *Cupressus majestica*, and also *Cupressus flagelliformis*, Knight and Perry, *Syn. Conif.* 20 (1850). A specimen of *C. majestica* cultivated at Montpellier is identical with typical *C. torulosa*.

² Both Gordon, *Pinet. Suppl.* 24 (1862), and Koch, *loc. cit.*, erroneously considered this variety to be the weeping cypress of China.

³ *Forest Flora N.W. India*, 533 (1874).

⁴ Collett, *Fl. Simlensis*, 483 (1902), says that it occurs at Simla, where it is known to the natives as deodar, on the road to the pumping station, and beyond the tunnel. On the north side of Mount Shali it grows at 8000 to 9000 ft.

⁵ *Forests of Upper India*, 42 (1902).

⁶ The alternate generation of this fungus occurs on the leaves of *Fyrus Fashia*. Cf. *Indian Forester*, xxv. 435.

sent to Europe by Dr. Wallich in 1824.¹ Though it has been planted at many places since that date, it has never become common in cultivation, and evidently requires, in order to succeed, a warmer climate than most parts of England afford.

Lawson quotes Palmer's tables to the effect that, in the winter of 1860-61, out of 52 specimens in England, 34 were killed, 9 much injured, 2 slightly injured, and only 7 unhurt. In Scotland and Ireland the results were very similar. Rarely, except in the south of England or near the sea, and in Ireland, where severe frosts have less effect, are trees of any size to be found.²

REMARKABLE TREES

The largest that we know of at present is in the grounds at Killerton, where there is a fine tree of about 65 ft. by 5 ft. 4 in., which when seen in 1905 was very thriving.

There is a fine avenue of *C. torulosa* at Cuffnells, near Lyndhurst, Hants (Plate 294), which, I am informed by Mr. Hargreaves, were raised from seed brought from India by Mr. C. Harland in 1860. This avenue consists of nine trees on each side of a walk, which are very regular in habit, and measure about 45 ft. by 4½ ft. They bore fruit in October 1907.

Mr. A. B. Jackson measured several trees in a plantation at Tregothnan, about 40 to 45 ft. by 3 ft., in 1909; and two trees at Pencarrow, which are 48 ft. by 4 ft. 8 in. and 35 ft. by 4 ft. 1 in. At Heanton-Satchville, North Devon, I measured, in 1905, a tree, about 45 ft. high and 3 ft. 5 in. in girth, dividing into three stems at 10 ft. from the ground, and forming a dense pyramid of foliage. At Haldon House, Exeter, a tree, which I saw in April 1908, measured 46 ft. At Melbury there is a tall fine tree of var. *Corneyana*, bearing fruit near the summit, which was 65 ft. by 4 ft. 11 in. in 1908.

At Eastnor Castle there is a tree 39 ft. high by 3 ft. 1 in. in girth, measured by Mr. Mullins in 1909. At Hewell Grange, Redditch, there are four trees of this species, the largest of which, measured by me in 1909, was 56 ft. high by 3 ft. 11 in. in girth. It is almost fastigiata in habit. These trees are growing at 530 ft. elevation, on sloping ground, exposed to the south-west. At Woburn there is a tree about 30 ft. in height; and Mr. J. M. Rogers has sent specimens from a tree at Riverhill, near Sevenoaks, about 40 ft. high.

In Ireland, the best specimen which we have seen is at Fota, and measured 56 ft. by 7 ft. in 1908. Another at Powerscourt is 27 ft. by 3 ft. 4 in.

In the nursery of Rovelli Frères, at Pallanza, I measured in 1906 a very

¹ Wallich sent seeds again in 1836; and Loudon, in *Gard. Mag.* xvi. 586 (1840), mentions a large stock of plants at Cullis's nursery at Leamington in 1840. Considerable quantities of seed of this cypress, as well as of the deodar, were imported in 1853 from the Himalayas by the Commissioners of Woods.

² According to *Gard. Chron.* 1868, pp. 152, 465, plants of *C. torulosa* were killed at Dropmore and Gunnersbury Park in the severe winter of 1867-68. According to *Kew Bulletin*, 1896, p. 8, the severe frost of 26th January to 22nd February 1895, when the thermometer fell at Kew on two occasions to 1° and 2° Fahr., proved fatal to *C. torulosa* and *C. lusitanica*, while *C. sempervirens* and *C. macrocarpa* were badly injured.

handsome tree, with stouter branchlets than usual, 80 ft. by 9 ft., which was bearing cones, and may be the variety described as var. *majestica*.

TIMBER

According to Gamble, the timber is even more durable¹ than that of the deodar, and is used for building temples and for sleepers, though not procured in sufficient quantity to have much commercial importance. The wood is also burned as incense in Hindu temples. It weighs from 34 to 44 lbs. per cubic foot. It is moderately hard and close-grained, with white sapwood, and light brown and very fragrant heartwood, which shows darker streaks. The annual rings are distinctly marked by a narrow dark-coloured belt, with resin-cells in lines near them, which are very numerous in old trees.

(H. J. E.)

CUPRESSUS CASHMERICANA

Cupressus cashmeriana, Royle,² ex Carrière, *Conif.* i. 161 (1867).

Cupressus funebris, Endlicher, var. *glauca*, Masters, *Kew Handlist Conif.* 37 (1896).

Cupressus torulosa, Don, var. *kashmiriana*, Kent, Veitch's *Man. Conif.* 234 (1900).

Juniperi sp.,³ Griffith, *Itin. Notes*, 100, No. 27 (1848).

A tree, the dimensions of which in the wild state are not known, but described by Griffith as small, extremely elegant, and with smooth bark. In cultivation narrowly pyramidal, with ascending branches, and very pendulous branchlets, the bark being divided into long narrow scaly ridges.

Branchlet systems long and pendulous, alternate, distichous, two- to three-pinnate, with the pinnæ disposed more or less in one plane. Ultimate branchlets compressed, tetragonal, ⅓ in. wide (not inclusive of the spreading leaves). Leaves glaucous blue, the lateral pair conduplicate, ridged on the back, the facial pair flattened with a longitudinal furrow, all four ranks about ⅓ in. long, decurrent in their basal half, with lanceolate acuminate spreading apices, tipped with a fine cartilaginous point. Older branchlets reddish brown, bare of leaves in the third or fourth year.

Cones, when young, greenish yellow, with a glaucous bloom confined to the prominent spreading umbos; ripening in the second year, when they become dark brown, almost blackish, ellipsoidal, nearly ½ in. in diameter when closed; scales ten,

¹ Experiments were made at Dehra Dun, with sleepers of various timbers, put down in 1881 and taken up in 1892, and the cypress wood was found to have resisted best of all. Cf. *Ind. Forest.* xix. 207.

² We are unaware of the reason why this species is ascribed to Royle, as no mention of it can be found in his published writings.

³ Griffith's description is as follows:—"Arbor parva elegantissima cortici levi. Ramulis pendulis foliis senioribus ferrugineo-brunneis, junioribus glaucis. Dewangiri near the faqueer's house." This locality is in Bhutan, and specimens labelled No. 27 are preserved at Kew and Cambridge. Mr. J. Claude White in *Sikkim and Bhutan* (London, 1909), speaks of an immense weeping cypress which he saw at Chalimaphe, and which measured 50 ft. in girth. He also speaks of fine forests of cypress at 8000 to 9000 ft. in Bhutan. I supposed that these might be the same as Griffith's tree; but am informed by Mr. W. C. Smith, curator of the Herbarium at Calcutta, that he can find no specimens of cypress in Mr. White's collection, and suspects that the tree in question may be a juniper.—(H. J. E.)

with a central depression and an acute triangular reflexed process. Seeds about ten on each scale, reddish or pale brown, $\frac{1}{8}$ to $\frac{1}{6}$ in., with narrow wings and scattered resin-vesicles.

This species, judging from the cones, which resemble those of *C. torulosa*, is possibly a form of that species with juvenile acicular foliage. A solitary example was seen in cultivation in Bhutan by Griffith. Hooker, who apparently did not distinguish this species from *C. funebris*, collected two specimens from cultivated trees in Sikkim. Carrière states that it was introduced into Europe from Tibet about 1862.

The only specimen which we know of in this country is the beautiful tree in the Temperate House at Kew, which is now about 30 ft. high, having recently been topped, as its summit had reached the roof.¹ It bears fruit abundantly, but no seed has been sown, and we do not know whether seedlings, if produced, would preserve the character of the parent tree. Messrs. Veitch tell us that it has not proved sufficiently hardy to be kept out of doors at Coombe Wood, and they have no plants at present. There is, however, a small tree doing well in the open air at Rostrevor House, near Newry.

(A. H.)

In Italy the finest specimen is growing in front of the villa on the Isola Madre in Lake Maggiore.² This is one of the most beautiful conifers that I have seen anywhere, and measured in November 1906, 60 ft. high by 6 ft. in girth, and covered an area 35 paces in circumference. It bore fruit near the top of the tree. Seedlings of this lovely species can be had from the nursery of Rovelli Frères at Pallanza.

(H. J. E.)

CUPRESSUS FUNEBRIS, CHINESE WEEPING CYPRESS

Cupressus funebris, Endlicher, *Syn. Conif.* 58 (1847); Planchon, in *Flore des Serres*, vi. 90 (1850); Lindley, in Paxton, *Fl. Gard.* i. 47 (1850); Hooker, *Fl. Brit. Ind.* v. 646 (1888); Masters in *Journ. Linn. Soc. (Bot.)* xxxi. 337 (1896), and xxvi. 540 (1902); Franchet, in *Journ. de Bot.* xiii. 263 (1899); Kent, Veitch's *Man. Conif.* 203 (1900); Diels, *Flora von Central-China*, 219 (1901); Brandis, *Indian Trees*, 694 (1906).

Cupressus pendula, Staunton,³ *Embassy to China of Earl Macartney*, ii. 525, pl. 41 (1798) (not Thunberg⁴); Lambert, *Genus Pinus*, ii. 124, t. 66 (1832); Loudon, *Arb. et Frut. Brit.* iv. 2479 (1838); Griffith, *Itin. Notes*, 131, 143 (1848).

Cupressus amœna, Koch, in *Monatssch. Garten- u. Pflanzkunde*, i. 110 (1873), and *Dendrologie*, ii. pt. 2, p. 164 (1873).

A tree, attaining in China 70 ft. in height and 2 ft. in diameter. Bark brown, smooth. Branches ascending and horizontal, ending in long pendulous reddish

¹ This tree was presented to Kew in 1894 by Mrs. Forster, Homewood, Chislehurst, who informs us that she had received it from the Rev. F. Murray, formerly Rector of Chislehurst. Its origin is unknown.

² Cf. Beissner in *Mitt. deut. dend. Ges.* 1906, p. 98.

³ Staunton's specimen, on which Lambert founded his description of this species, is preserved in the British Museum. It is identical with specimens collected by Fortune and by myself in China, and was collected near Lake Sihoo in Chekiang. The plate represents a view of the lake with a very pendulous cypress in the foreground, much more weeping in habit than any trees we have seen.

⁴ *Cupressus pendula*, Thunberg, *Fl. Jap.* 265 (1784), is *Thuja orientalis*, L., var. *pendula*, Masters.

brown terete slender branchlets. Branchlet systems alternate, distichous, bipinnate, with the pinnæ more or less in one plane. Ultimate branchlets compressed, $\frac{1}{20}$ in. wide, $\frac{1}{80}$ in. thick. Leaves of two kinds; lateral pairs conduplicate; facial pairs flattened, ovate, keeled or with a median furrow; all appressed, but with the mucronate apex free and slightly spreading, greyish green, not marked by whitish lines or streaks, about $\frac{1}{2}$ in. long.

Staminate flowers yellow, $\frac{1}{10}$ in. long; stamens about 8. Cones globose, $\frac{1}{3}$ to $\frac{1}{2}$ in. in diameter, on long slender often curved stalks, ripening in the second year and falling soon afterwards, dark brown covered with a plum-coloured bloom; scales eight, scarcely depressed in the centre from which arises a minute ovate usually appressed process. Seeds three to five on each scale, $\frac{1}{8}$ in., shining reddish brown, with scattered resin-vesicles and narrow wings. Cotyledons two.

This species is a native of central China, occurring in mountainous districts, at elevations usually below 3000 ft., in the provinces of Szechwan, Hupeh, Anhui, and Chekiang. It was discovered by Sir George Staunton, who was Secretary to Lord Macartney's embassy to China in 1793, in the Vale of Tombs,¹ near Lake Sihoo, in the Hangchow prefecture of Chekiang, where it was planted in quantity around the graves. Fortune² in 1848 found it common in the green tea district of Huichou in Anhui, growing in clumps on the sides of the hills, generally near villages or amongst graves. He afterwards saw it in great abundance in the mountains southwest of Ningpo, and at Nanche and Yenchou in the Chekiang province. Fortune also noticed it in cultivation at Shanghai.

It is common in the neighbourhood of Ichang, close to the Yangtze, in the centre of China, where I found it in 1884. Here it grows in valleys, often forming pure woods of considerable extent, which are the home of the Reeves' pheasant in this district.

According to Wilson,³ it is common from Ichang westward both in the immediate vicinity of the great river, and in the mountains north and south of it up to 3000 ft. altitude. He noticed it particularly in the Yangtze gorges between the Hsinlung rapid and Wanhsien. Here the temperature sometimes falls in winter below freezing point, and there are occasional heavy falls of snow, but the climate is excessively hot in summer, and wherever this cypress grows wild the orange can be cultivated to perfection. In Szechwan it was collected by Père Farges⁴ at 4000 ft. elevation in the Chengkou district, and by von Rosthorn in the Nanchwan district. Wilson describes its great utility for boat-building at Wanhsien. With the exception of a few cross-beams of oak, the river boats are built entirely of the timber of *C. funebris*. The wood is close-grained, and is much used in central and western China for house-building and general carpentry.

¹ This locality is erroneously stated by Lindley in *Gard. Chron.* 1849, p. 243, and by Kent, to be in northern China, where the tree is unknown, as the climate in winter is much too severe. The distribution as given by Masters in *Journ. Linn. Soc. (Bot.)* xxxviii. 202 (1908), also erroneously includes northern China and is much too extensive.

² Fortune, in *Gard. Chron.* 1850, p. 228, gives an account of his discovery of this tree. Cf. also his *Tea Countries*, 16, 61, 64, 107, 314, and fig. on p. 63 (1852), and *Residence among the Chinese*, 145, 177 (1857).

³ In *Gard. Chron.* xxxviii. 94 (1905).

⁴ Franchet, in *Journ. de Bot.* xiii. 263 (1899).

The tree, which has been known to the Chinese as *poh* or *peh* from the earliest times, was planted¹ by the founder of the Yin dynasty about the altars of the spirits of the land. In the *Ch'un Ts'iu Wei* (100 B.C.), the cypress was directed to be planted around the tumuli, where feudal princes were buried, the pine being reserved for the tombs of the emperors; while Koelreuteria and Sophora were planted around the graves of officials of various degrees, only the willow being allowed in the case of the common people.

This species is cultivated in the eastern Himalayas, in Nepal, Sikkim, and Bhutan,² at 4000 to 8000 ft., chiefly near temples and monasteries, and no doubt it was early introduced from western China by the Buddhist monks. Sir J. Hooker³ measured a tree in a temple at Doobdi, probably the oldest specimen in Sikkim, at 6470 ft. elevation, apparently 90 ft. high, and with a girth of 16½ ft. at 5 ft. from the ground. This tree was not pyramidal, as all the young trees were, but had spreading branches, those at the top being dead and broken.

According to Gamble⁴ it is a fine species, easy to grow, and in the Dhobijhora plantation near Kurseong, trees planted in 1866 had attained in 1899 a girth of over 4 ft. There are several specimens about Darjeeling, and a remarkably fine tree at the Tasingthong Monastery in British Bhutan.

The wood is moderately hard, close and even in the grain, light yellow, with the annual rays only visible in young trees, but with concentric bands of lighter and darker tissue. The medullary rays are very fine, close, and numerous. There are occasional resin-ducts and resin-cells.

Lambert thought that this species was introduced from south China by W. Kerr in 1804; but Loudon says "supposed to have been introduced in 1808, but respecting which we know nothing with certainty," and was in doubt as to whether a pendulous cypress at Chiswick, and another growing in the Kew Arboretum in 1838, were this species.⁵ Fortune⁶ sent cones to Standish in 1848, from which plants were raised at Bagshot. A further supply of seed was also forwarded from Huichou by Fortune in 1853. All the seedlings planted out at Kew⁷ were soon killed; and this species is not hardy,⁸ except in the south-west of England and in Ireland.

(A. H.)

This tree is rarely seen except in the south and west,⁸ and is too delicate to

¹ Bretschneider, *Bot. Sinicum*, ii. 336, 381 (1892). The name *poh* is also given to *Thuja orientalis*, *Juniperus chinensis*, and *Libocedrus macrolepis*.

² Griffith, *Itin. Notes*, 131, 143, found this tree in Bhutan at 6400 ft. often attaining 80 ft. in height. Anderson, in Eden, *Political Missions to Bootan*, Botany, 135 (1865), says it is cultivated much more frequently in Bhutan than in Sikkim, and at lower elevations, down to 2000 ft., while in Sikkim it is never found lower than 5000 ft.

³ *Himalayan Journals*, i. 316, 317, 336, fig. on 337 (1854).

⁴ *Indian Timbers*, 697 (1902).

⁵ J. Smith, *Records of Kew Gardens*, 290 (1880), says that a plant at Kew, 9 ft. high in 1864, and known as the "weeping cypress of China," was perfectly hardy, and had been introduced prior to Fortune's time. This is no longer living, and doubtless was a pendulous variety of *Thuja orientalis*.

⁶ Cf. Lindley, in *Gard. Chron.* 1849, p. 243, where it is erroneously stated that Fortune obtained the cones from a place 200 miles north of Shanghai. We have to understand here south-west of Shanghai, as Fortune collected this seed at Huichou, in Anhui. The most northerly point ever reached by Fortune was Soochow, lat. 31° 19'.

⁷ It is frequently seen in conservatories as a handsome pot plant, with slightly glaucous, juvenile acicular foliage. Some of the branchlets, however, usually display adult leaves of the normal form, and occasionally bear cones. This juvenile form is readily propagated by cuttings, and is often considered to be a juniper.

⁸ A tree in the park at Bath stood uninjured for twenty years, and was 20 ft. high in 1880 (*Gard. Chron.* xiv. 503 (1880)). It has succumbed since. At Linton, Kent, a tree was reported to be 16 ft. high in the same year.

stand out of doors in the colder parts of Britain. There are specimens in the temperate house at Kew.

At Haldon House, Exeter, there is a fine tree, 50 ft. by 6 ft. in 1908.

At Tortworth there is a healthy tree, about 35 ft. high in 1909, the origin of which, according to Lord Ducie, is unknown.

Trees about 30 ft. to 35 ft. high have also been observed at Killerton,¹ near Exeter; at Lamellan, Heligan, and Penjerrick in Cornwall; and at Osborne, Isle of Wight.

In Ireland, a tree at Powerscourt was found by Henry to be 30 ft. by 2 ft. 7 in. in 1906. There are also trees at Kilmacurragh and at Castlemartyr, which I saw in July 1908.

(H. J. E.)

CUPRESSUS MACROCARPA, MONTEREY CYPRESS

Cupressus macrocarpa, Hartweg, in *Journ. Hort. Soc.* ii. 187 (1847); Gordon, in *Journ. Hort. Soc.* iv. 296 (1849); Lawson, *Pinet. Brit.* ii. 195, t. 32 (1884); Engelmann, in Brewer and Watson, *Bot. Califor.* ii. 113 (1880); J. D. Hooker, in *Gard. Chron.* xxiii. 176, fig. 34 (1885); Sargent, in *Garden and Forest*, vii. 241 (1894), *Silva N. Amer.* x. 103, t. 525 (1896), and *Trees N. Amer.* 77 (1905); Masters, in *Journ. Linn. Soc. (Bot.)* xxxi. 342 (1896); Kent, Veitch's *Man. Conif.* 215 (1900); Mayr, *Fremdl. Wald- u. Parkbäume*, 286 (1906); Jepson, *Flora Calif.* 60 (1909).

Cupressus Lambertiana, Carrière, *Conif.* 124 (1855), and in *Rev. Hort.* 1855, p. 232.

Cupressus Hartwegii, Carrière, in *Rev. Hort.* 1855, p. 232, and *Conif.* 168 (1867).

Cupressus guadalupensis, S. Watson, in *Proc. Am. Acad.* xiv. 300 (1879).

Cupressus torulosa, Lindley, in Paxton, *Flower Garden*, i. 167, fig. 105 (1850), and in *Flore des Serres*, vii. 192 (1851) (not Don).

Cupressus Reinwardtii, Beissner, *Nadelholzkunde*, 103 (1891).

A tree, attaining at Monterey 70 ft. in height and 20 ft. in girth. Bark, about an inch thick, irregularly divided into broad flat connected ridges, separating on the surface into narrow elongated thick persistent scales, dark reddish brown on young stems, almost white on old and exposed trunks.

Branchlet systems alternate, spreading at various angles upwards and outwards, bi-pinnate, with the pinnæ not in one plane. Ultimate branchlets tetragonal, equal-sided, ½ in. in diameter. Leaves² uniform in four rows, appressed, 1½ in. long, ovate, obtuse at the apex, convex from side to side and swollen towards the tip, occasionally with a linear longitudinal furrow.

Staminate flowers yellow, ½ in. long; stamens, six to eight, each with an ovate connective bearing four or five dark-coloured anther cells. Pistillate flowers brownish, with reflexed thin-edged scales. Cones in the first year with prominent pyramidal scales, tipped with a mucro; ripening at the end of the second year, and persistent for many years afterwards on the branchlets; when mature, on stout, reddish brown scaly stalks, ellipsoidal, 1 in. to 1½ in. long, ¾ in. broad, shining reddish brown; scales usually ten, occasionally eight, twelve, or fourteen, with a central depression, overhung by an arcuate ridge-like thin-edged process. Seeds,

¹ Cultivated as *C. sinensis*.

² The foliage when rubbed emits an agreeable odour, resembling that of lemon.

about twenty on each scale, $\frac{1}{8}$ in. long, ridged, convex or angled on the two surfaces, which are marked with minute vesicles; wings broad, with a narrow, translucent border. Cotyledons,¹ three or four.

VARIETIES

In the wild state at Monterey, this species shows no variation, except the marked difference in habit due to age, young trees being narrowly pyramidal, while old trees assume a broad and flattened crown, resembling Lebanon cedars in their general appearance.

1. Var. *guadalupensis*, Masters, in *Journ. Linn. Soc. (Bot.)* xxxi. 343 (1896).

Cupressus guadalupensis, Watson, in *Proc. Amer. Acad.* xiv. 300 (1879), and Engelm. in Brewer and Watson, *Bot. Calif.* ii. 114 (1880).

This variety, growing on Guadalupe Island, differs slightly in the glaucous leaves and globose cones. Specimens of this variety growing at Montpellier show more slender branchlets and smaller leaves than typical *C. macrocarpa*. The foliage has a bluish tint. A young plant in the Temperate House at Kew is similar, but green in colour.

Under cultivation, the Monterey tree tends to assume two distinct habits, which are, however, connected by intermediate forms. Both have been found as seedlings in beds raised from the seeds of a single tree:—

2. Var. *fastigiata*,² Masters, *loc. cit.* Branches fastigate; tree narrowly pyramidal in form.

3. Var. *Lambertiana*,³ Masters, *loc. cit.* Branches spreading, the tree resembling when old a Lebanon cedar.

The following varieties⁴ have also arisen in the seed-bed:—

4. Var. *Crippsii*, Gordon, *Pinetum*, 93 (1875). A plumose or juvenile form, with short rigid branches, and leaves not appressed, but more or less spreading and sharp-pointed. This variety was raised in Cripps' nursery at Tunbridge Wells from an imported seed.

5. Var. *lutea*, Kent, Veitch's *Man. Coniferæ*, 215 (1900). Young shoots light yellow, turning green in the second year. Earl Annesley, *Beautiful Trees*, 57 (1903), figures this variety 21 ft. high, planted eight or nine years previously; and states that it is fastigate in habit, strikes easily from cuttings, and preserves its colour.

6. Var. *variegata*.⁵ Young branchlets irregularly blotched with white.

7. Var. *farallonensis*, Masters, in *Journ. Linn. Soc. (Bot.)* xxxi. 344 (1896). A peculiar form reported to exist on the Farallones Islands, near San Francisco.

¹ Described by Hill and De Fraine, in *Ann. Bot.* xxii. 702 (1908).

² Carrière states that the fastigate form is much less hardy than the other. This must have been an accidental peculiarity in a few trees noted by him.

³ This form is said to be obtained artificially by topping off the leading shoots of ordinary seedlings. The tops, if treated as cuttings and struck, assume also the flat-headed form. Such trees, obtained from cuttings, are said to be superior, when this species is used for a hedge or wind-break. Cf. *Gard. Chron.* xxvii. 44 (1900).

⁴ In *Gard. Chron.* 1872, p. 609, Messrs. Garraway, of Bristol, are said to have raised from seed a dwarf variety, 4 in. high at nine years old.

⁵ Lemaire, *Illust. Hort.* t. 587 (1869), and *Gard. Chron.* 1869, p. 1036.

Mr. Jepson writes to me that these islands are barren rocks without any woody vegetation. The specimens ascribed to this variety appear to be a form with glaucous foliage, which arose as a sport in the California University garden, and is unknown in cultivation in England.

DISTRIBUTION

This tree has a very restricted range¹ in the wild state, as it only occurs near Monterey in California, and on the island of Guadalupe, off the coast of Lower California. At Monterey, the main grove occupies an area along the sea-coast about two miles long and 200 yards wide, from Cypress Point to the shores of Carmel Bay. A smaller grove occurs on Point Lobos, the southern boundary of the bay. In this narrow area, which extends from the sea-cliffs inland to where the cypress begins to mingle with *Pinus radiata*, the trees are of different ages and appearance. When young and crowded, they have tall stems and narrow pyramidal crowns; older trees tend to stand wide apart and have flattened crowns, with far-spreading and gnarled stout branches. Plate 295 shows how different is the appearance of mature trees at Monterey from the young specimens which we see in this country.

Many of the trees at Monterey² are exposed to constant strong winds from the sea, which often prevent the development of branches on the windward side of the trunk, and cause many of the stems to lie almost prostrate on the ground. Near Monterey this cypress, in conjunction with *Pinus radiata*, is planted on the sand-dunes down to the margin of the breakers, so that the trees are often bathed in salt water, thrown up by large waves at high tide. Frost is almost unknown at Monterey,³ yet *C. macrocarpa* is cultivated on the Pacific coast, as far north as Oregon and Washington, where the winters are cold; and Mayr states that it thrives at Tokyo, where the thermometer often falls to 14° Fahr.

On the island of Guadalupe, this cypress is almost confined to the high central plateau, where it covers an area of two or three square miles. It is said by Dr. Franceschi⁴ to be very variable both in habit and in the size, shape, and colour of the cones.

(A. H.)

CULTIVATION

This species⁵ was cultivated in the Horticultural Society's Garden at Chiswick in 1838, from seeds of unknown origin presented by Lambert. Two or three years

¹ Cf. Sargent, in *Garden and Forest*, vii. 241, fig. 41 (1894), where the trees at Cypress Point are described and figured. Two photographs of the Monterey grove are also reproduced in *Gard. Chron.* xxii. 52, figs. 17, 18 (1897). Cf. also *The Garden*, xxx. 189, cum fig. (1886).

² Hickman, in *Erythea*, iv. 195 (1896), describes a miniature forest of this species at Monterey, consisting of trees scarcely a foot in height, yet bearing clusters of ripe fruit. In all probability these trees are *C. Goveniana*.

³ The climate at Monterey is described in our article on *Pinus radiata*, p. 1081.

⁴ *Zoe*, iv. 138 (1893).

⁵ Cf. Gordon, in *Journ. Hort. Soc.* iv. 296 (1849), and A. Murray, in *Garden*, i. 330 (1872). The date is wrongly given as 1831 by Kent, in Veitch's *Manual*.

afterwards plants were noticed in Low's nursery at Clapton, which had been raised from seed received from Fischer, Director of the St. Petersburg Botanic Garden, as a new species of cypress from California. Hartweg found the tree near Monterey in 1846, and sent home a further supply of seed.

Though the natural habitat of this tree is in a region where frost rarely occurs, yet its constitution is so robust that it thrives on dry soil in many inland districts where the thermometer descends to zero, and in the warmer and moister counties of the south and west has already attained as great a height as any recorded in its native country; but it cannot be called hardy¹ everywhere, as it is on heavy or wet soil liable to be severely cut by frost in winter and spring, especially in low-lying situations.

Its power of resisting strong gales from the sea, and its partiality for a maritime climate, make it a valuable tree for planting where shelter belts are required on the coast; and its rapid growth when young, coupled with its bushy habit, are additional points in its favour for this purpose.

Lawson's *Pinetum Britannicum* gives many particulars of its comparative hardiness in various parts of the country, and quotes statistics from Palmer's tables showing that in the severe winter of 1860-61 it was killed in 57 places, injured in 24, and unhurt in 27. Of the latter all those in the north are near the sea, but even as far north as the Orkney Islands it was said by Mr. Macdonald,² gardener at Balfour Castle, to be the most valuable of all the conifers, enduring the storms and saline winds without any signs of injury.

It seems indifferent to the nature of the soil in a well-drained situation, and grows well on limestone, sand, and peat.

It produces seed freely in this country, and is easy to raise from seed, growing faster when young than any other cypress, and attaining 6 to 10 in. in the first year's growth. It transplants without much risk in the spring or early autumn, and can be raised so cheaply and rapidly that there is every inducement to plant it more freely than has hitherto been done as an ornamental tree. But its timber seems to be so coarse and knotty as compared with that of other cypresses, that it is not likely to be of any economic value.

In habit it varies very much, and it is possible that by selection of seed from trees showing an upright and fastigate habit, varieties may be fixed in cultivation, which do not produce branches so freely as those commonly seen.

This cypress is one of the most valuable species for making hedges, good examples of which may be seen at Torquay.³ It bears clipping well, grows very fast, much faster than yew, and is of a lively green colour. It is said to be rarely attacked by rabbits,⁴ but I cannot say this from personal experience.

¹ According to *Gard. Chron.* 1868, p. 152, a tree planted at Gunnersbury Park in 1854, and which had attained 61 ft. in height, was destroyed by the severe frost of the winter 1867-68. In *Gard. Chron.* 1870, p. 249, it is stated that nearly all the specimens in the Thames valley were killed in 1860. This species was badly injured at Kew by the severe frost of February 1895. Cf. *Kew Bulletin*, 1896, p. 8.

² *Journ. Roy. Hort. Soc.* xiv. 526 (1892).

³ Cf. *Gard. Chron.* xxvi. 342 (1899). A hedge of this species, 10 ft. high and 400 yds. long, at Lofthouse, Torquay, which was planted in 1892, is illustrated in *The Garden*, lxvii. 358 (1905).

⁴ A. Gooden, in *Gard. Chron.* xxvi. 466 (1904), reports that four bullocks were killed at Burton Park, Petworth, it was supposed, through eating *C. macrocarpa*, but this is unconfirmed.

REMARKABLE TREES

Perhaps the largest tree¹ that I know of in England grows on an open hillside at Lamorran, on Lord Falmouth's property in Cornwall, and this in 1905 I found to be 86 ft. by 12½ ft. At the same place in a wilderness, which was once the garden of the late Hon. Rev. T. Boscawen, there are several trees almost if not quite as tall, with boles 8 to 9 ft. in girth, clear of branches up to about 20 ft.

At Enys, the seat of J. D. Enys, Esq., in the same county, there is a tree 80 ft. by 11 ft. 5 in., which he considered the finest in Cornwall; and at Carclew there is another 84 ft. by 11½ ft., which, however, has increased but little since 1891, when it was reported under the name of *C. Lambertiana* as 82 ft. high, and then the largest in England.² At Luscombe Castle there is a fine tree which Mr. Seaborne measured as 91 ft. by 14 ft. 2 in. in 1909. At Penrose, near Helston, a tree planted thirty-five years previously measured³ in 1894 80 ft. in height and 19 ft. in girth at 4 ft. from the ground, dividing above into six stems.

At Beauport, Sir A. Lamb showed me in 1905 a number of fine trees varying extremely in habit, of which Plate 296 shows one growing near his Araucaria grove, which spreads very widely and branches near the ground. At 3 ft. it is no less than 17 ft. in girth and about 64 ft. high. Another in an open part of the park is about 65 ft. by 14 ft., and of such an extremely dense bushy habit that a litter of fox cubs were bred in it at some distance from the ground. A third tree below the stables has a narrow fastigate habit, quite different from the others, and measures about 70 ft. by 9½ ft.

At Coolhurst near Horsham there is a fine timber-like tree about 70 ft. high by only 5 ft. in girth. Sir H. Maxwell has sent us a photograph of a tree at Wakehurst Place, Haywards Heath, which measured in 1907 70 ft. high and 9 ft. 8 in. in girth at 3 ft. from the ground.

At Brickendon Grange, Herts, which is 365 ft. above sea-level, with considerable cold in winter, yet little spring frost, there are numerous trees in an avenue averaging 65 ft. high and 5 ft. 2 in. in girth. Mr. Trotter, who presented a plank to the museum at Cambridge, considers the timber excellent, being very durable and strong, suitable for making wheelbarrows, carts, and rafters and beams in buildings; used for rails and posts in a fence, it has remained perfectly sound for fifteen years.

At Youngsbury, Ware, Herts, a tree planted in 1866 was 67 ft. by 8½ ft. in 1907. At Cobham, Kent, a tree measured in 1906 71 ft. by 9 ft. At Wexham Place, Stoke Poges, Bucks, there is a remarkable narrowly pyramidal tree, closely resembling the fastigate Mediterranean cypress in habit, which Mr. R. Woodward found to be 71 ft. in height and 5 ft. in girth.

At the Butlands, Burghley Park, Stamford, there is a fine specimen growing in

¹ Mr. H. Clinton-Baker made this tree 88 ft. by 13 ft. in 1909.

² *Journ. Roy. Hort. Soc.* xiv. 488 (1892).

³ *Gard. Chron.* xvi. 658 (1894).

a plantation, 75 ft. in height and 12 ft. 7 in. in girth at 3 ft. up, dividing above into three stems. At Wimpole, Cambridgeshire, a tree measured 68 ft. by 7 ft. 8 in. in 1909. At Fulmodestone, Norfolk, a tree planted in 1861 measured in 1903, according to Sir Hugh Beevor, 68 ft. by 6½ ft. At Orwell Park, on the coast of Suffolk, *C. macrocarpa* grows well, and is quite hardy, several trees being about 70 ft. high. In Northumberland, at Twizell, there is a good-sized tree of spreading habit.

Of the flat-topped and spreading variety *Lambertiana*, the best I have seen in England, is on the lawn at Cuffnells, near Lyndhurst, which in 1907 measured 75 ft. by 10 ft.; but this is not so typical as trees of much smaller size at Killerton, and at Coldrenick in Cornwall, the latter measuring in 1908 about 55 ft. by 7 ft., whilst a tree of the fastigate type growing close to it was about 70 ft. by 8 ft. In *Pinetum Britannicum* there is a coloured plate of a tree of this type, planted at Osborne in August 1846 by the Prince Consort, which in 1865 was of very regular and perfect shape, and 40 ft. high. Col. Kilkelly informs me that it now measures 78 ft., with a girth of 16 ft. at 3 ft. from the ground. It is perhaps the finest tree of its type in England. (Plate 298.)

In Wales this tree is quite at home all round the coast, the largest I have seen being a fine and spreading tree at Bodorgan, in Anglesea, which in 1906 was about 80 ft. by 11 ft. 4 in. At Stackpole Court there is a tree 72 ft. by 8½ ft.; but I have not noticed large trees anywhere in the interior of Wales, or in the English counties on the borders of Wales, where most conifers grow so well.

In Scotland it seems to thrive best in the south-west. The most remarkable tree I have seen is in the park at Poltalloch, which has the habit of a spreading Lebanon cedar, with small but very persistent cones. It measured in 1906 about 50 ft. by 11 ft. 9 in. Mr. Austin Mackenzie reports a considerable number of specimens at Carradale, Argyllshire, mostly flat-topped and like a Lebanon cedar in habit. The largest in 1906 was 50 ft. high and 9½ ft. in girth.

In Bute, on the Marquis of Bute's property, Mr. Kay reported in 1892 a splendid vigorous tree 57 ft. by 5 ft. 8 in., but I did not see it when I visited this place in 1906.

At Castle Kennedy large numbers were planted, and Mr. Fowler's account of this species in Lawson's *Pinetum Britannicum*, vol. ii. p. 197, is worth reading; but though it grows vigorously and has ripened seeds for many years, the soil is apparently too poor, or the exposure too great here to allow the tree to attain large dimensions, as I saw none worth measuring in 1906.

It is absent from all the Perthshire lists sent to the Conifer Conference, except that from Keir, where a tree was reported as 47 ft. by 4 ft. in 1891; and I saw a tree at Murthly which was nearly killed by the severe winter of 1895-96 when the thermometer went below zero. Though it survived some severe winters at Durriss and Gordon Castle, we have seen no tree of any size in other parts of Scotland.

In Ireland the Monterey cypress is at home in most parts, and there are numerous natural seedlings at Derreen in Kerry.

At Castlemartyr, Co. Cork, a tree measured in 1907 70 ft. by 9 ft. The finest tree, however, appears to be growing in a garden between Wicklow and Rathnew,

which Mr. A. C. Forbes found in 1908 to be 85 ft. in height and 14 ft. 3 in. in girth. At Hamwood, Co. Meath, there is also a splendid specimen, with a tall upright clean stem, which was planted in 1844, and measured in 1903 85 ft. by 10½ ft. There are fine specimens at Castlewellan,¹ Powerscourt, and Fota.

At Tykillen, Co. Wexford, the seat of Captain J. Walker, there is a large spreading tree (Plate 297) about 60 ft. by 11 ft., the branches covering an area 74 paces round; and at Adare, Co. Limerick, the seat of the Earl of Dunraven, there is another very densely branched and spreading tree of about the same dimensions. Mr. Bowles, the gardener here, told me that its seedlings did not preserve the habit of the parent tree, a circumstance which had been previously referred to in *Pinetum Britannicum*, ii. 196. (H. J. E.)

CUPRESSUS GOVENIANA, GOWEN'S CYPRESS

Cupressus Goveniana,² Gordon, in *Journ. Hort. Soc.* iv. 295, cum fig. (1849); Engelmann, in Brewer and Watson, *Bot. Califor.* ii. 114 (1880); Masters, in *Journ. Linn. Soc. (Bot.)* xxxi. 346 (1896); Sargent, *Silva N. Amer.* x. 107, t. 527 (1896), and *Trees N. Amer.* 79 (1905); Kent, Veitch's *Man. Conif.* 204 (1900).

Cupressus californica, Carrière, *Conif.* 127 (1855).

Cupressus attenuata, Gordon, *Pinetum*, 57 (1858).

Cupressus Sargentii, Jepson, *Flora Calif.* 61 (1909).

A tree attaining in California a maximum of 50 ft. in height and 2 ft. in diameter, usually considerably smaller, and often a small shrub. Bark about an inch thick, dark reddish brown, irregularly divided into narrow ridges, covered with thin persistent oblong scales. Small branches reddish brown, terete, and giving off alternate branchlet systems, which are tri-pinnate, short, with the pinnæ at varying angles and not in one plane; ultimate branchlets tetragonal, equal-sided, ¼ in. in diameter. Leaves in four equal ranks, ¼ to ⅓ in. long, ovate, appressed, acute and often mucronate at the apex, convex on the back, which is occasionally marked with a longitudinal depression.

Staminate flowers, ⅓ in. long, yellow. Cones ripening in the second season, and persistent for several years, on long stout stalks, globose, ½ to ¾ in. in diameter, dark purplish brown, shining; scales usually eight, occasionally six or ten, smooth, projecting and not depressed in the centre, which bears a prominent triangular, mucronate or rounded process. Seeds, ten to twelve on each scale, variable in size and colour, either (a) large, ⅓ to ⅔ in., brown, shining, marked with resin-vesicles on both sides, and with very narrow wings; or (b) small, ⅓ to ⅔ in., blackish.

Both in wild and cultivated specimens two forms of this species are readily distinguished: (a) the typical form described above, characterised by coarse

¹ Figured in *Flora and Sylva*, ii. 215 (1904), and in Earl Annesley, *Beautiful Trees*, 42 (1903).

² *Cupressus cornuta*, Carrière, in *Rev. Hort.* 1866, p. 250, fig. 32, with very irregular fruit, the upper scales of which bear long thick conical processes, described from a plant cultivated in the garden of M. Denis at Hyères, was considered by Carrière, *Conif.* 171 (1867), to be an abnormal variety of *C. goveniana*. We have not seen this plant.

branchlets and short branchlet systems, which give a rigid habit to the tree; and (b) the following variety:—

1. Var. *attenuata*, Carrière, *Conif.* 172 (1867).

Cupressus attenuata,¹ Gordon, *Pinetum*, 57 (1858).

Characterised by looser branching, with longer branchlet systems, and very slender ultimate branchlets, about $\frac{3}{16}$ in. in diameter. Leaves $\frac{1}{25}$ in., swollen towards the apex, which is tipped with a minute mucro. Two kinds of seed are produced, as in the typical form. This variety is said by Gordon to have been introduced by French collectors; but as seen in cultivation, it appears to be a seminal variety, and is commoner than the type.

2. Var. *pendula*.

Cupressus californica, Carrière, *Conif.* 127 (1855).

A shrub, pendulous in habit, with long and slender drooping branchlet systems, some of the branchlets being covered with spreading sharp-pointed leaves. This appears to be a transition form between the seedling and adult stages. A plant of this variety, cultivated under the name *C. californica*, Carrière, is growing in M. Allard's arboretum at Angers; and another specimen occurs at Kilmacurragh in Co. Wicklow.

The following is considered by Sargent to be a distinct species, but, so far as we can judge, the variation in the seed is sporadic, and depends upon unknown conditions, which should be studied in the field.

3. Var. *pygmaea*, Lemmon, *W. Amer. Cone-bearers*, 77 (1905).

Cupressus pygmaea, Sargent, in *Bot. Gaz.* xxxi. 239 (1901), *Silva N. Amer.* xiv. 95, t. 740 (1902), and *Trees N. Amer.* 79 (1905); Eastwood, *Trees of California*, 18 (1905).

Cupressus Goveniana, Jepson, *Flora Calif.* 60 (1909) (not Gordon).

A name given to trees bearing cones with small blackish seeds. This variety is prevalent near Monterey; and occupies a narrow belt in Mendocino County, California, beginning three-quarters of a mile from the ocean, and extending inland for about four miles from Ten Mile Run in the north to Navarro in the south. It is said to remain shrubby as a rule, producing fruit when only one or two feet high,² and grows commonly on poor soil, consisting of yellow clay covered with sand or peat; but it is admitted by Miss Eastwood to attain on good soil 30 or 40 ft. in height at fifty years old.

The typical form of *C. Goveniana* is rare and local,—apparently uncommon in the coast region of California, though it was found by Hartweg³ at Monterey,—and usually grows on dry mountain slopes, ascending in the cañons of the mountain ranges of the central part of the state to nearly 3000 ft. Jepson,⁴ who says it is a

¹ Erroneously identified with *C. Lawsoniana* by Masters in *Journ. Linn. Soc. (Bot.)* xxxi. 353 (1896).

² Cf. p. 1167, note 2.

³ Hartweg's specimen, No. 1971, in the Kew Herbarium, collected at Monterey, has large brown seeds, and is the type on which Gordon, who states that the seeds are brown, founded his description. Jepson, in *Flora California*, 60, 61 (1909) erroneously considers the form with small black seeds to be typical *C. Goveniana*; and on this account invents a new name, *C. Sargentii*, for the true *C. Goveniana* with large brown seeds. Both forms occur at Monterey, as Hartweg's specimen, No. 1979, preserved at the Cambridge Herbarium, was collected there and bears cones with small black seeds.

⁴ *Flora W. Mid. Calif.* 25 (1901).

shrub or small tree, 6 to 15 ft. high, gives as localities the Mayacamas Range, Mt. Tamalpais in Marin County, Cedar Mountain in Alameda County, and one or two stations in the Santa Cruz and Santa Lucia Mountains. According to Mayr,¹ it becomes a mere shrub on hot rocky precipices, but attains 50 ft. high on the banks of streams.

(A. H.)

This species was discovered² in 1846, growing near Monterey in company with *Pinus muricata*, by Hartweg, who sent home seeds to the Horticultural Society, from which plants were raised in the Chiswick Garden. It was named in compliment to J. R. Gowen, secretary of this Society at the time. It appears to be short-lived in this country, and has never become a popular or common tree; and is not now often to be found in nurseries.

The finest specimens we have seen are both on the property of J. B. Fortescue, Esq., one at Boconnoc in Cornwall, which measures 43 ft. high by 6 ft. 8 in. in girth, nearly as large as it grows in California; the other, at Dropmore (Plate 299), is 36 ft. by 5 ft. 6 in. Both of these are healthy and produce cones freely. At Luscombe Castle there is a good tree about 50 ft. by 4 ft. 4 in.

At Pencarrow, Cornwall, Mr. A. B. Jackson in 1909 measured a tree 38 ft. high and 9½ ft. in girth. Another at Heligan is 37 ft. by 3 ft. 4 in.

At Barton, near Bury St. Edmunds, Henry measured a tree in 1905 38 ft. by 2 ft. 6 in., which, according to Bunbury,³ was planted in 1862. It is now decaying. A healthy tree at Melbury, Dorchester, is 47 ft. by 4 ft.

A tree at Tortworth is 40 ft. high and 5 ft. 1 in. in girth. The Earl of Ducie informs us that the date of planting is uncertain, but it was recorded as 12½ ft. high in 1855. It seems to be failing, but may live a few years longer. Several plants have been raised from its seed. It withstood without injury the severe frosts of 1860 and 1895.

At Eastnor Castle a tree measured in 1909 37½ ft. high, girthing at 2 ft. from the ground 3 ft. 2 in. A tree in the Victoria Park, Bath, measured in 1909 46 ft. by 4 ft. 8 in. Mr. A. B. Jackson reports three healthy trees at Ponfield, Herts. A tree at Coldhayes, near East Liss, Hants, was measured by Mr. Gamble as 36 ft. by 6 ft. 2 in. at the base.

In Ireland, the best specimen is at Castlemartyr, which Henry found to be 48 ft. by 4 ft. 11 in. in 1907. Another at Fota measured, in 1903, 40 ft. by 4 ft. 4 in. A large bushy tree with many stems from the ground at Woodstock, Kilkenny, was about 40 ft. high in 1909. Webster⁴ mentions one at Churchill, Armagh, nearly 40 ft. high, growing on moist loam in an exposed situation.⁵

(H. J. E.)

¹ *Waldungen Nordamerika*, 272 (1890).

² Cf. Gordon, in *Journ. Hort. Soc.* iv. 295 (1849).

³ *Arboretum Notes*, 156. The tree at Barton is var. *pygmaea*.

⁴ In *Gard. Chron.* xx. 624 (1896). Cf. also Webster, *Hardy Conif. Trees*, 38 (1896).

⁵ While these pages were going finally through the press, I received specimens from Mr. Jepson, which shew that the trees of this species growing in Marin County and on Mt. Tamalpais bear larger cones than the type, with large reddish brown glaucous seeds. This form may be called var. *Sargentii*. Mr. Jepson's specimens shew various intermediate forms, one at least of which (from Monterey) is very probably a hybrid with *C. macrocarpa*.—(A. H.)

CUPRESSUS MACNABIANA, MACNAB'S CYPRESS

Cupressus Macnabiana, Murray, in *Edin. New Phil. Journ.* i. 293, t. 11 (1855); Lindley, in *Gard. Chron.* 420 (1855); Carrière, in *Rev. Hort.* 1870, p. 155; T. Moore, in *Florist and Pomologist*, 88, cum fig. (1874); Engelmann, in Brewer and Watson, *Bot. Califor.* ii. 114 (1880); Masters, in *Gard. Chron.* ix. 403, fig. 90 (1891), and in *Journ. Linn. Soc. (Bot.)* xxxi. 347 (1896); Sargent, *Silva N. Amer.* x. 109, t. 528 (1896), and *Trees N. Amer.* 80 (1905); Kent, Veitch's *Man. Conif.* 213 (1900); Jepson, *Flora W. Mid. California*, 25 (1901), and *Flora Calif.* 61 (1909); Eastwood, *Trees of California*, 18 (1905).
Cupressus nivalis, Lindley, in *Gard. Chron.* 1855, p. 421.
Cupressus glandulosa, Hooker, ex Gordon, *Pinetum*, 64 (1858).

Usually a shrub with several stems, 5 to 10 ft. in height, rarely a small wide-branching tree, attaining 40 ft. in height and 4 ft. in girth. Bark thin, reddish brown, separating on the surface into long thin persistent scales. Branches of the fourth and succeeding years smooth and purplish brown. Branchlet systems arising irregularly and spreading at varying angles, tri-pinnate, with the pinnæ not disposed in one plane. Ultimate branchlets short, tetragonal, compressed, $\frac{1}{20}$ to $\frac{1}{24}$ in. wide, and $\frac{1}{40}$ in. thick. Leaves $\frac{1}{20}$ in. long, appressed, ovate, thick, obtuse; lateral ranks conduplicate; facial ranks convex from side to side and somewhat flattened; all usually marked on the back with a circular glandular pit, often exuding resin. In native specimens, the foliage on the back and front is often covered with white streaks, and is said to be very fragrant.¹

Cones, ripening in the second year, erect on short stout stalks, globose, $\frac{1}{2}$ to $\frac{3}{4}$ in. in diameter, reddish brown, more or less covered with a glaucous bloom; scales usually six, rarely eight, with prominent processes, those on the lower scales thin and recurved, those on the upper scales thickened, conical, more or less incurved. Seeds numerous, ten to twelve on each scale, dark brown, $\frac{1}{8}$ in. long, with resin-vesicles; wings very narrow.

C. Bakerii, Jepson, *Fl. Calif.* 61 (1909), of which I have seen no specimens, appears to be a variety with small and very glaucous cones, the umbos of which are short, conical, and not incurved. It is said to be a small tree growing on lava beds in south-eastern Siskiyou and south-western Modoc counties.

C. Macnabiana is a native of California and is common in the hill country of eastern Napa County, from Samuel's Springs to Pope Valley, and extends northwards through Lake County to Red Mountain on the east side of Ukiah Valley in Mendocino County. It also occurs in Trinity County between Shasta and Whiskeytown. Carl Purdy² gives an interesting account of this species on Red Mountain, on the eastern slope of which it forms a pure forest about half a mile square, composed of old gnarled twisted trees, 12 to 20 ft. high, and covered with

¹ Miss Eastwood says that the fresh foliage has a delightful fragrance, somewhat like that of sandalwood with a flavour of pine-apple. Carrière, in *Rev. Hort.* 1870, p. 155, compares the odour to that of *pomme de Reimelle*, and says that branches cut and put in water purify the air of a room.

² In *Garden and Forest*, ix. 233 (1896), reproduced in *Gard. Chron.* xx. 65 (1896).

moss; while on the western side there is a dense thicket of cypress bushes, 6 to 8 ft. high in exposed situations and 15 ft. high in the gullies. Seedlings were observed in areas swept by fire; and a few seeds carried down the stream to the gravelly flats in the valley had produced a grove of handsome pyramidal specimens. Miss Eastwood¹ says that this cypress is more partial to the banks of streams than to dry slopes, and is often associated with *C. Goveniana*, though no hybrids have been observed. She mentions trees 30 to 40 ft. high between Hopland and Highland Springs, very unsymmetrical and loosely branching in habit. M'Lean found it on the road from Callistoga to the Etna mines, and Dr. Parry collected it at Chico, in Butte County.

This species was discovered by Jeffrey² in the Sierra Nevada in 1853, and was found soon afterwards in 1854 by W. Murray.³ Lobb sent seeds in the latter year to Messrs. Veitch, who raised young plants,⁴ remarkable, according to Lindley, for their glaucous green foliage and deep rich brown branchlets. They appear⁵ to have borne without injury the severe winter of 1860. This cypress appears to be short-lived,⁶ and having been neglected for many years, has almost gone out of cultivation, the best specimen we know being one at Highnam, 30 ft. high, forking near the ground, with the main stem 2 ft. 8 in. in girth at 18 in. from the base. This was bearing young and old cones and staminate flowers in February, 1910. A slender tree⁷ in Kew Gardens, with wide spreading branches is about 20 ft. high; and another⁸ at Brickendon Grange, Herts, 25 ft. high, and bearing fruit in 1909, is said to have been planted in 1860. There is also a small tree 15 ft. high at Bicton. Another about 8 ft. high, at Nymans, Handcross, was badly injured by frost last winter.

Elwes collected a specimen bearing fruit at Angers, France, in September, 1907. (A. H.)

¹ In *Zoe*, v. 11 (1900).

² Jeffrey's account of his specimen, taken from the advice note of his packet of plants sent in 1853, is: "Juniperus, No. 1481, Sierra Nevada mountains, growing in barren sandy places. Tree 15 ft. high, 1 ft. diameter, Oct. 1st, 1853."

³ In *Gard. Chron.* 1855, p. 420, the locality where Murray found the plant is said to be, "In California, about lat. 41°, at 5000 ft. elevation."

⁴ Lindley had described these young plants as *C. nivalis*, but was anticipated in his publication of this name by A. Murray's *C. Macnabiana*.

⁵ *Gard. Chron.* 1860, pp. 336, 362.

⁶ Those in the Botanic Gardens at Glasnevin and Edinburgh died many years ago. In the Kew herbarium there is a specimen dated 1878, from a tree 10 ft. high, growing at the upper end of the lake at Tortworth Court; but it is no longer living.

⁷ Obtained from Smith of Worcester in 1881.

⁸ Growing at the margin of a plantation. There were formerly two much finer specimens here, growing on the lawn, which were removed some years ago.

CUPRESSUS LUSITANICA, MEXICAN CYPRESS

- Cupressus lusitanica*, Miller, *Gard. Dict.* No. 3 (1768); Lambert, *Genus Pinus*, i. 95, t. 65 (1803); Loudon, *Arb. et Frut. Brit.* iv. 2477 (1838); Forbes, *Pin. Woburn.* 187, t. 62 (1840); Carrière, *Conif.* ii. 153 (1867); Masters, in *Journ. Roy. Hort. Soc.* xvii. 1 (1894), and *Journ. Linn. Soc. (Bot.)* xxxi. 331 (1896); Kent, *Veitch's Man. Conif.* 210 (1900).
- Cupressus pendula*, L'Héritier, *Stirp.* 15, t. 8 (1784) (not Thunberg).
- Cupressus glauca*, Lamarck, *Encycl.* ii. 243 (1786); Brotero, *Fl. Lusitania*, i. 216 (1804); Endlicher, *Syn. Conif.* 58 (1847); Dalzell and Gibson, *Bombay Flora, Suppl.* 83 (1861); Hooker, *Fl. Brit. Ind.* v. 645 (1888); Masters, in *Gard. Chron.* x. 761, fig. 110 (1891); Cooke, *Fl. Presid. Bombay*, ii. 666 (1907).
- Cupressus Coulteri*,¹ Forbes, *Pin. Woburn.* 190 (1839).
- Cupressus Lindleyi*, Klotzsch, in Endlicher, *Syn. Conif.* 59 (1847); Hemsley, in *Biol. Cent. Amer.* iii. 183 (1882).
- Cupressus Ehrenbergii*, Kunze, in *Linnaea*, xx. 16 (1847).
- Cupressus Karwinskyana*, Regel, in *Gartenflora*, vi. 346 (1857).
- Cupressus sinensis*,² Lee, ex Gordon, *Pinetum*, 63 (1858).
- Cupressus mexicana*,³ Koch, *Dendrologie*, ii. pt. 2, 159 (1873).

A tree, attaining in Mexico 100 ft. in height and 12 ft. in girth. Bark reddish brown, fissuring longitudinally into long thin brown strips. Branches widely spreading with pendulous branchlets. Branchlet systems alternate, not distichous, spreading at varying angles, bi-pinnate, with the pinnæ not disposed in one plane. Ultimate branchlets tetragonal, slightly compressed, $\frac{1}{16}$ in. wide, $\frac{1}{20}$ in. thick. Leaves nearly uniform in four ranks, $\frac{1}{16}$ in. long, appressed, but slightly free at the tips, ovate-acuminate, often mucronate, convex from side to side, occasionally marked with a depressed circular pit.

Staminate flowers yellowish, $\frac{1}{4}$ in. long; stamens about 20. Cones in the first year covered with a glaucous bloom, with the points of the scales spreading and reflexed; in the second year ripening and letting out the seeds, and remaining on the branches for about a year afterwards, globose, about $\frac{1}{2}$ in. in diameter, on straight long stalks, dark reddish brown, but covered with a glaucous bloom, whitish and thick in trees growing in Mexico, France, and Portugal, faint or absent in England and Ireland; scales eight, each with a central, usually prominent, triangular and reflexed process. Seeds eight to ten on each scale, $\frac{1}{8}$ in. long, brown, with conspicuous resin-vesicles; wing narrow with a translucent border.

¹ The plant described by Forbes in 1839 as *C. Coulteri* was raised from seeds taken from a cone, said to have been fifteen years old, in Coulter's herbarium. Loudon, *Encycl. Trees*, 1077 (1842) states that this plant was raised at Glasnevin in 1837; but as Coulter did not arrive in Mexico till 1834 there must be some error in the age ascribed to the seeds. A specimen in the Kew herbarium, dated 1878, from the tree at Glasnevin is *C. lusitanica*, and this tree is probably one of the rare Mexican cypresses which was destroyed by a storm in 1878, as Mr. F. W. Moore informs me. Further storms in 1883 and 1893 swept away the remaining Mexican trees at Glasnevin. Masters, in *Journ. Linn. Soc. (Bot.)* xxxi. 348 (1896) is in error in identifying the specimen of *C. Coulteri*, preserved at Kew, with *C. Macnabiana*.

² Specimens cultivated under this name at Tokai, near Cape Town, are *C. lusitanica*.

³ A tree cultivated under this name at Glasnevin, which was destroyed in 1878, is *C. lusitanica*, according to a branch preserved in the Kew herbarium.

VARIETIES

A careful examination of all the native material in the Kew herbarium and in Lindley's collection at Cambridge, together with a study of the numerous examples in cultivation in England, Ireland, France, Italy, and Portugal, show that there is only one species of *Cupressus* in Mexico, comprising two main forms, distinguishable by their habit of growth, and resembling in this respect *C. sempervirens* and *C. macrocarpa*. Pringle writes to me as follows: "After a score of years of vain endeavour to distinguish several species of *Cupressus* on the mountains of Mexico, it is gratifying to learn that you think it possible that there exists only one variable species there. The Mexican cypress, so far as I have seen, varies no more in all its characters than any one of the admitted species of Mexican pines. Consider its distribution through sixteen degrees of latitude and from 4000 to 10,000 ft. altitude, and its growth in widely different soils, from the richest humus to the poorest volcanic soil, infinitely varying conditions which tell effectively on the character of the species."

1. The typical form, which has been described above, and which is identical in every particular with the "cedar of Goa," long cultivated in Spain and Portugal, is distinguished by its wide-spreading branches and pendulous branchlets, the ultimate ramifications of which arise at varying angles and are not disposed in one plane. The other form, usually cultivated as *C. Knightiana*, is distinguished as follows:—

2. Var. *Benthami*, Carrière, *Conif.* 155 (1867).

Cupressus Benthami, Endlicher, *Syn. Conif.* 59 (1847); Hemsley, in *Biol. Cent. Amer.* iii. 183 (1883); Masters, in *Journ. Linn. Soc. (Bot.)* xxxi. 338 (1896); Kent, *Veitch's Man. Conif.* 201 (1900).

Cupressus thurifera, Schlechtendal, in *Linnaea*, xii. 493 (1838) (not Humboldt, Bonpland, and Kunth); Bentham, *Plant. Hartweg.* 57 (1840).

Cupressus Knightiana, Knight and Perry, *Syn. Conif.* 20 (1850); Carrière, *Conif.* i. 158 (1867).

Cupressus Udeana, Carrière, *Conif.* 129 (1855) (not Gordon).

Cupressus elegans,¹ Low, ex Koch, *Dendrologie*, ii. pt. 2, p. 156 (1873).

This variety usually forms a narrow pyramidal tree, with very regular branches. Branchlet systems and their pinnæ disposed in one plane. Ultimate branchlets more flattened and compressed than in the type, $\frac{1}{8}$ in. wide, $\frac{1}{32}$ in. thick. Leaves, lateral pair narrow, conduplicate, with acuminate free mucronate tips; facial pair flattened, ovate-acuminate; all usually marked with a central circular glandular depression. Bark, cones, and seeds, as in the type.

This variety occurs in the wild state in Mexico, and is represented in the Kew herbarium by specimens collected by Hartweg at Banco, by Bourgeau at Orizaba, and by Parry and Palmer at 6000 to 8000 ft. near San Luis Potosi, and is doubtless sporadic throughout the whole range of the species.

3. Var. *Skinneri*.

Cupressus Skinneri,² Carrière, *Conif.* 128 (1855).

Cupressus excelsa, Scott, ex Carrière, *Conif.* 128 (1855).

¹ This is referred to as a garden name for *C. Knightiana*, in Carrière, *Conif.* 127 (1855).

² Skinner was one of the partners in the firm of Klee, Skinner, and Co., in Guatemala, and was much interested in natural history. Cf. Koch, *Dendrologie*, ii. pt. 2, 157 (1873).

This cypress which occurs in Guatemala, where it was collected¹ by Donnell-Smith at 5000 ft. altitude, does not differ from var. *Benthani* in botanical characters, but is perhaps more tender in cultivation. The late Lord Annesley raised some plants from seeds imported from Guatemala, one of which succumbed at Castlewellan to the frost of April 1908. Another plant given to Canon Ellacombe in 1897, is, however, thriving at Bitton and has attained 14 ft. in height.

4. Var. *glauca*. Specimens with very bluish glaucous foliage from Monserrat in Portugal may provisionally be distinguished by this varietal name. The leaves show usually the dorsal resin-gland, which is characteristic of *C. arizonica*, and afford evidence that the latter species is only a geographical form of *C. lusitanica*.

DISTRIBUTION

This species is widely distributed in Mexico,² and extends into the high mountains of Guatemala. According to Pringle it is found at altitudes between 4000 and 10,000 ft., usually growing in the neighbourhood of mountain streams, and on moist slopes. It rarely forms a forest to the exclusion of other species, and even when crowded generally branches from near the ground. Pringle speaks, however, of a small wood straggling along brooks for a mile or more on the mountains overlooking the valley of Mexico on the south, the trees showing great variation in foliage and mode of branching. This species attains its largest size, 2 to 4 ft. in diameter, in damp volcanic soil on the plains at the base of the mountains, as near the city of Mexico. It is also generally planted in the towns of the southern tablelands. (A. H.)

The only place where I remember to have seen this beautiful tree in Mexico was in a grove of planted trees in the so-called "Sacro monte" at Amecameca, a village on the lower slopes of the great volcano of Popocatepetl, at an elevation of nearly 8000 ft. Here it was a picturesque tree with buttressed trunks 5 or 6 feet in diameter, and clothed with pendulous branches, which in many places were covered with *Tillandsia* and other epiphytes. Many of the trees were dying at the tops and seemed of great age. A good illustration of these trees is given under the name *C. Benthani* by Karsten and Schenck.³ The vegetation and climate of this region is subtropical, and, though very dry at the season when I was there, has a long rainy season, and, as far as I could learn, little frost or snow.

HISTORY

So far as I know, no account has been written in English of the forest of Bussaco, in Portugal, which is celebrated as the home of the tree called *Cupressus lusitanica*, Miller, by botanists, and popularly known as the cypress or cedar of Goa. An attempt to decide the origin of this tree was made by the late Dr.

¹ Heyde and Lux also gathered specimens of *C. lusitanica* in the Santa Rosa department of Guatemala at 4000 feet altitude in 1892.

² Hartweg collected both the typical form and var. *Benthani* in Mexico in 1839.

³ *Vegetationsbilder*, ii. t. 16 (1905).

Masters in the *Journal of the Royal Horticultural Society*, xvii. 1-11 (1894); but I cannot accept his conclusion that *C. sempervirens*, *C. torulosa*, and *C. lusitanica* may have all arisen from a common stock, and at a relatively not very remote period. All the trees that I have seen of *C. sempervirens* in England, Portugal, and other countries are of a very different habit, at all stages and under all conditions of growth. The same applies to *C. torulosa*.

Dr. Goeze's statement in his letter to Dr. Masters that the old monks' chronicles gave the Azores¹ as the native country of the tree is not supported by any historical or botanical evidence. I prefer to believe that it is of Mexican origin, as a careful comparison of numerous Portuguese and Irish specimens with native specimens of *Cupressus Lindleyi* from Mexico shows that Carrière and Koch² were correct in identifying *C. lusitanica* with that species. The tree may as easily have been introduced by Spanish friars³ from Mexico as by Portuguese monks from Goa,⁴ though we cannot now discover by whom and when; and as the real origin seems lost in antiquity, and the tree has for at least three centuries been naturalised in Portugal, the name of *C. lusitanica*⁵ is not inappropriate.

I visited Portugal in April 1909, mainly with the object of studying on the spot the cypress and the oaks of Portugal, which are extremely variable and interesting. Professor Henriques, of Coimbra, was good enough to accompany me to Bussaco, which is reached by a short railway journey from Coimbra to Luzo; whence a drive of two miles brings one through the village to the entrance of the Royal domain, which was formerly the property of a Trappist monastery; on the site of which a large and beautiful hotel has been erected. The forest is surrounded by a wall about three miles long, and appears to be a virgin forest in which have been planted at various times, but mainly forty to fifty years ago by Rodrigo de Moraes Soares, an immense variety of exotic trees. The old monks appear to have planted the cypresses at first round the monastery, and later at many points

¹ In the Azores large logs of a coniferous timber are frequently found deeply buried under volcanic debris. A block of this wood, presented to the Kew Museum by Dr. Goeze, and supposed by Dr. Masters to be *Cupressus sempervirens* or *C. lusitanica*, has recently been examined at the Jodrell laboratory by Mr. Boodle, and proves to be that of a juniper, and is probably *Juniperus brevifolia*, Parlatores, a tree still common on the Azores. There are not any grounds for supposing that *C. lusitanica* ever inhabited the Azores. Cf. *Gard. Chron.* 1867, p. 929; Kent, Veitch's *Man. Conif.* 180 (1900); and Trelease, *Missouri Bot. Gard. Rep.* viii. 169 (1897).—(A. H.)

² Koch, *Dendrologie*, ii. pt. 2, p. 155 (1873), who describes the Mexican native species under the name *C. Coulteri*, Forbes, and *C. lusitanica* under the name *C. pendula*, L'Héritier, states that the former is probably the wild form of the latter, and adds that it is often impossible to distinguish one from the other.—(A. H.)

³ *C. lusitanica* is common in cultivation in southern Spain, and there is a specimen at Kew labelled Los Martyres Monastery, Granada City. According to Willkomm and Lange, *Prod. Fl. Hispan.* i. 21 (1861), Guira found it apparently wild in Torre de Guil, at the base of the Sierra de Carrascoy, in Murcia.—(A. H.)

⁴ The tree is unknown at Goa, and there is not a single specimen from any part of India in the Kew herbarium. Dalzell and Gibson, *Bombay Flora, Suppl.* 83 (1861), say: "Now common in gardens, native and European, does not succeed below the Ghauts, and above only where the soil is deep and rich. The healthiest appears to be those planted in front of Sir Jamsetjee's bungalow in Poona, but they are young and have their trials to go through." Gammie wrote from Poona, 17th July 1903: "Said never to fruit in the Bombay Presidency. This is the result of repeated inquiries on my part. It is by no means common in Poona now, as many plants were killed in the drought of 1899-1900." Brandis, *Forest Flora*, 534, and Hooker, *Fl. Brit. India*, v. 645, are apparently in error in stating that the tree is extensively cultivated in the western Ghats. No one, in any case, has ever seen old trees in India.

Hutchins, in *Gard. Chron.* xxxvi. 275 (1904) and xxxvii. 219 (1905), reports that he cultivated *C. lusitanica*, *C. sinensis*, and *C. torulosa*, so-called, at Tokai, near Cape Town, and concluded that the two former were cultivated varieties of *C. torulosa*. Hutchins kindly sent us copious specimens of the three forms, which he had in cultivation, and they are all *C. lusitanica*. He had not obtained true plants of *C. torulosa*.—(A. H.)

⁵ *C. lusitanica* is the oldest name of the species, and is adopted by us on that account.—(A. H.)

along the roads and paths which lead to the nine entrances to the forest, but always singly or in lines, apparently for ornament alone. The oldest of these trees are still, with one or two exceptions, quite sound, and although difficult to measure on account of their being crowded by other trees, I was able to make the following measurements:—

1. A tree near the hotel, just below the road leading to the Coimbra gate, about 110 ft. by 11 ft. 2 in., with a clean bole about 40 ft. high.
2. A tree which M. Lacerda, the director of the domain, considers the largest of all, is 85 to 90 ft. high, with a bole of 30 ft., 15 ft. 10 in. in girth, and situated just below the small chapel of San José.
3. A little above this is a tree, perhaps 100 ft. high or possibly more, with a straight clean bole 66 ft. by 12 ft. 8 in.
4. Above the avenue of Mosteiro a very tall fine tree, possibly taller than No. 1, but I could not measure it.
5. A little way down towards the water-staircase a very large hollow tree, the only one which seems to be decayed, measured 15 ft. 10 in. in girth.

There is much variation in the form and habit of this cypress according to the situation; it seems capable of growing in fairly dense shade, and when crowded by other trees cleans its trunk well. Some fine young trees, said to be about fifty years old, in the deep moist hollow called the Valle dos Abietos, measured about 90 ft. high by 4 to 5 ft. in girth, and were clean to half their height. I have no doubt that these, in the course of another fifty years or so, will attain a greater height than any of the old ones, and may eventually equal, if not surpass, the splendid young silver firs which are growing in the same valley; whose seedlings come up as thickly and evenly as I have ever seen them do in their native country. The cypress, though it sows itself freely, requires more light when young, and reproduces best where a shallow bed of leaf-mould is partially exposed to the sun. In such places I found plenty of seedlings which seemed to have an excellent root system, and I was able to transplant some of them to the garden of Baron Soutelinho (Mr. A. Tait), of Oporto, and to send some small ones home by post.

Owing to the kindness of Senhor Lacerda I have received a fine plank and section of the wood, cut from a tree which shows 160 annual rings on a radius of 18 in.; it appears to be very similar to the wood of *Cupressus sempervirens*. This account¹ has been read by Prof. Henriques, who informs me that the mountain of Bussaco is on the inferior Silurian formation. With regard to the date of its introduction, he says that it must certainly have existed before 1634, when it was mentioned in a poem called *Soledades de Bussaco*. When the mountain was acquired by the Trappists from the monks of Vacarica in 1626, there was already a great variety of trees, forming a dense forest. The chapel of San José, near which the largest tree grows, was founded in 1644, and the *Chronicles of the Carmelite* (cap. xx. p. 110), published in 1721, speaking of this chapel, says that near it is found the first cypress, progenitor of all the others in the forest. In 1689 Tourne-

¹ M. Jacques L. de Vilmorin, in *Bull. Soc. Deud. France*, 1907, p. 49, gives an interesting account of the forest of Bussaco, which he visited in 1906.

fort, in the original manuscript of his *Voyage en Portugal*, which is now in Prof. Henriques' possession, describes the species as follows: *Cupressus lusitanica*, patula, fructu minori.

I saw this cypress growing at many other places in Portugal, but nowhere very large, except in the beautiful garden of Monserrat, formerly the property of Mr. Beckford, but purchased in 1855 by Sir Francis Cook, whose son, the present Sir Frederick Cook (Viscount Monserrate in Portugal), keeps up this unique place with the greatest care. The oldest cypresses here seem to have been planted something like a century ago, and are extremely varied in habit, as well as in the size, shape, and colour of their fruit. The tallest, in a low sheltered valley north of the house, was blown down a year ago, and measured 3 ft. 5 in. in diameter on the stump. It is said to have been taller than two trees still standing in the same place, one of which is from 105 to 110 ft. high by 10 ft. 5 in. in girth, the other being about 90 ft. by 12½ ft. In the Mexican garden there is an old tree about 70 ft. high, with a flat umbrella-shaped top and a trunk clean to about 50 ft.; several others on the slope just below the house are extremely unlike this in habit, having spreading branches down to the ground profusely covered with old cones, some of which were persistent on branches twenty to thirty years old. Some of these trees were very glaucous in colour, and had longer fruit with larger protuberances. The fruit was much more abundant on these comparatively young and spreading trees than on the tall old ones, and seed was escaping from the cones in the middle of April. Some trees were so covered with male flowers as to give them a yellow appearance, and these bore comparatively few cones.

INTRODUCTION

This tree was in cultivation¹ in 1682 in the Chelsea and Fulham gardens and at Badminton, and was probably introduced from Portugal a short time previously. Miller, writing² in 1768, says that it was then rare in English gardens, and mentions large trees that had been killed by the frost of 1740 and 1762. It was probably re-introduced during the Peninsular War, when many officers must have seen this species at Bussaco; and Loudon³ states as a fact that Lord Ferrard brought seeds to Ireland in 1809, which produced many plants. Plants were raised⁴ at Glasnevin in 1837 from seeds obtained from Coulter's Mexican specimens; and in all probability Hartweg sent seeds from Mexico in 1840 to 1843.

Var. *Benthami* was introduced, according to Loudon,⁵ under the name *C. thurifera*, in 1838, when there was a plant a few inches high in the Horticultural Society's garden at Chiswick. In 1843, a plant⁶ 7 ft. high was growing in Lucombe, Pince, and Co.'s nursery at Exeter. Uhde,⁷ who was Prussian Consul at Matamoras, in Mexico, also sent seeds soon afterwards to Berlin, the plants from which were known as *C. Uhdeana*. This variety was sent out under the name *C. Knightiana*

¹ Cf. Masters, in *Journ. Roy. Hort. Soc.* xvii. 5 (1894). It is mentioned by Ray, *Hist. Plant.* ii. 1414, 1798, 1916 (1688).

² *Dict.* ed. 8, No. 3 (1768).

³ Loudon, *Trees and Shrubs*, 1077 (1842).

⁴ *Gard. Mag.* xix. 36 (1843).

⁵ *Arb. et Frut. Brit.* i. 109 (1838).

⁶ Loudon, *Arb. et Frut. Brit.* iv. 2480 (1838).

⁷ Cf. Koch, *Deutrologie*, ii. pt. 2, p. 154 (1873).

by Knight and Perry, who stated¹ their ignorance of its origin in 1850; but in all probability their plants were raised from seed sent by Hartweg.

REMARKABLE TREES

In England² we know of no trees which can be certainly distinguished as of Portuguese origin.

There is a fine one at Hemsted Park, Cranbrook, which measured 50 ft. by 10 ft. in 1905, and seems to be a very old tree (Plate 300). At Westonbirt there are two good trees, about 50 ft. high, somewhat differing in habit, one with rather wide-spreading branches, which was bearing cones in 1909; the other, a narrow pyramidal tree, was without fruit in that year. At Luscombe Castle, Dawlish, a tree, which I saw in 1908, was about 50 ft. by 5 ft. There are several trees in Cornwall, which Mr. A. B. Jackson measured in 1909; at Heligan, a good specimen, 40 ft. by 6 ft. 8 in.; and at Glendurgan, two trees, the larger, 40 ft. by 4 ft. 11 in. There are smaller ones at Liphook, and at Grayswood, Haslemere. This species is not hardy at Barton,³ Suffolk, where all the specimens were killed in the winter of 1860-61.

In Ireland this species thrives at several places. The finest,⁴ perhaps, is at Woodstock, and in 1909 measured about 57 ft. by 10½ ft., dividing low down into six large stems, and bearing many new and old cones. The forester informed me that 23° of frost had been registered here.

Loudon records a tree at Oriel Temple, Co. Louth, now the seat of Lord Masserene, which was 32 ft. high in 1834, and had been raised, as stated above, from seed brought from Portugal by Lord Ferrard in 1809. I visited this place in July 1908, and found no less than three large trees, which may be of the same age. The first is a stunted tree, with a wide-spreading crown 19 yards in diameter, and a short trunk only 4 ft. high and 7 ft. 7 in. in girth. It was covered with new fruit, while those of the preceding year remained, and contained plenty of ripe seed. The second is a much finer tree (Plate 301), about 40 ft. high, with spreading branches and a straight trunk 8 ft. 1 in. in girth and about 20 ft. high. The third is forked near the ground, where it is 7 ft. 9 in. in girth, and it is about 40 ft. high, with wide-spreading branches.

A tree at Kilmacurragh, which is probably of the same age and origin, is 48 ft. by 8 ft., with a bole of 10 ft. high. From it a cutting was struck many years ago (as I was informed by Mr. Moore, of Glasnevin) which has now grown into a fine tree, and had abundance of new and old fruit containing ripe seeds.

There is a tree⁵ at Rostrevor House probably of the same origin as those at Oriel Temple. At Fota there is a fine specimen, cultivated under the name

¹ *Syn. Conif.* 19 (1850).

² We have seen no trees in Scotland. The specimen at Rosdhu, Dumbartonshire, reported in *Journ. Roy. Hort. Soc.* xiv. 507 (1892), was incorrectly named, and is *C. Lawsoniana*. Cf. Masters, in *Journ. Roy. Hort. Soc.* xvii. 1, note (1894).

³ Bunbury, *Arboretum Notes*, 155.

⁴ This tree measured at 2 ft. from the ground 3 ft. 9 in. in 1825, 4 ft. 8 in. in 1834, 6 ft. 8 in. in 1854, and 6 ft. 8½ in. in 1860.

⁵ A much larger tree than the one now standing at Rostrevor was blown down in 1903.

C. Macnabiana, which was 55 ft. by 6 ft. 3 in. in 1907. There is also a fine tree in the old deer park, Castlemartyr, about 60 ft. high, which Henry saw in 1907. At Birr Castle, King's County, the Earl of Rosse informs us that there is an old tree, 8 ft. in girth at 2 ft. from the ground, and dividing above this into many stems.

In England we have distinguished as belonging to var. *Benthami* a tree at Lamorran, Cornwall, which Mr. A. B. Jackson measured as 49 ft. high in 1909.

At Culver, Exeter, a tree, raised from seed brought by Mr. Byrom from the south of France in 1879, measured, in 1909, 35 ft. high, and 7 ft. in girth close to the ground.

In a sheltered dell at Bicton, there is a tree—No. 286 in the Bicton MS. catalogue—of var. *Benthami*, which, though the main stem is broken off some distance from the ground, measured, in 1906, 56 ft. in height, and 12½ ft. in girth at the base. There are two tall trees, close to it, of which No. 290 is typical *C. lusitanica*, and No. 274 is *C. torulosa*. No. 283 in the same dell, a tall narrow tree, labelled *C. religiosa*, and 55 ft. by 7 ft. in 1909, is *C. lusitanica*, var. *Benthami*. There was formerly a tree of var. *Benthami* growing near the Rhododendron dell at Kew, which was cut down about twelve years ago. A specimen preserved in the Arboretum herbarium shows that it produced fruit freely.

In Ireland the largest tree of this variety grows on Fota Island (Plate 302), and measured no less than 75 ft. high by 7 ft. 4 in. in girth in 1908. Lord Barrymore informs us that his beautiful specimens of *Abies religiosa* and *Pinus patula* were sent by J. Knight in 1844, and planted in 1847. He suspects that this tree, long known under the name *C. Lindleyana*,¹ was of the same origin. There is another of similar habit at Woodstock which in 1909 was 57 ft. by 6 ft. 3 in.

In the nursery of Rovelli Frères at Pallanza, there is a fine specimen of typical *C. lusitanica*, 50 ft. by 6 ft. 8 in. in 1909, which is erroneously labelled *Cupressus sp.*, *Hills of India*.² Var. *Benthami* is represented by several large trees, which are named incorrectly *C. elegans* and *C. Hügelii*. (H. J. E.)

CUPRESSUS ARIZONICA

Cupressus arizonica, Greene, in *Bull. Torrey Bot. Club*, ix. 64 (1882); Rusby, in *Bull. Torrey Bot. Club*, ix. 79 (1882); Masters, in *Gard. Chron.* x. 364 (1891); Sargent, *Silva N. Amer.* x. 105, t. 526 (1896), and *Trees N. Amer.* 78 (1905); De Wildeman, *Icon. Hort. Thén.* iv. 111, t. 145 (1903); Purpus, in *Mitt. deut. dend. Ges.* 1904, p. 50, t. iv.; Eastwood, *Trees of California*, 17 (1905).

Cupressus guadalupensis, Sargent, *Tenth Census Report, U.S. Forest Trees N. Amer.* 180 (1884) (not Watson).

Cupressus Benthami, Endlicher, var. *arizonica*, Masters, *Kew Hand-list Coniferae*, 37 (1896), and in *Journ. Linn. Soc. (Bot.)* xxxi. 340 (1896).

A tree attaining in Arizona a height of 70 ft. and a girth of 12 ft. Bark reddish brown, separating on the surface into long shreds, which are about 1 in. or

¹ This name goes to show that Knight and Perry raised from Mexican seed both the type *C. lusitanica* (*C. Lindleyi*) and the variety *C. Benthami* (*C. Knightiana*).

² This is erroneously referred to it in *Mitt. deut. dend. Ges.* 1906, p. 98, as a juvenile form of *C. torulosa*. The small plants at Pallanza, labelled "*Cupressus* from Kumaon," are very glaucous, and may be a form of *C. lusitanica*; but are too young to be accurately determined. I have raised plants, which have hitherto proved hardy at Colesborne.

2 in. wide, and often persist for many years. Branchlets of the third year purplish brown, terete, smooth, and often covered with a glaucous bloom. Branchlet systems irregularly disposed at varying angles, bi-pinnate, with the pinnæ not in one plane. Ultimate branchlets tetragonal, equal-sided, $\frac{1}{20}$ in. in diameter. Leaves light green or conspicuously glaucous, uniform in four ranks, appressed, marked with a glandular pit on the back exuding resin, ovate-acuminate and $\frac{1}{12}$ in. long on young trees, ovate-acute and $\frac{1}{20}$ in. long on old trees.

Cones, on short stout straight stalks, globose, $\frac{1}{2}$ in. to $\frac{3}{4}$ in. in diameter, covered with a thick whitish bloom, ripening in the second year; scales usually six, occasionally eight, with spreading or incurved prominent processes. Seeds, eight to ten on each scale, $\frac{1}{8}$ in. long, marked with a few inconspicuous resin-vesicles; wings narrow.

This species is probably a northern form¹ of *C. lusitanica*, but is distinguishable by the peculiar pits on the leaves, which exude a whitish resin. The foliage, closely appressed to the stout quadrangular branchlets, often glaucous in colour, and covered with a protecting layer of resin, is adapted, through diminution of evaporation, for arid sunny regions. *C. arizonica* is a native of the mountains of central, eastern, and southern Arizona, and also occurs in the provinces of Sonora and Chihuahua in northern Mexico. It was discovered in 1880 by Greene near Clifton in eastern Arizona, and shortly afterwards was seen by Rusby in the San Francisco mountains of the same state, where it is abundant in the cañons and on northern slopes, forming almost pure forests of considerable extent² at 5000 to 6000 ft. altitude. Like most species of cypress it is variable in habit, tall and narrow, or short with wide-spreading branches, and showing all tints of foliage from light green to silvery white. Purpus, who gives a picture of the tree³ in the Mogollones mountains, says that it grows there on rocky places on the cliffs on the sandstone formation.

C. arizonica, introduced⁴ into England in 1882 from the Arnold Arboretum, U.S.A., has proved considerably hardier than its near relative *C. lusitanica*, and promises to be a most valuable ornamental tree. At Cambridge it is one of the few cypresses that thrive out of doors, and is fast in growth. The finest specimen we know is growing in Messrs. Hillier's nursery at Shroner, Winchester, and is now about 25 ft. high; it bears occasionally a few cones, and is said to have been planted in 1889. Another at Nymans, Handcross, was planted in 1899 when about 3 ft. high, and is now 20 ft. high by 1 ft. 3 in. in girth, and is bearing cones which show in the mature state none of the thick white glaucous bloom so characteristic of the fruit in Arizona. None of the plants that I have seen in England show any glaucous hue on the branchlets. Another tree, similar in size at the same place, procured in the south of France, with bluish glaucous foliage, has not yet borne cones. A plant at Castlewellan, 9 ft. high, bore fruit in 1909. At Trebah, Cornwall, a tree, obtained from Messrs. Veitch about 1892, is 15 ft. high, but has not as yet produced cones.

¹ Scarcely distinguishable in botanical characters from *C. lusitanica*, var. *glaucæ*.

² In *Garden and Forest*, viii. 22 (1895), mention is made of a large grove, containing many thousands of trees, at the Natural Bridge in central Arizona.

³ In *Mitt. deut. dendr. Ges.* 1904, p. 50.

⁴ *Gard. Chron.* x. 364 (1891).

Seeds were introduced into Germany by Purpus,¹ who says it is the hardiest of all the true cypresses, and that young seedlings grow extraordinarily fast, but are somewhat difficult to transplant. Beissner,² however, states that in many parts of Germany it is tender and has suffered much from frost.

At Angers there is a tree of this species with remarkably glaucous silvery foliage, which bore fruit in 1907. Elwes found this also in E. Rovelli's nursery at Pallanza. He also saw a fine specimen under the name *C. guadalupensis* in the Botanic Garden at Montpellier. It was about 30 ft. high, with handsome glaucous foliage, but bore no fruit. (A. H.)

CUPRESSUS OBTUSA, HINOKI CYPRESS

Cupressus obtusa, Koch, *Dendrologie*, ii. pt. ii. p. 168 (1873); Masters, in *Journ. Linn. Soc. (Bot.)* xxxi. 355 (1896); Kent, *Veitch's Man. Conif.* 220 (1900).

Chamaecyparis obtusa, Siebold et Zuccarini, ex Endlicher, *Syn. Conif.* 63 (1847); Mayr, *Fremdländ. Wald- u. Parkbäume*, 277 (1906).

Chamaecyparis breviramea and *pendula*, Maximowicz, in *Mél. Biol.* vi. 25 (1866).

Retinispora obtusa, Siebold et Zuccarini, *Fl. Jap.* ii. 38, t. 121 (1844).

Thuya obtusa, Masters, in *Journ. Linn. Soc. (Bot.)* xviii. 491 (1881).

A tree, attaining in Japan 120 ft. in height and 12 ft. in girth, larger trees of very rare occurrence being reported by Mayr. Bark reddish brown, scaling off in long thin strips. Branches and branchlet systems similar to those of *C. Lawsoniana*. Ultimate branchlets flattened, compressed, $\frac{1}{15}$ in. wide. Leaves appressed; lateral pair conduplicate, $\frac{1}{12}$ in. long, obtuse at the apex, which often bears a minute mucro; facial pair, much smaller, $\frac{1}{24}$ in. long, flattened, rhomboid, often keeled, non-glandular, with a triangular scarcely acute apex. The foliage is dark green on the upper side of the branchlet, but is marked below with X-shaped white markings, due to a coating of wax on the inner margins of the lateral leaves and on both margins of each ventral leaf. Leaves on the main axes oblong, unequal, the lateral $\frac{1}{4}$ in. long, the facial $\frac{1}{8}$ in. long, with spreading rather obtuse tips.

Staminate flowers yellow. Cones on the ends of short scaly branches, ripening in the autumn of the first year, and falling in the following year, globose, $\frac{1}{3}$ in. in diameter, orange brown when ripe; scales eight, rarely ten, with the outer surface depressed in the centre, from which arises a minute ovate appressed process. Seeds, two to five on each scale, ovate, $\frac{1}{8}$ in. long, brown, with conspicuous large resin-vesicles and narrow wings.³ Seedling with two cotyledons, which are about $\frac{1}{4}$ in. in length.

VARIETIES

This species has long been cultivated in Japan, where it has given rise to numerous peculiar varieties.

¹ Cf. *Mitt. deut. dendr. Ges.* 1906, p. 32.

² *Ibid.* 1908, p. 61.

³ Some seeds from a tree growing at Nikko have three wings, instead of the normal lateral two wings.

1. Var. *breviramea*, Masters, in *Journ. Linn. Soc. (Bot.)* xxxi. 355 (1896).

Var. *filicoides*, Masters, in *Kew Handlist Conif.* 45 (1896).

Chamaecyparis breviramea, Maximowicz, *Mél. Biol.* vi. 25 (1866); Beissner, *Nadelholzkunde*, 97 (1891).

Thuja obtusa, Masters, var. *breviramea*, Masters, in *Journ. Linn. Soc. (Bot.)* xviii. 494 (1881).

Thuja obtusa, Masters, var. *filicoides*, Masters, in *Journ. Linn. Soc. (Bot.)* xviii. 494, fig. 5 (1881).

Retinispora filicoides, Veitch, ex Gordon, *Pinetum*, 363 (1875); Syme, in *Gard. Chron.* v. 235, fig. 40 (1876).

Retinispora Nobleana, Beissner, *Nadelholzkunde*, 94 (1891).

Denser and dwarfer in habit, with sub-opposite oblong branchlet systems, composed of short equal closely-set opposite pinnæ. Ultimate branchlets tetragonal, scarcely compressed. Leaves nearly equal in four ranks, ovate, obtuse, often glandular. The foliage is usually dark green, but is occasionally marked with white streaks beneath. The cones are similar to, but slightly smaller than those of the type.

Maximowicz saw this peculiar form wild on the northern shore of the island of Kiusiu, but states that it is often cultivated in gardens at Tokyo. It was introduced¹ by J. Gould Veitch in 1861. A small tree of this variety is growing well at Tregothnan; and at Haldon, Exeter, it is about 20 ft. high and was bearing yellow staminate flowers in April 1908.

2. Var. *tetragona aurea*, Masters, in *Journ. Linn. Soc. (Bot.)* xxxi. 355 (1896).

Var. *filicoides aurea*, Kent, Veitch's *Man. Conif.* 221 (1900).

Retinispora tetragona aurea, Kent, Veitch's *Man. Conif.* 250 (1881).

Chamaecyparis obtusa, Siebold et Zuccarini, var. *tetragona aurea*, Beissner, *Nadelholzkunde*, 95 (1891).

A dwarf form, with tufted branchlet systems, the pinnæ of which arise at varying angles in different planes. Ultimate branchlets tetragonal, scarcely compressed; leaves nearly uniform, ovate, acute, spreading at the tips. Young shoots golden yellow, becoming dark green in the second year.

This originated in the Elvaston Nursery in 1873, and obtained a first-class certificate at the Royal Horticultural Society in 1876. It is very slow in growth, a plant at Castlewellan being only 5 ft. high after twenty years' growth.²

3. Var. *lycopodioides*, Masters, in *Journ. Linn. Soc. (Bot.)* xxxi. 355 (1896).

Retinispora lycopodioides, Standish, ex Gordon, *Pinet. Suppl.* 92 (1862).

Retinispora monstrosa, Gordon, *loc. cit.*

Thuja obtusa, Masters, var. *lycopodioides* in *Journ. Linn. Soc. (Bot.)* xviii. 493 (1881).

Chamaecyparis obtusa, Siebold et Zuccarini, var. *lycopodioides*, Carrière, *Conif.* 132 (1867).

A dwarf form with rigid branches. Branchlet systems closely set, overlapping, but tending to be in one plane. Ultimate branchlets fasciated, crowded with closely appressed, elongated, obtuse leaves in many ranks. Foliage dark green in colour.

According to Gordon this was sent by Fortune to the Bagshot Nursery in 1861; but it is stated by J. H. Veitch³ to have been introduced in the

¹ *Hortus Veitchii*, 339 (1906).

² Earl Annesley, *Beautiful Trees*, 74 (1903).

³ *Hortus Veitchii*, 339 (1906).

same year by J. Gould Veitch. There are fine shrubs of this variety at Tregothnan, at Coldrenick, and at Chipping Campden in the garden of Mr. Griffiths.

4. Var. *pendula*, Masters, in *Journ. Linn. Soc. (Bot.)* xxxi. 355 (1896).

Chamaecyparis pendula, Maximowicz, *Mél. Biol.* vi. 26 (1866).

A form resembling *Thuja orientalis*, L., var. *pendula*, Masters, in habit, with long pendulous branches, and tetragonal branchlets and obtuse leaves.

This was seen by Maximowicz in gardens around Tokyo; but does not seem to be known in Europe, unless it is identical with an extremely handsome pendulous form,¹ which originated from Japanese seed sown in Prince Lobkowitz's nursery at Eisenberg in Bohemia.

The principal forms, which only differ from the type in the colour of the foliage are:—

5. Var. *aurea*. Young branchlets golden yellow. This is said to have been sent from Japan by Fortune to the Bagshot Nursery. According to the late Earl Annesley, it is dense in habit, holding its rich colour in spring and early summer. Kent considers it to be the most remarkable of all the coloured conifers.² In var. *gracilis aurea*, the branches are pendulous, with yellow branchlets, turning to light green when mature. Var. *Keteleeri*, though said by Parlatores³ to have juvenile foliage, is described by Gordon⁴ as resembling the type in every respect, except that about half the branchlets are yellow; and apparently this was early introduced from Japan. Var. *Crippsii*, at Kew, is a form with pale yellow young branchlets. A shrub cultivated at Osborne as var. *nana aurea*, planted in 1873, is now about 15 ft. high.

6. Var. *albo-spica*. Young shoots cream coloured when they first appear, gradually changing to pale green in summer. Var. *argentea*, introduced from Japan by Fortune, is similar, but silvery white or glaucous.

7. The principal dwarf forms are var. *nana* and var. *compacta*. The latter has lately produced⁵ fertile seeds, but the seedlings are too young as yet to judge of their precise character. Var. *pygmaea* scarcely exceeds a foot in height and spreads horizontally on all sides, and is much used for rockeries.

8. Var. *Troubetzkoyana*, Rovelli, ex Masters, in *Gard. Chron.* vii. 108 (1890).

A dwarf compact form, densely branched, with short, divaricating branchlets, and appressed light green, rather thick, lanceolate, acute but not acuminate leaves, which bear a central gland on the back. This originated at Pallanza, in the garden of Prince Troubetzkoy.

9. Var. *erecta*. A fastigiate variety, like *C. Lawsoniana*, var. *erecta viridis*. Introduced by Waterer and Sons.⁶ (A. H.)

¹ Described as *Chamaecyparis obtusa pendula*, by Beissner, *Nadelholzkunde*, 96 (1891).

² Mayne, in *Gard. Chron.* xli. 217 (1907) reports two specimens 25 ft. high at Bicton.

³ In DC. *Prod.* xvi. 2, p. 466 (1868).

⁴ *Pinetum*, 368 (1875).

⁵ Cf. *Proc. Roy. Hort. Soc.* xxxiv. p. cxxix. (1908).

⁶ It obtained a first-class certificate at the Horticultural Society, according to *Gard. Chron.* 1870, p. 315.

DISTRIBUTION

In Japan this tree is indigenous, so far as I could learn, only in the central and southern parts of the main island, and in Kiusiu and Shikoku; but it is so highly valued for its timber, which is considered the best of all the soft woods of Japan, that it has been largely planted in many places, and is always found in the grounds of Shinto temples, which are usually built of its wood. It is one of the five royal trees which were reserved for imperial and religious uses in ancient times; and is known in Japan as *Hinoki*.

The best natural forests which I saw are in the districts of Kisogawa and near Koyasan, where the tree grows at an elevation of from about 2000 to 5000 ft. on rich volcanic and granitic soil, usually mixed with *C. pisifera* and other conifers and hardwood trees, and sometimes attains very large dimensions. It is not easily distinguished in the forest from *C. pisifera*, but has smoother and paler bark; and the branches have a more ascending and less drooping habit.

Though in the forest the trees do not usually attain more than 80 to 90 ft. high, yet I saw many at Koyasan over 100 ft., and measured one close to the gate of the great temple at Koyasan which was 108 ft. by 12½ ft.; and in the temple court at Nikko there were two fine trees said to be about 300 years old, and nearly as large.

Plate 303 shews an isolated tree which I found at Maichi near Nikko. Plate 304 represents a tree grown in forest for timber.

Mayr says that at its upper limit, where it mingles with *Picea Alcockiana* and *P. hondoensis*, it attains about 80 ft., but that on good soil, mixed with chestnuts and other hardwoods, over which its crown towers in the forest, it attains 140 ft. in height and 7 ft. in girth, with a stem clear of branches to 60 ft. The largest tree recorded by Mayr grew in Mizumine, mixed with Zelkova, maples, and oaks.

In Japan the reproduction by seed is easy; and though the growth is much slower than that of *Cryptomeria*, yet *C. obtusa* is preferred for planting wherever the soil and climate are suitable.

This species has recently been discovered in Formosa, growing on Mount Morrison, with leaves, cones, and seeds somewhat smaller than is usual in Japan.¹

CULTIVATION

This species was introduced into cultivation in Europe by J. Gould Veitch in 1861, and has become popular as an ornamental small tree in English gardens. It is perfectly hardy, but probably requires more heat than our climate affords to bring it to timber size; and being generally propagated by cuttings is usually seen in a shrubby form. It dislikes lime in the soil, and, according to Mr. Coleman, does not thrive on that account at Eastnor. It ripens its seed perfectly in the south of England.

¹ Distinguished as *forma formosana* by Hayata in *Gard. Chron.* xliii. 194 (1908), and in *Journ. Coll. Sc. Tokyo*, xxv. 208 (1908). Mr. Hayata informs us that this tree attains an enormous size in the mountains of Formosa.

The largest trees which we have seen are one at Bicton, 36 ft. by 4 ft. 4 in. in 1906; and another at Dinas Mawddy, 30 ft. by 2 ft. in 1906, growing well on slate here and at Tan-y-bwlch. There are good specimens also at Tortworth, Westonbirt, Campden (Gloucestershire), and at Castle Kennedy in Scotland. In Ireland it grows well, a tree at Woodstock, Kilkenny, 38 ft. high, having a number of layered branches, which are now growing erect round the parent.

This species has been tried at fourteen different forestry stations in Prussia, the plots amounting to 10 acres in extent. Dr. Schwappach¹ says that seedlings grow slowly in the first two years, but attain in five years 20 to 40 in. in height, in ten years 5 to 9 ft., and in fifteen years 11 to 15 ft. Young plants are susceptible both to heat and to frost; and he advises planting out well-rooted transplants at five years old in gaps in woods of broad-leaved trees. This species, like all of the section *Chamaecyparis*, seems very liable in Germany to attacks of the fungus, *Pestalozzia funerea*.

In New England² *C. obtusa* is quite hardy, and in its early years makes a handsome plant, but it soon develops a tendency to grow thin, and well-furnished specimens more than 20 ft. high are not common.

TIMBER

No coniferous timber is now so highly valued in Japan for the finest buildings, as well as for interior work, as that of the *Hinoki*; and Sargent says that the palaces of the Mikado, as well as the temples, are built of it. But the high-priest of the Gemyo-in Temple, where I stayed at Koyasan, said that the wood of *Tsuga* used to be preferred until it became too scarce. To this very courteous gentleman I am indebted for a large slab 3 ft. across, cut from a burr of this tree, which was quite free from flaws, sound to the centre, and showed a very twisted and varied grain; in colour resembling satinwood, from which a highly ornamental table top has been made in England, the legs and framing of which are of Japanese yew.

Hinoki wood is white, straw-colour, or pale pink, very straight-grained, light, strong, and tough, and is distinguished by its remarkably fine-grained and silky lustre, which make it suitable for lacquer. Neat round rice-boxes are made in Kiso from thin pieces of this wood, ⅓ of an inch thick, bent into a circle, and sewed with cherry bark, which are sold for a few sen. For any fine work requiring a perfect surface it seems to me unsurpassed among coniferous woods, resembling most nearly in texture that of *Cupressus nootkatensis*.

The most beautiful ceiling which I saw in Japan, in a new inn at Nakatsugawa, was made from thin boards of this wood, about 18 in. square, cut from the butts of old trees, and showing a most varied wavy figure. These cost on the spot about fifteenpence each, and if they could be imported would be highly valued in Europe. The wood is also used for making chip braid; and an ordinary quality is worth in Tokyo about 80 yen or £8 per 100 cubic feet. The bark is also highly valued for

¹ *Anbauvers. Fremd. Holzarten*, 28 (1901).

² Sargent, *Garden and Forest*, x. 431 (1897), and *Pinetum Wellesley*, 13 (1905), where a tree is said to have attained 31 ft. high in Mr. Hunnewell's pinetum.

roofing temples and palaces. This bark is stripped from living trees, and as I was informed by a forester at Koyasan, this can be done about once in ten years without injuring the tree. It was worth 2s. to 4s. per tree. It is used for roofing in strips of about a foot long by 3 to 6 in. wide, which are laid together in packets of eight or ten strips, and put on the roof to the thickness of about a foot, the eaves and ridge being protected with wood or bamboo work. Such a roof will last for about fifty years even in this damp hot climate. (H. J. E.)

CUPRESSUS PISIFERA, SAWARA CYPRESS

Cupressus pisifera, Koch, *Dendrologie*, ii. pt. ii. p. 170 (1873); Masters, in *Journ. Linn. Soc. (Bot.)* xxxi. 355 (1896); Kent, Veitch's *Man. Conif.* 224 (1900).
Chamaecyparis pisifera, Siebold et Zuccarini, ex Endlicher, *Syn. Conif.* 64 (1847); Mayr, *Fremdl. Wald- u. Parkbäume*, 276 (1906).
Retinispora pisifera, Siebold et Zuccarini, *Fl. Jap.* ii. 39, t. 122 (1844); Syme, in *Gard. Chron.* v. 235 (1876).
Thuya pisifera, Masters, in *Journ. Linn. Soc. (Bot.)* xviii. 489 (1881).

A tree similar to *C. obtusa* in dimensions, bark, branches, and branchlets. Ultimate branchlets flattened, $\frac{1}{16}$ to $\frac{1}{12}$ in. wide. Leaves appressed, but with their mucronate tips free and slightly spreading; lateral pair conduplicate, acute; facial pair slightly smaller, $\frac{1}{16}$ in. long, ovate-acuminate, flattened, often ridged, obscurely glandular. The foliage is shining green above, while below it is marked with conspicuous white patches in hollows, two on the bases of the lateral leaves towards the middle line, and two on the base of each ventral leaf. Leaves on the main axes equal in four ranks, oblong, $\frac{1}{8}$ to $\frac{1}{5}$ in. long, with spreading triangular acuminate points.

Staminate flowers yellowish, with eight or ten pairs of stamens. Cones on the ends of short scaly branchlets, ripening in the autumn of the first year, and falling in the second year, globose, $\frac{1}{4}$ in. in diameter, dark brown; scales usually ten, with the outer surface wrinkled, deeply depressed in the centre, from which arises a very minute process. Seeds, one or two on each scale, brown, ovate, with large prominent resin-vesicles, $\frac{1}{10}$ in. long and $\frac{1}{5}$ in. wide, inclusive of their broad lateral wings, when these are well developed. Seedling with two cotyledons, similar to that of *C. Lawsoniana*.

VARIETIES

This species has been cultivated for centuries in Japan, and has given rise to many varieties.

1. Var. *squarrosa*, Masters, in *Journ. Linn. Soc. (Bot.)* xxxi. 356 (1896).

Retinispora squarrosa, Siebold et Zuccarini, *Fl. Jap.* ii. 40, t. 123 (1844); Kent, Veitch's *Man. Conif.* 249, fig. 59 (1881).

Chamaecyparis squarrosa, Siebold et Zuccarini, ex Endlicher, *Syn. Conif.* 65 (1847).

Cupressus squarrosa, Lawson, ex Gordon, *Pinetum*, 296 (1858).

Thuya pisifera, Masters, var. *squarrosa*, Masters, in *Journ. Linn. Soc. (Bot.)* 490 (1881).

This variety, which retains indefinitely the juvenile form of foliage, occurring on seedlings in their first three or four months, is a low tree or large dense shrub, with

glaucous silvery foliage; ultimate branchlets tetragonal; leaves soft in texture, in opposite decussate pairs or whorls of fours, decurrent on the branchlet, sessile, linear, flattened, $\frac{1}{4}$ in. long, whitened on both surfaces, acuminate. The bluish tint of the foliage is very handsome.

According to Siebold, "it is said to occur wild in Kiusiu," but in all probability it is only known in the cultivated state in Japan, where it is called *Himuro* or *Shimofuri-hiba*. It was introduced into Europe in 1843, and for a long time was considered to be a distinct species; but Syme¹ in 1879 found a tree of this variety giving off a branch with foliage exactly like that of *C. pisifera*; and in 1882 it produced² fruit with Messrs. Veitch, unmistakably the same as the species. Elwes brought from Japan specimens in fruit collected by Watanabe on Nokogiri-yama. The seed produced in England appears to be unfertile.

Syme first showed³ the true nature of these *Retinispora* forms. In 1875 he raised 2000 seedlings of *C. pisifera*, many of which were 2 ft. high in 1879. These seedlings during the first four months resembled *Retinispora squarrosa*, but towards the end of the season the great majority assumed the branchlets and leaves of *R. plumosa*, and in the following year developed the adult foliage of *C. pisifera*. A few of the seedlings, however, did not change from the juvenile stage till they were two years old, and one plant when three years old changed into the plumose stage, and remained so. Probably var. *squarrosa* and var. *plumosa* originally were accidental seedlings; but in most cases now plants of the different stages of *Retinispora* are artificially produced by propagation from cuttings. Hochstetter⁴ states that if lateral branches are used as cuttings, *Retinispora* forms are produced, while terminal shoots give *C. pisifera*. Var. *squarrosa* and var. *plumosa* can also be produced by using offsets from young seedlings of *C. pisifera*.⁴

A sub-variety, known as var. *squarrosa sulphurea*, yellowish in colour, is known; and Mr. Paul has a specimen of this at Cheshunt, which is growing into the form *plumosa*, while still retaining its colour.⁵

This variety⁶ has attained 29 ft. in height at Wellesley, Massachusetts, U.S.A.

2. Var. *plumosa*, Masters, in *Journ. Linn. Soc. (Bot.)* xxxi. 356 (1896).

Retinispora plumosa, Veitch, ex Koch, *Dendrologie*, ii. pt. ii. p. 170 (1873); Syme, in *Gard. Chron.* v. 236, fig. 42 (1876).

Thuya pisifera, Masters, var. *plumosa*, Masters, in *Journ. Linn. Soc. (Bot.)* xviii. 490, fig. 2 (1881).

Chamaecyparis pisifera, Siebold et Zuccarini, var. *plumosa*, Beissner, *Nadelh.* 87 (1891).

A dense shrub or small tree, usually of conical habit; branchlet systems crowded, more or less overlapping, often curved at the distal end, bi-pinnate, with the pinnæ in one plane. Leaves crowded in decussate pairs, decurrent in their basal half, $\frac{1}{8}$ in.

¹ *Journ. Linn. Soc. (Bot.)* xviii. 490 (1881).

² Syme in *Gard. Chron.* xviii. 395 (1882). At the present day it often produces fruit, as at Kilmacuragh and elsewhere. Shepherd sent a specimen covered with cones from Wolverston Park to Dr. Masters. Cf. *Gard. Chron.* iv. 671 (1888).

³ In *Gard. Chron.* xviii. 395 (1882).

⁴ *Gartenflora*, xxix. 362 (1880), translated in *Gard. Chron.* xv. 333 (1881).

⁵ *Proc. Roy. Hort. Soc.* xxxiv. p. cxxviii. (1909).

⁶ Sargent, *Pinetum Wellesley*, 13 (1905), who says that the inability of the Japanese cypresses to flourish in the eastern United States for any length of time has been well shown at Wellesley, where of the several hundred individuals, in nearly all the obtainable varieties, that had been planted at different times, few have survived.

long, subulate, ending in a sharp cartilaginous point, slightly spreading, concave from side to side, and whitened on the inner surface.

This variety is known in Japan as *Shinobu-hiba*, and was introduced from there by J. Gould Veitch in 1861. It produces fruit¹ similar to that of the type, but smaller, as at Osborne, where it is 25 ft. high.

Syme² observed on this variety branches with the foliage of *C. pisifera*; and Beissner mentions a tree at Wilhelmshöhe, Cassel, the lower half of which is bushy and covered with foliage of var. *plumosa*, the upper half having the loose branches and foliage of *C. pisifera*.³

This variety is very hardy, and as a small plant is suitable for window boxes out-of-doors in winter.⁴ During the severe frost of February 1882, the golden Retinisporas at Kew⁵ lost many small branches; while those with green, glaucous, or silvery foliage remained uninjured.

Several coloured sub-varieties are known:—

Var. *plumosa albo-picta*. Tips of many of the branchlets pure white.

Var. *plumosa argentea*. Young branchlets creamy white, becoming green in the following spring.

Var. *plumosa aurea*. Young branchlets golden yellow, gradually changing to green as the season advances.

3. Var. *filifera*, Masters, in *Journ. Linn. Soc. (Bot.)* xxxi. 356 (1896).

Retinispora filifera, Standish, ex Gordon, *Pinetum*, 364 (1875); Syme, in *Gard. Chron.* v. 235, fig. 43 (1876).

Thuya pisifera, Masters, var. *filifera*, Masters, in *Journ. Linn. Soc. (Bot.)* xviii. 491, fig. 3 (1881).

Chamaecyparis pisifera, Siebold et Zuccarini, var. *filifera*, Beissner, *Nadelh.* 90 (1891).

A low tree, with spreading branches, and long pendulous branchlets, undivided for the greater part of their length, and terminating towards the end in bi-pinnate divisions. Leaves in decussate pairs, subulate, sharp-pointed, about $\frac{1}{8}$ in. long, decurrent in their basal half, concave and whitened on their inner surface.

This is known in Japan as *Hiyoku-hiba*, and was apparently introduced by Fortune into the Bagshot Nursery in 1861. There is a good specimen of this at Tortworth, bearing fruit exactly like that of the type. Planted at Osborne in 1873, it is now 15 ft. high and covered with small cones. Both Syme and Beissner mention cases in which branches reverted to the ordinary foliage of *C. pisifera*.

Sargent⁶ says this is one of the most remarkable of pendulous conifers, but in New England it is very capricious, sometimes flourishing with great luxuriance, as in Mr. Hunnewell's pinetum at Wellesley, Massachusetts, but more often perishing from the cold of severe winters.

4. Var. *aurea*. Normal branching and foliage, the latter in the first year bright yellow, changing to green in the following year. This originated in Barron's nursery at Borrowash. (A. H.)

¹ Masters, in *Gard. Chron.* iv. 671 (1888), mentions a tree at Canterbury of this variety, laden with cones of *C. pisifera*.

² In *Gard. Chron.* xviii. 395 (1882).

³ Mr. Bartlett sent from Pencarrow to Dr. Masters a branch of var. *plumosa*, which was produced on a tree of *C. pisifera*, about eighteen years old. Cf. *Gard. Chron.* xxvii. 9 (1900). Elwes saw the same thing at Woodstock.

⁴ *Gard. Chron.* xvi. 410 (1881).

⁵ *Kew Bull.* 1896, p. 8.

⁶ *Garden and Forest*, x. 431 (1897).

DISTRIBUTION

This tree¹ has much the same distribution as *C. obtusa*, and is called *Sawara* in Japan. Where the two are mixed in natural forest it is usually the commoner, as it reproduces more freely from seed, and on account of the lower value of its timber is not so much felled except in places easy of access. Its habit of growth is more pendulous and graceful, and it attains about the same size as its congener. The largest that I measured in the Atera valley was by the roadside, and had its roots partially cut through. It appeared to be about 150 years old, and was 115 ft. by 13 ft.; but Mayr states that he saw, in a chestnut forest, a tree 120 ft. high and 3 ft. in diameter; and among beech and oak, another 130 ft. high and 3 ft. in diameter, whose first branch was at 80 ft. from the ground. The tallest he measured was 134 ft. high, and the thickest 7 ft. in diameter. On a stump recently cut in the forest of Atera I counted about 200 rings in a diameter of 4 ft., but the heart was rotten and the tree must have been 250 years or more old.

I saw no trees of the numerous varieties which are grown as pot plants in a dwarfed condition, but these do not seem to be so popular among the Japanese as among foreigners.

The timber, though fine in grain, is not so much valued, though used for the same purposes as that of *C. obtusa*. When the trees have died standing, it turns to a greyish colour, and a large slab of this wood which I brought home shows a very pretty grain.

CULTIVATION

This species was introduced by J. Gould Veitch in 1861, and like *C. obtusa* has become widely spread in gardens, where it is usually seen as a small shrubby tree. It is perfectly hardy, and ripens seed freely in the warmer parts of England, but shows no signs of attaining timber dimensions in this country. It appears to grow slightly faster than *C. obtusa*, and like it dislikes lime in the soil.

The finest specimens that we have seen are:—at Bicton, 41 ft. by 4 ft. 10 in. in 1906 (Plate 305); at Canford Manor, Dorset, 40 ft. by 4 ft. 3 in. in 1906; at Moncrieffe, 38 ft. by 3 ft. 10 in. Smaller trees have been seen by us at Chatsworth, Killerton, Tortworth, Dropmore, High Canons (Herts), Golden Grove, Tan-y-bwlch, and Castle Kennedy.

This species is well adapted for hedges, as it bears pruning well, and by continual cutting acquires a very dense habit.

In New England² it is a more rapid-growing and perhaps a hardier tree than *C. obtusa*, but with its loose narrow crown of more upright branches is less ornamental than that species. It has attained 32 ft. high at Wellesley, Massachusetts.³

In Prussia⁴ this cypress has been tried in thirteen experimental plots, covering

¹ It is unknown in the wild state out of Japan, and is not yet recorded for Formosa. We have not been able to find the specimen, collected in Yunnan by Anderson, referred to by Kent, Veitch's *Man. Conif.* 227, note (1900).

² Sargent, in *Garden and Forest*, x. 431 (1897).

³ Sargent, *Pinetum Wellesley*, 13 (1905).

⁴ Schwappach, *Anbauvers. fremd. Holzarten*, 30 (1901).

five acres. It grows quicker than *C. obtusa* in youth, attaining in its fifth year a height of 2 to 5 ft., in its tenth year 7 to 10 ft., and in its fifteenth year 13 to 20 ft. It begins to bear fertile seed when about fourteen years old. It appears to be more hardy in Prussia than either *C. obtusa* or *C. Lawsoniana*. (H. J. E.)

CUPRESSUS NOOTKATENSIS, SITKA CYPRESS.

- Cupressus nootkatensis*, Don, in Lambert, *Genus Pinus*, ii. 18 (1824); Loudon, *Arb. et Frut. Brit.* iv. 2480 (1838); Masters, in *Journ. Linn. Soc. (Bot.)* xxxi. 352 (1896); Sargent, *Sitka N. Amer.* x. 115, t. 530 (1896); Kent, *Veitch's Man. Conif.* 217 (1900).
Cupressus nutkaënsis, Hooker, *Fl. Bor. Amer.* ii. 165 (1839); Murray, in Lawson, *Pinet. Brit.* ii. 199, t. 34 (1869).
Cupressus americana, Trautvetter, *Imag. Pl. Fl. Rossica*, 12, t. 7 (1844).
Chamaecyparis nutkaënsis, Spach, *Hist. Vég.* xi. 333 (1842); Syme, in *Gard. Chron.* xi. 560 (1879); Mayr, *Fremdländ. Wald- u. Parkbäume*, 276, t. 1. (1906).
Chamaecyparis nootkatensis, Sargent, *Trees N. Amer.* 83 (1905).
Thuya excelsa, Bongard, in *Mém. Acad. Sci. St. Pétersb.* ii. 164 (1833); Macoun, *Cat. Canad. Plants*, i. 461 (1883).
Thuopsis borealis, Carrière, *Conif.* 113 (1855); Lemaire, *Illust. Hort.* ii., *Misc.* 84 (1855).

A tree, attaining in America 120 ft. in height and 18 ft. in girth. Bark about $\frac{1}{2}$ in. thick, brownish grey, and separating on the surface into large thin loose scales. Branches of the fifth year smooth, terete, brown; those of the third and fourth year roughened with persistent brownish remote leaves. Branchlet systems distichous, on the upper part of the tree pendulous in vertical planes at right angles to the stem, tri-pinnate, with alternate pinnæ disposed in one plane. Ultimate branchlets flattened, compressed, $\frac{1}{15}$ in. wide. Leaves, $\frac{1}{8}$ to $\frac{1}{12}$ in. long, green, not marked with whitish lines or streaks, appressed; lateral pair conduplicate, acute and minutely mucronate at the spreading apex; facial pair flattened, rhomboidal, with an acute or mucronate apex, and a shining median ridge, often furrowed longitudinally. Leaves on the main axes equal in length, $\frac{1}{4}$ in. long, with acute free tips.

Staminate flowers yellow, $\frac{1}{8}$ in. long, with eight to twelve stamens. Pistillate flowers dark plum colour. Cones, ripening in the second year, and falling soon after the escape of the seed, on the ends of short leaf-clad branchlets, dark brown tinged with a glaucous plum colour, globose, $\frac{1}{3}$ in. in diameter; scales usually four, rarely six, bearing near their centre a prominent triangular sharp-pointed process, occasionally covered with resinous glands. Seeds two on each scale, flattened-pyriform, acute at the apex, reddish brown, without resin-vesicles; with the broad wings nearly $\frac{1}{4}$ in. wide.

Seedling:—Cotyledons two, $\frac{1}{3}$ in. long, sessile, linear, rounded at the apex. Primary leaves usually in whorls of fours, occasionally in pairs or threes, $\frac{1}{3}$ in. long, decurrent at the base, acute or acuminate at the apex, linear, green beneath with indistinct stomatic bands. The stem in the first year attains about an inch in height,

developing about eight whorls of leaves and a tiny lateral branchlet, and ending in a tuft of smaller leaves. The tap-root is slender, flexuose, about $1\frac{1}{2}$ in. long.

VARIETIES

Scarcely any varieties have been noticed in the wild state. Under cultivation it has shown much less tendency to variation than *C. Lawsoniana*. The most notable varieties are:—

1. Var. *pendula*. Branches and branchlets very pendulous. Fine examples occur at Bayfordbury. Dr. Masters¹ figures a pendulous variety in a forest clearing in British Columbia.
2. Var. *lutea*. Young branchlets yellow, changing to a yellowish green when older. It is fast in growth and is similar in habit to the type.² At Powerscourt this variety is pendulous and remarkably beautiful.
3. Var. *glauca*. Leaves glaucous.
4. In var. *argenteo-variegata* some of the young branchlets are creamy white, while in var. *aureo-variegata* some are yellowish. There are good specimens of these at Highnam.
5. Dwarf forms are also known, as var. *compacta*, a shrubby form with crowded branchlets; and var. *gracilis*, with very slender branches.
6. Var. *nidifera*,³ Rovelli, which originated at Pallanza, is said to be feathery-looking, owing to the slender shoots, densely covered with appressed deep green subulate leaves, each with a central gland on the back. (A. H.)

DISTRIBUTION

According to Pinchot,⁴ this species, which is universally known in its native habitat as yellow cedar, grows in the Pacific Coast region from the head of the Santiam river in the Cascade mountains of northern Oregon, northward through Washington, British Columbia, and Alaska to Prince William Sound.

It is most abundant, and reaches its best development, on the coast and adjacent islands of British Columbia and southern Alaska, where it often predominates in the forest. In Washington small stands, covering thirty or forty acres, sometimes yield as high as 150,000 board feet per acre.⁴

It occurs occasionally pure; but is usually scattered through the forests in British Columbia and Alaska, with Sitka spruce, giant Thuya, western hemlock, and swamp hardwoods; and at timber line occurs in a stunted form with Sitka spruce, black hemlock, and lodge-pole pine. Farther south on the coast it is associated with lowland fir and yew; while at higher elevations, in the Cascades, it is mixed with black hemlock, lodge-pole pine, *Abies amabilis* and *A. nobilis*, Douglas fir, western larch, white pine, alpine fir, and Engelmann's spruce. On the coast of Puget Sound this tree is not seen, as in this latitude it hardly extends

¹ *Gard. Chron.* xl. 166, fig. 68 (1906).

² Cf. *Gard. Chron.* vii. 108 (1890).

³ Figured by Earl Annesley, *Beautiful Trees*, 55 (1903).

⁴ *U.S. Forest Service, Sylvical Leaflet*, No. 12 (1908).

to sea-level, though farther north, in Queen Charlotte Sound and Islands, it becomes one of the most common trees. In Vancouver Island¹ I did not see it, as it grows only at a higher elevation and farther north than I reached, and as yet forms no part of the produce of the lumber mills.

In Washington it is found only in small areas, and is not abundant. Plummer says² that it is found between 2600 and 7400 ft., generally associated with mountain fir, pine, and hemlock, preferring shady valleys and basins, and not exceeding 100 ft. high by 3 ft. in diameter. But I found on the road from Longmire Springs to Paradise Valley, on Mt. Rainier, a tree of remarkable size, 108 ft. high and 17 ft. 10 in. in girth; above the point at six ft. where the tree forks just below this, it measured no less than 26 ft. in girth, and seemed quite sound. This appears to be the largest girth recorded for this species. Plate 306 from a photograph taken in this district, and Plate 307 from photographs taken in Washington, give a good idea of the habit of the tree in its native forests.

In Washington it crosses the Cascade mountains to the valleys running east, where Mr. Gorman found it from 2100 ft. on the Stehakin, to 6000 ft. about the headwaters of the Methow and Rattlesnake Creek. He says:³—"Of all the trees of this region the Alaska cedar is the most pronounced lover of moisture, and on this account it is not only confined to the moist valleys, but to those only which head in or about the main divide of the Cascade range. The finest specimens are in the Stehakin and Agnes Creek, where it ranges from 50 to 75 ft. high and 10 to 25 in. diameter. About its upper limits, especially in Horseshoe Basin, the tree was quite alpine in habit and very stunted in growth, but even the most stunted trees, some of which did not exceed 10 ft. in height, were found to be fairly well covered with the typical small barbed cones, which take three years to mature their seed.⁴ The bark of the young tree is somewhat red and shreddy, becoming checked and grey with age, when it bears a strong resemblance to that of *Thuja plicata*; but the mature tree, unlike the latter, continues sound at the core."

HISTORY AND CULTIVATION

The yellow cedar was discovered in 1793 by Archibald Menzies, who accompanied Vancouver, as surgeon and naturalist, in his voyage round the world. His specimens, gathered on the shore of Nootka Sound, were described by Don in 1824. It was first cultivated about 1850 in the St. Petersburg Botanic Garden,

¹ According to Butters, in *Postelsia*, 199 (1906), it is common in the south-eastern part of Vancouver Island, at elevations above 1000 feet. Anderson, in *Canad. Forestry Convention Report*, 1906, p. 71, says the nearest point to Victoria where trees are found is on the Nanaimo River and on Mt. Benson; and adds that it grows in large quantities in the interior of the island, and extends to the snow-line.

² 21st Ann. Rep. Geol. Survey, Mount Rainier Forest Reserve (1900).

³ 19th Ann. Rep. Geol. Survey, Washington Forest Reserve, 339 (1899).

⁴ Pinchot, in *U.S. Sylvical Leaflet*, 12, p. 3 (1908), says: "Flowering takes place in April, and the seeds mature and are scattered in the early autumn of the same season. They are distributed by the wind, and though they will germinate on moss and decaying wood, mineral soil is preferred as a seed-bed." Sargent also states that the fruit ripens in the first season. Both, however, in America and in England, the seeds do not ripen till late in the spring of the second year, and the cones usually do not open until the autumn following.

whence it was sent out under the name of *Thujopsis Tschugatskoi*, Fischer;¹ and, soon after, it became known in France² under the name *Thujopsis borealis*, Carrière. It appears to have been first introduced¹ into England by Pontey, of Plymouth, who received plants from Booth, of Hamburg, which in 1854 were 3 ft. high.

Though not so generally planted, or so common, in gardens as Lawson cypress, it has been during the last fifty years a popular tree among nurserymen under its old name of *Thujopsis borealis*. Though looked on as an ornamental tree only, my experience of it on poor dry soil justifies me in thinking that, if it could be procured at a reasonable cost, it would be one of the most valuable trees for such soils that can be planted; because it is not only absolutely hardy³ under all conditions in every part of the country, but will thrive where no other tree whose timber at all approaches it in value, except perhaps the larch, will grow to any size. Though a slow grower at first, and not likely to attain in this country the dimensions of *Thuja plicata*, it has all the other good qualities of that tree in an even greater degree. The difficulty of raising it from seed, which I and others have experienced, is one that I cannot yet explain, for though I have on several occasions sown carefully both imported seed and freshly gathered seeds saved from my own trees, I have never had more than a very small percentage of germination, the seeds mostly lying dormant for more than a year without losing their apparent freshness.

Mr. J. Rafn, of Copenhagen, whose tests of the germination of tree seeds have been published in the *Trans. Roy. Scot. Arb. Soc.* xvi. 277 (1900), informed me that his experience was similar.

In October 1905, I gathered a quantity of seed from my own trees, which had been produced in 1904, and seemed mature in the spring of 1905, though the cones remained closed till autumn. Part of this seed was sown under glass in boxes, part in a frame, and part in the open ground, as soon as it was dry; but the proportion which germinated in the following year was not 1 per cent. I was much surprised, therefore, when in the spring of 1907 the seed germinated regularly and well, a unique instance, in my experience, with seeds of this character when properly treated. I am however informed by Capt. the Hon. R. Coke, that he raised a considerable number of seedlings of this tree, by gathering the fruit in May, drying it in the sun, and sowing at once. In this case, the seed germinates in the succeeding spring, and so gains a year over autumn sowing.⁴

As it is easily propagated from cuttings, the plants sold in nurseries are usually so produced; and though I have the same preference for seedlings in this case as in others, I am not able to say from experience that cuttings will not make as good trees eventually.

¹ Cf. Lindley, in *Gard. Chron.* 1854, p. 727, and 1856, p. 772, who says that the seeds were supposed to have come from "Tschukotsk, a cape on the west coast of Kamschatka."

² It was exhibited, as *Thujopsis borealis*, by Thibaut and Keteleer, at a horticultural meeting in Paris in 1852, and occurs in the list of plants cultivated in the Jardin des Plantes in 1853. Cf. *Gard. Chron.* 1854, p. 727. It was also called *Pinus Tschugatskoi* by French nurserymen. Cf. *Gard. Chron.* 1856, p. 342.

³ In Palmer's frost-tables, quoted by Lawson, out of seventy-eight places from which he had reports of the effects of the severe winter of 1860-61, not one tree was killed, and only three were slightly injured.

⁴ On 19th October 1909, I sowed a packet of seed freshly gathered at Bayfordbury, and kept the pot in a cold frame. On 10th April 1910, a large proportion of this seed had germinated. Messrs. B. Reid of Aberdeen also inform me that for the first time in their experience, seeds of this species have germinated in the next spring after sowing; so there is evidently some condition that we do not yet understand, which governs the germination of the seeds of this species.

I have rarely seen a sickly, diseased,¹ or frost-bitten tree of this species in England, and though on good soils I would prefer Lawson cypress, I have so much confidence in its ultimate value as a timber tree, that I would on my own soil plant ten thousand, if I could get that number of seedlings at anything like a forest tree price. It seems to grow equally well on limestone, clay, or sand, but I have no experience on peat. I have not observed any case of rabbits eating the bark of this tree.

In its native country the yellow cedar seems to grow best in a mild damp climate, where the rainfall ranges from 30 to 100 in. or more. It seems absolutely indifferent to any sudden changes, and endures the severest frosts, whether in winter, spring, or autumn, without the slightest injury.

Though it grows faster and larger on deep fertile well-drained soils, it seems to suffer less from drought on dry oolite soil than any of the trees which accompany it in its native country. It will grow, perhaps, better than any other western conifer on this soil. Six trees which I planted in 1876 or 1877 are now 35 ft. high by 2 ft. in girth, and very uniform in height and habit; whilst Corsican pines planted close to them at the same time are about 40 ft. It does not seem to respond to good soil so well as most trees; the largest that I know in England having made about the same rate of growth, namely, one foot per annum.

It has a narrow conical crown, a rapidly-tapering stem set with persistent, horizontal or slightly-drooping branches, and flattened pendent sprays of foliage. The branches do not seem to die, however closely the tree may be crowded, until it has attained considerable age. The root-system is comparatively shallow and fibrous, making the tree very easy to transplant in spring or autumn; and the percentage of death after transplantation on my soil is unusually small.

REMARKABLE TREES

The largest that I have measured in England grows not far from the great Douglas fir at Eggesford, and in 1908 measured 61 ft. by 5 ft. 7 in., a tree of perfect shape with a very good trunk. At Killerton there is one of 52 ft. by 5 ft.

At Streatham Hall, near Exeter, there are many good trees growing on each side of the drive, which prove the fitness of this species for planting avenues of moderate width and length. At Tortworth there are two fine trees, one of which (Plate 308) is about 55 ft. by 4½ ft.; another, with a double leader, is about 50 ft. high. At Eastnor Castle there is one which Mr. Mullins reported in 1909 to be 57 ft. by 4½ ft.

At Leonardslee there is a well-shaped tree about 50 ft. high and only 3 ft. 8 in. in girth. At Hewell Grange there is a very thriving specimen 60 ft. high by 4 ft. 4 in. in girth. At Bayfordbury, in a drier soil and climate, there is a tree with such a graceful pendulous habit, and which has the rank disagreeable smell, usually possessed by this species, so faint, that I at first mistook it for *Cupressus funebris*.

¹ In Germany, according to Unwin, *Future Forest Trees*, 96 (1905), it suffers more even than Lawson cypress, from a fungus, *Pestalotia funerea*, which causes the decay of the bark of the young shoots.

At Shadwell Court, near Thetford, Henry measured a tree 58 ft. by 3 ft. 8 in., growing on poor sandy soil which contains lime.

In all parts of Scotland where I have seen it, especially in the west, this species grows well, and should be valuable, not only for ornament, but also for planting in rocky and exposed situations, though so far as we know it has not yet been planted under forest conditions. The largest that I have measured is a very healthy tree in the Dolphin Walk at Murthly, which, in 1906, was 45 ft. by 3 ft.¹ At Poltalloch, in the same year, I measured one of 42 ft. by 3½ ft.

In Ireland we have seen fine trees at many places, the largest perhaps at Woodstock, about 55 ft., the average rate of growth being about one foot per annum, though at Powerscourt it was 40 ft. high twenty-four years after being planted. Everywhere it seems to grow as well as in England, and to be worth planting more extensively.

In France and Germany the climate does not seem to suit it so well as in Great Britain, and we have seen no specimens of remarkable size. But a tree is reported² to be growing in the grounds of the Villa Lindenhof, at Lindau, on the Lake of Constance, which was no less than 30 metres high, though I suspect this to be a misprint, for I have found no other records at all approaching this. Pardé³ states that it has produced natural seedlings at Auteuil (Oise), and that the plantations of it which he saw at Weinheim, in Baden, are superb. In Norway, Schübeler says, it is hardy as far north as Trondhjem, and grows well at Christiania and Stockholm.

TIMBER

Of all the coniferous trees of North America, none has better wood than this, though it is little known even in its own country, on account of the difficulty of getting it in commercial sizes from the comparatively inaccessible places where it grows. Hough says that for cabinet-making it has few if any equals among North American woods, and that it has been exported to China in considerable quantities where it is used as a substitute for satin-wood. Though its lustre does not equal that of satin-wood, yet the section in Hough's book which was cut from a tree growing on Mt. Hood, Oregon, shows a remarkable density and slowness of growth. Hough counted 427 rings in a radius of 9¼ in. only; and I have never seen any coniferous wood so compact, or in which the rings are so hard to distinguish.

Ordinary commercial boards of much inferior quality to this were quoted in 1904 at Victoria, B.C., at 60 dollars per 1000 ft., or more than double the price of the finest Oregon fir or red cedar; and though, owing to this high price, it is little used except in the best houses, yet the work done with it in the house of the Hon. James Dunsmuir, Lieut.-Governor of British Columbia, proved to me that it was a wood which, if it could be procured in this country, would take a high rank among fancy woods for furniture, cabinet-making, and panelling.

¹ In *Journ. Roy. Hort. Soc.* xiv. 533 (1892) a tree was reported here as 50 ft. by 1 ft. 9 inches, but this I could not find, and suspect a misprint. Another at Brahan Castle was said (*op. cit.* 541) to have been then 45 ft. by 6 ft. 8 in., which also seems doubtful.

² *Mitt. deut. dendr. Ges.* 1905, p. 32.

³ *Arb. Nat. des Barres*, 39 (1906).

I do not find that the strong, and to most persons offensive smell, which is present in the leaves and bark of this tree, is noticed in the wood except when freshly planed, and this smell soon disappears after exposure.

A small importation of this wood which I recently purchased in Liverpool, has been tested by my house carpenter, who reports that it takes a finer surface and absorbs less polish than any soft wood he knows.

Mr. J. R. Anderson,¹ Deputy Minister of Agriculture in British Columbia, writes to me as follows, in reply to my inquiry as to this timber:—

“It is a grand wood, and you are quite right in designating it the finest of the N. American coniferous woods. It is a tree of slow growth, and therefore close grained. A specimen I have which was cut on the Nanaimo river, where it grew on good soil not far above sea-level, shows 137 rings for 13 in., that is at the rate of about 10 years to the inch, assuming that the rings represent a year's growth; and at high altitudes it is reasonable to expect a still slower growth. The soil that it affects is not what may be termed poor, but rather of a peaty cold nature, and in this latitude high up on the mountains. Two to four feet is a good size, and I have seen quite extensive groves at the base of Mount Arrowsmith, and elsewhere where the size is much less.”

Mr. Anderson enclosed me a letter from Mr. C. Harrison, who states that yellow cedar claims were, in 1907, for disposal at 3½ dollars per acre, which would carry on an average about 12,000 ft. board measure to the acre, with a quantity of spruce and hemlock in addition. But the obligation to cut all timber within a few years which existed under the Government leases of timber lands in British Columbia, and which was described by one of the best authorities in Canada as insane, offers no inducement to any one to take up timber limits in the province, who has not the intention and the means to realise everything that can be got to market at a profit, and then abandon the land as quickly as possible.

CUPRESSUS LAWSONIANA, LAWSON CYPRESS

Cupressus Lawsoniana, Murray,² in *Edin. New Phil. Journ.* i. 292, t. 10 (1855); Hooker, in *Bot. Mag.* t. 5581 (1866); Murray, in Lawson, *Pinet. Brit.* ii. 191 (1866); Masters, in *Journ. Linn. Soc. (Bot.)* xxxi. 353 (1896); Sargent, *Silva N. Amer.* x. 119, t. 531 (1896); Kent, Veitch's *Man. Conif.* 205 (1900).

Cupressus fragrans, Kellogg, in *Proc. Calif. Acad.* i. 103 (1857).

Cupressus nutkanus, Torrey, in *Bot. U.S. Explor. Exped. Wilkes*, ii. t. 16 (1874).

Chamaecyparis Lawsoniana, Parlatores, in *Ann. Mus. Stor. Nat. Fir.* i. 181 (1864); Sargent, *Trees N. Amer.* 84 (1905).

Chamaecyparis Boursierii, Carrière, *Conif.* 125 (1867) (not Decaisne).³

A tree attaining in Oregon about 200 ft. in height, and 6 to 12 ft. in diameter above the abruptly enlarged base. Bark on old trunks, 3 to 10 in. thick, reddish

¹ In *Canad. Forestry Convention Report for 1906*, p. 71, Anderson says that the strong but rather unpleasant odour is objectionable to insects. The Indians make canoes and carvings of the wood.

² This description is reprinted in *Gard. Chron.* 1855, p. 372.

³ *Chamaecyparis Boursierii*, Decaisne, in *Bull. Soc. Bot. France*, i. 70 (1854), is *Juniperus occidentalis*, Hooker. Cf. *Gard. Chron.* xi. 726 (1879).

brown, with a dark compact inner thin layer, and a spongy outer thick layer, dividing on the surface into rounded ridges covered with small appressed scales; on young stems thin, slightly scaly, with narrow longitudinal fissures.

Branches of the fourth year slightly compressed, brown, with traces of the leaves. Branchlet systems disposed in planes tangential to the trunk of the tree, distichous, tri-pinnate, with the pinnæ in one plane. Ultimate branchlets flattened, compressed, about $\frac{1}{16}$ in. wide. Leaves appressed, usually marked on the under surface with ill-defined streaks of white, partly on the ventral leaf and partly on the lateral leaves; lateral pair conduplicate, $\frac{1}{12}$ to $\frac{1}{16}$ in. long, often minutely mucronate; facial pair rhomboidal, much smaller, $\frac{1}{20}$ in. long, acute, often marked with a glandular furrow or circular pit. Leaves on the main axes, oblong, unequal, the lateral pair $\frac{1}{4}$ in., the facial pair $\frac{1}{8}$ in. long, with acute or acuminate, slightly spreading apices.

Staminate flowers¹ crimson, the connectives usually bearing two anther-cells. Pistillate flowers plum-coloured, with horizontally spreading scales. Cones, ripening in the first autumn, globose, $\frac{1}{3}$ in. in diameter, reddish brown and covered with a glaucous bloom; scales eight, depressed in the centre and with an ovate acute reflexed process. Seeds, two to five on each scale, ovate, acute, $\frac{1}{8}$ in. long, brown, with conspicuous large resin-vesicles, and narrow wings.

The seedling² has two cotyledons, about $\frac{1}{3}$ in. long, broader and more rounded at the apex than in *C. nootkatensis*. Primary leaves arranged in whorls, as in that species, acuminate at the apex, $\frac{1}{5}$ in. long, conspicuously white beneath. The young plant attains 1 to 2 in. in height in the first year, frequently giving off two or three lateral branches, and has a very long slender flexuose tap root.

VARIETIES

Hardly any tree has shown under cultivation so much variation as the Lawson cypress, no less than forty-eight varieties being mentioned in the *Kew Handlist of Coniferae*.³ The more important⁴ may be arranged as follows:—

1. *Columnar or fastigiata in habit.*

1. *Var. erecta viridis* (var. *stricta*). Narrow, erect, pyramidal, with a close dense mass of branches, all set with their foliage-bearing ramifications in planes radially disposed to the main stem. Foliage bright green. This originated⁵ in Waterer's nursery at Knap Hill as a seedling, which was raised from seed imported from California in 1855. It was propagated and sold for some time as var. *erecta*, but in

¹ Masters describes in *Journ. Linn. Soc. (Bot.)* xxvii. 312, fig. 19 (1890), an androgynous flower, the lower scales bearing anthers and the upper scales bearing ovules.

² Trees often produce seed abundantly when only 6 to 12 ft. high; and plants were raised from seed of very small trees in England as early as 1863 by W. Tillery. Cf. *Gard. Chron.*, 1864, p. 1013. Barron, in *Gard. Chron.*, 1861, p. 718, gives an instance of plants only 2 ft. high bearing cones.

³ Beissner, in the second edition of his *Handbuch* (1909), describes 77 named forms, many of which seem to be hardly worth notice.

⁴ *Var. fragrans*, kept up in the *Kew Handlist*, differs in no respect from the type, and appears from Gordon, *Pinetum*, 88 (1875), to have been sent out by Standish, and possibly may have been raised from seeds sent by Beardsley. See *infra*, p. 1206, note 1.

⁵ Cf. *Gard. Chron.*, 1870, pp. 249, 279, fig. 49; and 1874, ii. 329.

1870, when the original plant was 9 ft. high, it obtained a first-class certificate at a meeting of the Royal Horticultural Society, and was renamed *erecta viridis*. It is quite unique as regards beauty, and never needs pruning or cutting; but snow or even heavy rain will bend and break the branches, which never recover, leaving unsightly hollows in its outline. It is most useful as a small decorative plant; but in some places has succeeded as a walk or avenue tree, and at Terling Place, Essex, has attained 30 ft. in height. It is perfectly hardy, even in the south of Norway. This has been largely planted in many places, the tallest that we have seen being at Bowood, where it is 43 ft. high. At Westonbirt and at The Hendre there are fine specimens 35 to 40 ft. high. At Baron's Court, Co. Tyrone, the seat of the Duke of Abercorn, there are several good specimens about 25 ft. high, planted about forty years ago, which, like most of the older trees of this variety, have become bare at the base on the north side.

2. Var. *Allumi* (var. *Fraseri*). Similar to var. *erecta viridis* in habit, but bluish in colour, due to the presence of a glaucous bloom on the leaves. Sir Herbert Maxwell tells us that this variety has come true from seed.

3. Var. *erecta filiformis*.¹ Similar to var. *erecta viridis* in habit, but with very slender branches and branchlets.

4. Var. *ericoides*. Branchlets very slender; leaves bright green, free and spreading at the apex.

5. Var. *Smithii* is columnar in habit, being nearly the same in diameter at the top as it is at the base. The foliage is glaucous.

6. Var. *Wisseli*¹ is also columnar in habit, with erect crowded branches and branchlets. The leaves are said to be juvenile in character, subulate, and spreading, with a glaucous tint; but in an example at Kew they are only slightly more spreading than in the type.

II. *Pendulous in habit.*

7. Var. *gracilis*. This name may be given to varieties with slender pendulous branches, the original form² of which originated in Waterer's nursery at Knap Hill, and received a first-class certificate from the Royal Horticultural Society in 1870. A more pendulous form, var. *gracilis pendula*, originated in Barron's nursery, Borrowash, Derby. In var. *gracilis aurea*³ all the branches are similarly pendulous, but the growths of the current season are golden yellow in spring, changing to bright green in autumn, and to dark green in the succeeding year. A pendulous variety with white foliage, var. *pendula alba*, raised by Paul and Son, obtained⁴ a first-class certificate at a meeting of the Royal Horticultural Society in 1869. At Little and Ballantyne's nursery, Carlisle, there is a peculiar pendulous variety, about 8 ft. high, resembling in form the weeping variety of *Sequoia gigantea*.

¹ Cf. *Gard. Chron.* xxv. 116 (1899).

² *Gard. Chron.*, 1870, p. 249.

³ The original plant was raised in the Hillsborough Nursery, Co. Down, and was purchased by the late Earl Annesley, *Gard. Chron.* xvi. 192 (1894). It was very beautiful in colour when I saw it in July 1907.

⁴ *Gard. Chron.*, 1869, p. 1067.

III. *Spreading in habit.*

8. Var. *intertexta*. A robust plant, with distinct and arching branches, and remote stout divaricate branchlets. Foliage slightly glaucous or bluish green.¹

9. Var. *juniperina*. Branchlets regularly pinnate, the ultimate divisions slender, with the leaves free at their apices, and yellowish green in colour.

10. Var. *patula*. Of pyramidal compact habit, with the branchlets very slender and forming fan-shaped expansions; leaves dark green, shining.

11. Var. *Youngi*, Masters, in *Gard. Chron.* i. 176 (1887). Of elongated pyramidal habit, with ascending, loosely-arranged, more or less concave and twisted branches.

12. Var. *filifera*. Branches spreading or sub-pendulous; the terminal branchlets being very long, with short remote lateral branchlets. There are good examples of this peculiar variety at Grayswood, Haslemere, and at Brickendon Grange, Herts.

IV. *Dwarf in habit.*

13. Var. *nana*. This includes the dwarf varieties, the original form having been obtained² in 1861 by Dauvesse. It is ovoid in shape, with stiff erect flattened branches and branchlets, and seldom exceeds 3 ft. in height. There is, however, a specimen at Westonbirt, said to be forty years old, which is about 7 ft. high. There are two distinct forms, one bluish green, which is the best, and another light green. Coloured dwarf varieties are also known as var. *nana alba*, with yellowish white foliage, and var. *nana glauca*, with very glaucous foliage.

V. *Coloured varieties.*

14. Var. *albo-spica*. Densely pyramidal in habit; terminal branchlets variegated with creamy-white. Forms known as *albo-maculata*, *albo-picta*, and *argenteo-variegata*, are very similar, if not identical, with this variety. The best example that we have seen of this is at Inverary, where it measured about 30 ft. in 1908.

15. Var. *argentea* (var. *glauca*). Foliage very glaucous, varying from almost a silvery white to steel blue. The forms known as "Silver Queen" and "Triomphe de Boskoop"³ are similar, but differ somewhat in their degree of glaucescence. The latter is said to be the bluest conifer known. Other glaucous forms known as var. *Bowleri* and var. *californica* are in cultivation at Kew.

16. Var. *albo-variegata*. A dwarf compact variety, with the foliage profusely spotted and blotched with white. This originated in the Coombe Wood Nursery.

17. Var. *aurea*. Foliage golden yellow in the spring and summer of the first year, greenish yellow in autumn and winter following, becoming green in the second year. This is one of the best and most vigorous golden conifers for formal gardens and lawns, and has been largely planted at Baron's Court, where it forms a number of round compact bushes about 15 ft. high and as much in diameter. It requires exposure to full sunlight to bring it to perfection. It was shown by Waterer⁴

¹ A MS. note of Dr. Masters says that this was the form which first appeared in cultivation at Lawson's nursery.

² *Gard. Chron.*, 1864, p. 579. In the King's Acre Nursery, Hereford, a dwarf bright green variety, known as var. *pygmea*, is only 3 ft. high after twenty-four years' growth.

³ Cf. *Gard. Chron.* xxv. 116 (1899).

⁴ *Gard. Chron.*, 1870, p. 315.

at a meeting of the Royal Horticultural Society in 1870, and obtained a first-class certificate.

18. Var. *lutea*.¹ Paler yellow in colour, but equally fine, and of a more erect habit. About the best that we have seen is a tree now about 25 ft. high at Castlewellan.² Var. *ochroleuca* appears to be another yellowish variety.

DISTRIBUTION

The Lawson cypress in its distribution occupies a much smaller area than *Thuja plicata*, with which it mingles at its northern limit, and which it entirely resembles in its occurrence as a shade-bearer in the mixed coniferous forest of western North America at low altitudes. It grows in south-western Oregon and north-western California, in a climate characterised by moderate temperatures, heavy rainfall, a high degree of humidity, a foggy atmosphere, and a large proportion of cloudy days. On the coast the temperature ranges between 10° and 95° Fahr., and the rainfall between 30 and 100 in., averaging 56 in. Increase in altitude is attended by greater seasonal and daily ranges of temperature, and by an increase in snowfall; but the Lawson cypress, usually growing below 3000 ft. (rarely reaching 5000 ft.), is only luxuriant and plentiful in the region under the influence of the ocean winds.

In Oregon it reaches its northern limit on Coos Bay, and is most abundant in Coos and Curry counties on the western slopes of the foothills of the coast range.³ It extends across the coast range to Camas valley in Douglas County, twenty-six miles south-west of Roseburg, and goes farther inland in Josephine County, extending to Love's Station, sixteen miles west of Grant's Pass, and to Selma and Waldo; while it appears to be scattered throughout the Siskiyou mountains between Oregon and California. In California it extends southward as an unimportant component of the Redwood belt on the coast as far south as Humboldt County,⁴ and attains its most inland point (a hundred miles from the coast) on the southern slopes of Mount Shasta, at the headwaters of the Sacramento river.

This cypress nowhere forms pure woods, but is always scattered through the forest singly or in small groups, though near Port Orford it is very abundant, and in some places forms 25 per cent of the mixed forest of Douglas fir, Sitka spruce, hemlock, and Thuja. At Coquille, the most northerly point where I saw this species, it occurs on the slopes of the low hills, on which there is a luxuriant forest of enormous trees of several species, with a dense underwood of *Acer circinatum* and tall fern (*Aspidium munitum*), forming a scene like that of the Redwood belt in California. Here the Lawson cypress is most prized on

¹ Mentioned as an entirely new plant in *Gard. Chron.*, 1873, p. 6.

² Figured by Earl Annesley, *Beautiful Trees*, 52 (1903).

³ Sargent in *Gard. Chron.* xvi. 8 (1881), estimated that the belt in which this tree occurs most abundantly from north of the mouth of the Coquille river southward, about twenty miles long and twelve miles wide, contained 200,000 million feet, board measure, and speaks of the immense destruction of Port Orford cedar by a forest fire some years previously, which raged for three months in the vicinity of Coos Bay.

⁴ Mr. Henry Melde of Eureka says that trees 75 to 100 ft. high occur along the gulches of the Mad river in Humboldt County (*Erythea*, v. 99 (1897)).

account of its superior timber; but it is surpassed both in size and numbers by the Douglas and Thuja, which attain 250 to 300 ft. in height and 20 to 30 ft. in girth, while the largest cypress that I measured was¹ only 200 ft. by 14 ft. 6 in. A tree which had been felled had a diameter, exclusive of bark, of 44 in., and showed 220 annual rings, with 2½ in. of sapwood, containing thirty-three rings.

I saw a great deal of this species on my way by stage-coach from Grant's Pass, on the railway, through the Siskiyou mountains to the Redwood belt on the coast of California at Crescent City. Here it follows the course of the streams up to 3000 ft., growing in company with Douglas fir and other species in shady ravines, and attaining about 120 ft. in height and 3 ft. in diameter. On the dry hills it is immediately replaced by *Libocedrus decurrens*, though Pinchot says it is occasionally found on dry and sunny exposures in company with *Pinus ponderosa* and *P. Lambertiana*. Both here and at Coquille I saw numerous seedlings, less numerous but very uniform in appearance, in the shade of the parent tree in the forest; while they were excessively common on clearings and on agricultural land on the outskirts of the forest, and showed great variation when they were exposed to sunlight in youth. They grow most freely on mossy banks, rooting between the crevices. In the Redwood belt I saw cypress trees only on the banks of wide streams, where they are much smaller in stature and girth than the immense redwoods behind them. Pinchot says, however, that this species grows well in the north-west of California in swampy situations near the sea, associated with Sitka spruce, *Abies grandis*, and hemlock, but rarely forming a considerable part of the forest.

In Oregon close to the coast it thrives on sandy soil, and grows even on the sand dunes within reach of the spray of the ocean. In this State it has to compete with *Thuja plicata* in the moister deeper soil, as the latter species tends to outgrow and suppress it. In the forest it has a straight cylindrical stem, free of branches for half its height, with a slender drooping leader, which is bent away from the direction of the prevailing wind. It begins to bear seed when six to twelve years old, continuing annually in profusion to an advanced age. This abundance of seed enables it to spring up readily on logged-over and burnt areas. Seedlings in Oregon 5 ft. high showed ten annual rings. It occasionally is seen with a double stem; but, as a rule, it repairs its leader readily, which is, however, rarely injured except high up in the mountains when there is a heavy snowfall. It differs from all the other cypresses in its remarkably thick bark, which in its structure of two layers resembles that of the redwood. (A. H.)

CULTIVATION

William Murray first sent seeds of this tree from the valley of the upper Sacramento river in California to Lawson's nursery at Edinburgh in 1854, but only

¹ Sargent, Pinchot, and Mayr all agree in giving 200 ft. in height and 12 ft. in diameter as the maximum measurements of the Lawson cypress, but I doubt if it ever exceeds 7 ft. in diameter. The Douglas fir, Redwood, and Thuja, wherever they are associated with the Lawson cypress, much surpass it both in height and girth. Sir Victor Brooke, quoted by Lord Annesley in *Beautiful Trees*, 8 (1903), states that he measured a Lawson cypress 66 ft. 11 in. in girth, but he evidently refers to *Thuja plicata*, as there is nothing in his diary to show that he was ever in the region where the Lawson cypress grows.

four plants were raised, of which one growing at this nursery was 11 ft. 2 in. high in 1865, and is figured in *Pinetum Britannicum*, p. 194. In 1855¹ a larger supply of seed was sent by the same collector, and it soon became one of the most popular and generally cultivated trees all over Great Britain, where it is seen in almost every villa garden; but its value as a forest tree has been almost lost sight of. It yields seed² profusely at a very early age, and develops so many varieties of size, habit, and colour that it is hardly possible to believe that they have all had a common origin. The usual manner of propagation adopted by nurserymen is by cuttings, which are easily struck, and reproduce the different named varieties which are most admired; but if it is desired to plant the tree in a situation where it will have room to develop its natural size and habit, it is far better to gather seed from the tallest and most clean-stemmed trees, and select from the seedlings those which follow their parent most closely.

Self-sown seedlings of this tree are found in many places where the soil and shelter are suitable, but of the millions of good seeds which must be shed annually, only a very small proportion succeed in passing through their delicate first stage. It is best to sow the seeds in a box, and keep them shaded and watered in a frame for a year or two. I have seen a self-sown seedling at Penllergare, near Swansea, 30 ft. high, which Sir John Llewellyn thought to be about as many years old.

The seedlings can be raised as cheaply as spruce, and much more so than silver fir. They grow fast and vigorously after the first two years on almost any soil, and are very easy to transplant in autumn or spring, though for cold localities I prefer September. Large plants should not be used in exposed situations, as on account of their dense foliage they are apt to be swayed by the wind.

It is perhaps premature to say that this is a valuable forest tree, for it has not been long enough in Europe to show whether it will grow to a really large size; and has seldom been planted closely enough together, or in situations where it has had a fair chance to show its capacity for forming a fairly clean trunk.

Its hardiness is astonishing, as in the greater part of the native habitat the climate is mild and damp, and severe frosts are unknown; and yet in Murray's³ own words: "So far as is yet known there is not a hardier plant in Britain. Exposed in the winter of 1860-61 to the extremest cold which has visited this country in the memory of the present generation, it remained as green and fresh in the greatest frost and most exposed and unfavourable districts as in the midst of summer. Mr. Palmer's tables give only two slightly injured out of seventy-nine reported on." This was written about 1865, and has been amply confirmed by later experience.⁴

As regards soil it is equally accommodating, for though like all other trees it enjoys a good fertile loam, it will grow on dry sandy and on poor limestone

¹ Beardsley found this tree near Empire City on Coos Bay in 1855, and Kellogg described his specimens as *C. fragrans* in 1857. Plants cultivated under the latter name are identical with *C. Lawsoniana*. Cf. *Gard. Chron.*, 1869, p. 252.

² Unwin, *Future Forest Trees*, 94 (1905), states that a pint of seed weighs $\frac{1}{3}$ lb., and contains nearly 300,000 seeds. Of seed raised in the forest district of Freising near Munich, 70 per cent germinated.

³ In Lawson, *Pinet. Brit.* ii. 193 (1866).

⁴ Masters, in *Journ. Roy. Hort. Soc.* xix. 433 (1896), says that the young growths of Lawson's cypress suffered in the vicinity of London from the abnormal frost of February 1895 as they had never before been observed to do. *Var. erecta viridis* was much more injured than the ordinary spreading forms.

soils, a cold and wet peat being, according to Kent, the only one unfavourable to it.¹

It is not, so far as we know, subject to any fungoid disease in this country.

It endures heavy shade and requires close planting to keep its trunk free from large branches. It has a tendency to fork, especially when grown from cuttings. Judging from what I have seen, the beech will probably be its best nurse, though on damper ground alder might be preferable, and I should expect it to be one of the best evergreens to use for under-planting, or filling up gaps in thin woods. In Earl Bathurst's park at Cirencester a large number were planted on the edge of one of the broad grass drives leading west from the "Ten Rides," and these, surrounded and shaded by beech trees, have grown to be over 60 ft. high in about fifty years or less, and for the most part have trunks which are much less branchy than spruce or silver fir would be in similar conditions. These trees are growing on thin dry oolite soil not more than 6 to 8 in. deep, and as Mr. R. Anderson tells me were planted in 1864. The average height of twelve of them in January 1909 was 55 ft., and the average girth 3 ft. If we estimate their cubic contents at about 10 ft. each, one might reasonably expect to grow on this land 200 to the acre, giving 2000 cubic feet per acre in fifty years. Our Plate 98, of Larches, near the Woodhouse in the same park, shows trees under similar conditions.

For avenues, Lawson cypress seems very suitable, provided that trees of uniform habit and equal growth are selected, and for this purpose they should be frequently transplanted before their final selection, as in the nursery some vigorous trees generally take the lead and keep it, whilst others remain comparatively dwarfish.

As a cheap and ornamental hedge plant it has many advantages. Its shade of green is more agreeable than any other evergreen used for this purpose, and its feathery branchlets are more graceful than the rigid shoots of the holly or yew. According to a writer in *Woods and Forests*, small plants, 18 in. to 4 ft. high, should be used for this purpose, as they can be clipped and headed back until they become dense at the base. They may be planted, 12 to 18 in. apart, according to the size of the plants. Such hedges are best clipped in early September.

In the eastern United States, Lawson cypress thrives from New York southwards; but in New England it merely survives in sheltered situations, and Sargent² says that it cannot be used for general planting.

In Germany³ Lawson cypress has been tried in forest plots at different stations in Prussia, the total area being about thirty acres, and at Grafrath in Bavaria. Judging from an experience of twenty years, the wood grown in Germany is as good as that of Oregon. Heartwood begins to form in the tenth year with the characteristic fragrant odour of the timber in America. Trees, which had succumbed to the worst enemy of this species, *Agaricus melleus*, were successfully used for palings, without removing the bark. Another fungoid disease, *Pestalozzia funerea*,

¹ It grows, however, on deep bog at Churchill, Armagh, where it had been planted with Scots pine and birch, and numerous natural seedlings sprang up which were used for transplanting on other parts of the estate.—(A. H.)

² *Garden and Forest*, x. 430 (1897).

³ Cf. Schwappach, *Anbauversuche fremdl. Holzarten*, 26 (1901); Mayr, *Wald- u. Parkbäume*, 272, fig. 74 (1906); and Unwin, *Future Forest Trees*, 93, fig. 2 (1905).

has proved disastrous to many plantations in Germany. This attacks the young branchlets, and is readily recognised by the appearance of a white resinous drop, by the decay of a band of bark, and by a characteristic swelling in the part of the branchlet beyond, which continues to grow for a time. Mayr says that after a severe frost in April, when the temperature fell to 10° Fahr., Lawson cypress at Grafrath was attacked by *P. funerea*, which, however, killed only the weakly trees, the stronger plants surviving. Mayr recommends close planting, about 3 ft. apart, in mixture with light-loving deciduous trees; and gives a picture of a plot where oaks thirty-five years old had been underplanted successfully twenty years ago with Lawson cypress.

REMARKABLE TREES

There are many specimens of this tree all over Great Britain from 50 to 60 ft. high; but it is difficult to select the finest. The tallest that I have measured in England is one at Eggesford, which in 1908 was 70 ft. by 5 $\frac{3}{4}$ ft. At Killerton two of very different habit stand together on the slope behind the house (fig. 309), and measured in 1906 about 65 ft. by 6 ft.

At Brickendon Grange, Herts, there is a beautiful avenue, 100 yds. long and 8 ft. wide, of this tree, planted 8 ft. apart in the line; and an average specimen measured in 1907, 52 ft. high and 2 $\frac{1}{2}$ ft. in girth. At Ryston Hall, Downham, Norfolk, there is another fine avenue.

At Canford Manor, the seat of Lord Wimborne in Dorsetshire, I measured in 1906 a fine specimen, said to have been planted about forty years ago, which was 53 ft. by 6 ft.; and at Belvoir Castle one of about the same age was 56 $\frac{1}{2}$ ft. by 4 ft. 10 in. in 1908.

At Leaton Knolls near Shrewsbury, the seat of Major Lloyd, there is a very handsome tree 59 ft. by 4 ft. 4 in.; and at Willey Park, the seat of Lord Forester, near Broseley, a slender tree is 59 ft. by 3 ft. 9 in.

In south Wales the tree grows everywhere very vigorously, the tallest I have seen being a slender tree crowded in the pinetum at Singleton Abbey, the seat of Lord Swansea, which, in 1907, was about 75 ft. by 3 $\frac{1}{2}$ ft. At Penrhyn Castle and elsewhere in north Wales there are many fine trees.

In Scotland the tree is as common as in England, every place where conifers have been planted having some fine examples, but at Murthly there are more and bigger ones than I have seen elsewhere. In a flat below the castle, a lawn, measuring 50 yds. by 25 yds., has been surrounded with fine trees nearly 50 ft. high, very uniform in habit, whose branches now touch each other and form a dense enclosure.

At Dupplin Castle, near Perth, there are fine trees, one¹ of which was 55 ft. high in 1891, and is probably now the tallest in Scotland; and at Moncrieffe House there are some nearly as large. At Shanbally, Dumfries, Henry measured in 1904 a tree 60 ft. by 8 ft. 5 in. at 3 ft., dividing above into three stems; and at Benmore, where the tree has been largely planted, it seems to enjoy the very wet climate as much as *Thuja plicata*.

¹ Malcom Dunn, in *Journ. Roy. Hort. Soc.* xiv. 89 (1892), who reports a tree of similar height at Rossie Priory.

In Ireland this species is, if possible, even more vigorous than in Scotland, and certainly grows faster. A tree at Kilmacurragh, Co. Wicklow, was reported¹ in 1906 as being about 80 ft. high, but the tallest that I could find when I was there in 1908, and which I believe to be the same tree, was only 60 ft. by 6 ft. There are three very fine ones in a group in the valley west of Castlewella, of which the late Lord Annesley took a photograph (Plate 310) at my request shortly before his death. Though I was unable to measure them accurately, I believe they are well over 60 ft. high, and a tree in his garden which forms the first illustration in his book, measured 62 ft. high in 1903.

TIMBER

Though this splendid timber has long been known and valued in Oregon and California, where it is second in value only to that of *Cupressus nootkatensis*, it does not appear to be known in European commerce. Sargent describes it as light, hard, strong, and very close-grained, abounding in fragrant resin, very durable in contact with the soil, easily worked and capable of taking a good polish. All these good qualities are well shown by some boards of this wood which I purchased in San Francisco, and which have been used for lining a wardrobe made for me by Messrs. Emanuel of London, who considered it one of the nicest woods for the purpose they had ever seen. The scent is extremely fragrant and persistent, so that linen kept in this wardrobe comes out with an odour more agreeable and delicate than that of camphor wood; but this scent is not present in a sample brought by Henry from Myrtle Creek, Oregon, which I believe to be taken from a tree long dead. This gives it a great advantage over the wood of *C. nootkatensis* for all inside work; and if selected and sawn from the butts of old trees, which show some figure, it would be very handsome wood for decorative purposes.

Mr. L. J. Simpson, manager of the Simpson Lumber Co. at North Bend, Oregon, whose mills are near the forest of this tree in Coos County, writes to me as follows:—"We have cut many logs of white cedar which are 6 to 8 ft. in diameter. Some of them get hollow at heart after attaining a great age, but this is very much less frequent than it is in red cedar or redwood. I enclose you a photograph of a spruce tree 7 $\frac{1}{2}$ ft. in diameter, which has grown on the fallen stem of a smaller white cedar, the roots extending like the claws of a parrot around each side of the tree, and locking together underneath. The spruce tree must be over 200 years old, and the white cedar is to-day as sound as any of the green standing trees near it. You will notice in this photograph that the moss and dead leaves which have accumulated on the fallen log have been scraped away to show the soundness of the wood."

The Simpson Lumber Co. state in their circular that vessels built of this wood on Coos Bay over forty years ago are still as sound as when launched, the essential oil in the wood seeming to act as a preservative; and the smell is stated to be an absolute safeguard against moths when used for chests, presses, or wardrobes.

¹ *Gard. Chron.* xl. 351 (1906).

They also say that the trees are usually sound and free from hollow butts, and produce a large proportion of lumber free from knots.

Mayr¹ states that each species of the cypress family, including *Thuja*, etc., has a wood recognisable by a special odour, that of *C. nootkatensis* being the strongest and most disagreeable. The wood of Lawson cypress, he adds, is so strongly aromatic, that it can easily be smelt on approaching a saw-mill where it is being cut up, and many pieces of the wood are so saturated with an oily resin that they become heavy and reddish in colour. He speaks of the durability of the wood in the highest terms, saying that, when used as piles for building in swampy ground near the sea-coast, it lasts four or five times as long as that of Douglas fir.

The trees in this country are as yet too young and mostly too branchy to show how soon these good qualities will be developed, but I have no doubt that in time it will be one of our most valuable home-grown timbers. (H. J. E.)

CUPRESSUS THYOIDES

Cupressus thyoides, Linnæus, *Sp. Plant.* ii. 1003 (1753); Loudon, *Arb. et Frut. Brit.* iv. 2475 (1838); Masters, in *Journ. Linn. Soc. (Bot.)* xxxi. 352 (1896); Sargent, *Silva N. Amer.* x. 111, t. 529 (1896); Kent, Veitch's *Man. Conif.* 231 (1900).

Chamaecyparis spherioidea, Spach, *Hist. Veg. Phaner.* xi. 331 (1842).

Chamaecyparis thyoides, Britton, Steens, and Poggenburg, in *Prel. Cat. New York*, 71 (1888); Sargent, in *Garden and Forest*, ii. 484 (1889), and *Trees N. Amer.* 82 (1905).

Thuja spheroidalis, Richard, *Mém. Conif.* 45 (1826).

Thuja spherioidea, Sprengel, *Syst.* iii. 889 (1826).

A tree, attaining in New England 50 ft. in height and 2 ft. in diameter, and in the south-eastern United States 80 ft. high and 4 ft. in diameter. Bark, an inch thick, reddish brown, irregularly divided into narrow flat connected scaly ridges, which are often spirally twisted around the stem. Branches of the sixth year very slender, terete, brown, smooth, but retaining traces of the leaves, which roughen with their brown acute spreading tips the branchlets of the third, fourth, and fifth years. Branchlet systems alternate,² somewhat umbellate or radiating, forming short erect wedge-shaped expansions, tri-pinnate, with the pinnæ more or less in one plane and often directed to one side. Ultimate branchlets flattened, $\frac{1}{30}$ in. wide. Leaves, $\frac{1}{16}$ to $\frac{1}{12}$ in. long, glaucous green, and not marked with whitish lines or streaks; lateral pairs conduplicate, with mucronate spreading tips; facial pairs appressed, ovate-triangular, acute, flat or keeled; most of the leaves marked on the back with a conspicuous raised circular resinous gland. Leaves on the main axes, equal in length, glandular, $\frac{1}{8}$ in. long, oblong, with a triangular mucronate spreading tip.

Staminate flowers minute, dark brown, with five or six pairs of stamens. Pistillate flowers with ovate acute spreading dark brown scales, and black ovules.

¹ *Waldungen N.-Amer.* 318 (1890).

² The peculiar branching of this species is described by Masters, in *Journ. Linn. Soc. (Bot.)* xxvii. 288 (1890).

Cones ripening in the autumn of the first year, globose, $\frac{1}{4}$ in. in diameter, on the end of a short scaly branchlet, bluish purple and covered with a glaucous bloom when ripe, ultimately reddish brown; scales six, each with an ovate acute, often reflexed central process. Seeds one or two on each scale, $\frac{1}{10}$ in. long, ovate, brown, without resin-vesicles, and with narrow wings. Cotyledons two.

VARIETIES

This species appears to show little or no variation in the wild state. Under cultivation a number of peculiar forms have arisen:—

1. Var. *leptoclada*, Kent, Veitch's *Man. Conif.* 232 (1900).

Var. *andelyensis*, Carrière, *Conif.* 123 (1867).

Retinispora leptoclada, Gordon, *Pinetum Suppl.* 91 (1862).

Retinispora andelyensis, Carrière, in *Rev. Hort.* 1880, p. 36, figs. 4, 8.

Chamaecyparis leptoclada, Henkel and Hochstetter, *Syn. Nadelh.* 257 (1865).

A shrub with close-set branches, terminating in flattened branchlet systems, bearing partly adult foliage and partly primordial acicular leaves, which soon tend to disappear. This originated in M. Cauchois's nursery at Andelys (Eure) about 1850, and the plants were, in 1861, put on the market by Messrs. Henderson and Co., of the Wellington Nursery, St. John's Wood. This shrub produces fruit freely, and according to Carrière comes true from seed.¹ It is cultivated for sale at Rogers's nursery near Southampton, but is such a slow grower, that it is not much in favour, and seems to be less hardy than the type.

2. Var. *ericoides*, Beissner, *Nadelholzkunde*, 67 (1891).

A small dense pyramidal bush, with spreading subulate primordial leaves, glaucous in colour, but turning bronze or purplish brown in winter. This is supposed to be a juvenile form of *C. thyoides*; but its origin is doubtful, and by different authors it has been called a *Cupressus*, a *Juniperus*, a *Retinispora*, a *Frenela*, and a *Widdringtonia*.²

3. Var. *glauca*, Endlicher, *Syn. Conif.* 62 (1847). Occasionally known as var. *lewensis*. A shrubby form with glaucous foliage.

4. Var. *nana*, Endlicher, *Syn. Conif.* 62 (1847).

A dwarf bluish form, forming a small rounded bush.

5. Var. *Hoveyi*, a slender form with short ultimate branchlets, forming dense terminal tufts.

6. Var. *variegata*, Endlicher, *Syn. Conif.* 62 (1847).

Leaves yellowish. Loudon mentions a variegated form which was received at Chiswick from the Dunganstown Nursery in Ireland about 1831.

DISTRIBUTION

This tree grows mainly in maritime swamps in the Atlantic and Gulf states, which are liable to be overflowed by the sea during several months of the year.

¹ This is confirmed by Mr. Paul. Cf. *Proc. Roy. Hort. Soc.* xxxiv. p. cccix. (1909).

² Cf. Sargent, in *Garden and Forest*, x. 430 (1897). It is probably the same as *Retinispora pseudosquarrosa*, Carrière, *Conif.* 140 (1867), and in *Rev. Hort.*, 1880, p. 96, who says it was obtained at Le Mans in 1840 by M. Bergeot from a seed of *C. thyoides*.

It extends from southern Maine to northern Florida, and westward to Pearl River, Mississippi, forming pure forests in the north, and mingling with deciduous cypress and other moisture-loving species in the south. It is confined in Maine to the southern part of York County, and in New Hampshire to Rockingham County. It is common in south-eastern Massachusetts and in Rhode Island, and is occasionally seen in Connecticut on wet peat mosses.¹ Harper² describes the cedar swamp along Baldwin Creek on Long Island, where there are thousands of trees 30 to 40 ft. high and 3 to 10 in. in diameter. He says it is one of the very few trees in the north that are indigenous both in the glaciated region, and on the coastal plain. In the south, Harper states that it has a very erratic and local distribution, being entirely absent from Georgia, and confined strictly to near the sea-coast. He found it abundant for a few miles in Moore County, North Carolina, between Aberdeen and Keyser, where it grew in non-alluvial swamps between the sand-hills. It also grows in some parts of New Jersey and Maryland, and in the great Dismal Swamp of Virginia. Mayr³ found the average size of trees growing on white sandy soil in Alabama to be 86 ft. in height and 2 ft. in diameter; in New York it attains 19 in. in diameter at 128 years old. Plate 311 is from a photograph taken in North Carolina, for which we are indebted to the U.S. Forestry Bureau. (A. H.)

CULTIVATION

The white cedar was introduced⁴ into England by Peter Collinson in 1736; but it has never flourished except in rare cases, and its cultivation has been entirely neglected for the last fifty or sixty years.

Though Loudon states that in his time there was a magnificent specimen at Pains Hill 50 ft. high and 2 ft. in diameter, and another in the Duke of Devonshire's grounds at Chiswick, we can now find no trace of these.

The only good specimens which we have seen in cultivation are:—At Woburn Abbey, where by a walk leading to the estate office, I found in 1908 the finest tree of the species known in England, growing in rather damp soil, and measuring 46 ft. by 4½ ft. The next best are two at Arley Castle, which measured 44 ft. by 2 ft. 7 in., and 35 ft. by 2 ft. 9 in., in 1907. Another grows in rather heavy land at Strathfieldsaye, and measured in 1907, when it was bearing fruit, 38 ft. by 3 ft. 10 in.

A specimen at Pencarrow was 27 ft. by 3 ft. in 1909. There are others at Bayfordbury and High Canons in Herts, and at Kew. The glaucous form is flourishing at Little and Ballantyne's nursery, Carlisle, where it is reported that this species is perfectly hardy. It ripened seed as far north as Biel in 1825.⁵

We are informed by Mr. F. R. Twemlow that at Peatswood, Market Drayton,

¹ Dame and Brooks, *Trees of New England*, 25 (1902).

² In *Torreya*, iii. 122 (1903), vii. 199 (1907), and in *Rhodora*, vii. 71 (1905).

³ *Waldungen Nord-Amer.* 193 (1890).

⁴ Aiton, *Hort. Kew.* iii. 372 (1789). The following note, written by Peter Collinson, probably refers to this tree:—"Juniper, a new species, raised from Peter Kalm's seeds that he gave me, which he collected in a journey from Philadelphia to Quebec, and so to the Falls of Niagara and back to Pennsylvania. It has fine silver leaves." Cf. Dillwyn, *Hortus Collinsonianus*, 16 (1843).

⁵ *Caled. Hort. Soc.* iii. 412 (1825).

there are three trees of which the best is 31½ ft. high and 4 ft. 4 in. in girth near the ground, where it divides into several stems.

It is probable that if it was planted on the southern coast in suitable places it would be longer-lived, and might be worth trying on account of its ornamental appearance and interest. As Loudon, however, points out, a swamp would probably be too cold in summer in this country; and a deep moist sand is probably the best soil for it.¹

TIMBER

In America the wood of this tree is highly valued for shingles, which were formerly used in New York, Philadelphia, Baltimore, and other towns in the district where it grows, in preference to those made of the wood of the deciduous cypress, because they do not split when nailed on the rafters. They were said to be more durable than white pine shingles, and to last for thirty to thirty-five years. It was also largely used by coopers for casks; and the poles are still highly valued for telegraph and fencing posts.

Defebaugh² quotes from Hough's *Report on Forestry* (1877), and from Cook's *Geology of New Jersey* (1868), very interesting details on the submerged cedar forests, which are found near Dennisville and elsewhere in New Jersey, and which are supposed by geologists to have been caused either by a subsidence of the land or an irruption of the sea. The trees here were larger than any found living in the adjacent country within the memory of man, some having been dug up which were 6 ft. in diameter, while trees 4 ft. through were common.

"The timber which is buried in the swamps undergoes scarcely any change, and trees which have been buried hundreds of years are as sound as ever. It would seem that most of the timber which ever grew in these swamps is still preserved in them. Trunks of trees are found buried at all depths, quite down to the gravel, and so thick that in many places a number of trials will have to be made before a sounding-rod can be thrust down without striking against them. Tree after tree, from 200 to 1000 years old, may be found lying crossed one under the other, some partly decayed, as if they had died and remained standing a long time and then been broken down. Others had been blown down, and some had continued to grow for a long time after falling, as known by the heart being much above the centre, and by the wood on the under side being hard and boxy. The trees lie in all directions, as if fallen at different times, and their united ages, as shown where trees have grown where others have fallen, amounts to some thousands of years. The process of mining this timber is as follows:—With an iron rod the swamp is sounded till it hits what is thought to be a good log. Its length and size is determined by the rod, as near as may be. A hole is dug with a sharp spade

¹ Since writing the above, I have seen *C. thyoides* flourishing in the remarkable plantation near Borleaux, made eighty to ninety years ago at Catros, by a nurseryman of that name. M. Jaille, the present proprietor, showed me, among other rare American trees, a specimen of this measuring 52 ft. by 4½ ft., and others perhaps taller with trunks clean to 8 or 10 ft. high. Several self-sown seedlings were growing in this place on a sandy moist soil, similar to that of the Landes.

² *History of the Lumber Industry of America*, ii. 494 (Chicago, 1907).

down to the log and a chip obtained, which, by its smell, shows whether it was a windfall or a breakdown. If the former, it was probably sound when it fell, and has since remained so. If thought worth working, the matted roots are cut away, the log is sawed off, and when loosened it at once floats in the water, which is always near the level of the swamp. Logs are sometimes worked, though rarely, to a length of 30 ft. These logs come up with as much buoyancy as newly-fallen cedar, not being in the least water-logged, and the bark on the under side is quite fresh. The under side is always lightest, and turns up in rising to the surface. The workmen go over the same ground again and again, and find new logs each time, the lower logs probably rising in the mud when the roots over them are cut loose, and the logs which had laid on them are removed. These logs are found not only in the swamp, but also out in the salt-marsh beyond the living timber, and are worked below present tide-level.”

(H. J. E.)

QUERCUS

Quercus, Linnæus, *Gen. Pl.* 291 (1737), *Sp. Pl.* 994 (1753); Bentham et Hooker, *Gen. Pl.* 407 (1880).

Lithocarpus, Blume, *Bijdr. Fl. Ned. Ind.* 526 (1825).

Synædrys, Lindley, *Introd. Nat. System*, 441 (1836).

Cyclobalanopsis, *Cyclobalanus*, and *Pasania*, Oersted, in *Vidensk. Medd. Kjöbenh.*, 1866, pp. 77-81.

TREES or shrubs, belonging to the order Fagaceæ. Buds usually clustered at the ends of the branchlets, covered with numerous scales, imbricated in five ranks, and marking when they fall the bases of the branchlets with ring-like scars. Leaves either deciduous in autumn or in the following spring, or persistent two to four years; simple, alternate, five-ranked, stalked; lobed, toothed, or entire.

Flowers unisexual or rarely perfect, monœcious, apetalous, in spikes or catkins. Staminate flowers: calyx four- to seven-lobed; stamens four to six, rarely two, ten, or twelve, with slender filaments. Pistillate flowers, each enclosed in an involucre of imbricated scales; calyx six-lobed; ovary with two ovules in each of the three to five cells; styles three to five.

Fruit, a nut (the acorn), ripening in one or two years, with a large pale scar at the base, more or less surrounded by the woody cupule, resulting from the growth of the involucre of the flower. The acorn contains one seed, which is marked at the base, apex, or sides by the aborted ovules; cotyledons thick and fleshy, not raised above the ground on germination.

About 275 species of oak have been described, inhabiting the temperate regions of the northern hemisphere and high altitudes within the tropics, ranging in the New World southwards to Colombia, and in the Old World to the Malay Archipelago.

The genus may be divided into the following sections, one of which, *Pasania*, is now considered by many botanists to be a distinct genus.

* *Staminate flowers in pendulous, slender, clustered spikes. Styles flattened, with the stigmatic surface on the upper side.*

I. LEPIDOBALANUS, Endlicher.

Staminate flowers solitary. Pistillate flowers in few-flowered separate spikes. Cupule of the fruit saucer- or cup-shaped, with imbricated scales, free at their apices.

This section includes, with one exception (*Q. densiflora*), all the oaks of North America, Europe, northern Africa, and western Asia; and a large number

of those in the Himalayas and eastern Asia. Many of these are in cultivation, and may be grouped into the following subsections:—

(a) *Erythrobalanus*, Spach.

Fruit ripening in two years; aborted ovules in the upper part of the acorn; cupule scales all appressed. Trees with bristle-pointed leaves, confined to North America, and comprising the oaks there known as willow, black, and red oaks. The introduced species are—*Q. Phellos*, *Q. cinerea*, *Q. imbricaria*, *Q. nigra*, *Q. marylandica*, *Q. cuneata*, *Q. ilicifolia*, *Q. velutina*, *Q. Kelloggii*, *Q. rubra*, *Q. coccinea*, *Q. palustris*, *Q. Schneckii*, with deciduous foliage; and *Q. agrifolia*,¹ *Q. Wislizeni*, and *Q. crassipes*, with evergreen foliage.

(b) *Cerris*, Spach.

Fruit ripening in two years; aborted ovules at the base of the acorn; cupule scales spreading, often reflexed.

Trees of Europe, northern Africa, and Asia. The species in cultivation are—*Q. Cerris*, *Q. Ægilops*, *Q. castaneifolia*, *Q. Libani*, *Q. macedonica*, *Q. serrata*, *Q. variabilis*, and *Q. dentata*,² with deciduous foliage; *Q. alnifolia* and *Q. coccifera*, with evergreen foliage.

(c) *Leucobalanus*, Engelmann.

Fruit usually ripening in one year; aborted ovules at the base of the acorn; cupule scales appressed.

Trees of North America, Europe, northern Africa, and Asia. All the oaks which are known to produce timber of the first quality belong to this subsection, which may be divided into three groups:—

(a) Leaves evergreen. The species in cultivation are—*Q. Ilex* and *Q. Suber*³ of the Mediterranean region, *Q. incana*³ and *Q. semecarpifolia*³ from the Himalayas, *Q. phillyræoides*³ from Japan, and *Q. chrysolepis* and *Q. glabrescens* from North America.

(β) Leaves deciduous. The white oaks of North America. The species in cultivation are—*Q. alba*, *Q. lyrata*, *Q. macrocarpa*, *Q. lobata*, *Q. bicolor*, *Q. Prinus*, *Q. Muehlenbergii*, *Q. prinoides*, and *Q. obtusata*.

(γ) Leaves deciduous. Natives of the old world. The species in cultivation are—*Q. pedunculata*, *Q. sessiliflora*, *Q. lanuginosa*, *Q. Toza*, *Q. conferta*, *Q. Mirbeckii*, *Q. pontica*, *Q. macranthera*, *Q. lusitanica*, *Q. infectoria*, *Q. glandulifera*, *Q. grosseserrata*.

II. CYCLOBALANOPSIS.

Flowers as in *Lepidobalanus*. Cupule of the fruit cup-shaped, with scales united into concentric zones.

Evergreen trees, inhabiting the Himalayas, China, and Japan; leaves

¹ This species ripens its fruit in one year.

² In this species the fruit ripens in one year.

³ The leaves of *Q. semecarpifolia* are subevergreen. In *Q. Suber*, var. *occidentalis*, *Q. phillyræoides*, *Q. incana*, and *Q. semecarpifolia*, the fruit ripens in the second year.

usually dentate. The introduced species are *Q. glauca*, *Q. Vibrayeana*, and *Q. acuta*.

** *Staminate flowers in erect, simple or panicled spikes. Styles terete, erect, stigmatic at the apex only.*

III. PASANIA.

Staminate flowers solitary or in cymes of two to five. Pistillate flowers, in separate spikes or at the base of the staminate spikes. Fruit ripening in two years; cupule various, (a) completely enclosing the acorn and dehiscent or indehiscent at maturity, (b) cup-shaped, with scales imbricated and free at their apices, or (c) cup-shaped, with scales coalesced into concentric zones.

This section comprises about 100 species, all evergreen trees, with entire or toothed leaves, mostly inhabiting eastern and south-eastern Asia and the Malay Archipelago, one species (*Q. densiflora*) occurring in California. The latter species and two from Japan, *Q. glabra* and *Q. cuspidata*, have been introduced into cultivation.

The following artificial key of the cultivated species of *Quercus* is based upon the characters of the branchlets, leaves, and buds.

I. *Leaves deciduous in autumn, or early in the following year, falling before the new leaves appear.*A. *Leaves entire, with a bristle at the apex.*1. *Quercus Phellos*, Linnæus. United States. See p. 1228.

Branchlets glabrous. Leaves oblong or lanceolate, glabrous beneath, 2½ to 5 in. long, about ½ in. wide; stalk ⅛ to ¼ in.

2. *Quercus cinerea*, Michaux. United States. See p. 1230.

Branchlets tomentose. Leaves lanceolate, white-tomentose beneath, 2 to 3 in. long, ½ to ¾ in. wide; stalk ⅛ to ¼ in.

3. *Quercus imbricaria*, Michaux. United States. See p. 1231.

Branchlets glabrescent. Leaves lanceolate, with a greyish green stellate-pubescent under surface, 4 to 6 in. long, 1 to 2 in. wide; stalk ½ in.

B. *Leaves lobed; lobes and their teeth tipped with long fine bristles.** *Leaves oblong, with short variable lobes.*4. *Quercus heterophylla*, Michaux. A hybrid. See p. 1233.

Branchlets glabrous. Leaves glabrous, except for axil-tufts beneath, 3 to 6 in. long, 1 to 2 in. wide; stalk ½ to 1½ in.

5. *Quercus Leana*, Nuttall. A hybrid. See p. 1232.

Branchlets stellate-pubescent. Leaves with scattered stellate pubescence beneath, 5 to 7 in. long, 2 to 2½ in. wide; stalk ½ to 1 in.

6. *Quercus nigra*, Linnæus. United States. See p. 1235.

Branchlets glabrous. Leaves extremely variable, oblong with three to seven short lobes, obovate, or oval; glabrous beneath, except for axil-tufts; 3 to 4 in. long, 1 to 2 in. wide; stalk short, not exceeding ¼ in. long.

** *Leaves obovate,¹ with three to five lobes.*

7. *Quercus marylandica*, Muenchhausen. United States. See p. 1236.
Branchlets at first stellate-pubescent, later glabrous. Leaves with dense bands of stellate pubescence along the sides of the midrib and nerves, 5 to 7 in. long and wide; stalk not exceeding $\frac{1}{2}$ in.
8. *Quercus ilicifolia*, Wangenheim. United States. See p. 1238.
Branchlets pubescent. Leaves densely white or grey tomentose beneath, 3 in. long, 2 in. wide; petiole $\frac{1}{2}$ in. long.
9. *Quercus cuneata*, Wangenheim. United States. See p. 1237.
Branchlets pubescent. Leaves either (a) cuneate at the base and three-lobed above; or (b) oblong obovate, five- to seven-lobed, cuneate or rounded at the base; densely grey tomentose beneath; 5 to 7 in. long, 3 to 4 in. wide; petiole $\frac{3}{4}$ to 1 in. long.
10. *Quercus Catesbaei*, Michaux. United States. Not now in cultivation in England.
Branchlets glabrescent. Leaves (Plate 333, Fig. 1) divided into three to five long narrow lobes; lower surface glabrous, except for dense pubescence in the axils and on the main nerves; stalk $\frac{1}{4}$ to $\frac{3}{4}$ in. long.

*** *Leaves oval, with seven to nine large lobes, usually toothed.*

(a) *Leaves densely tomentose beneath.*

- 10A. *Quercus cuneata*, Wangenheim. See No. 9, the five- to seven-lobed form.
11. *Quercus pagodaefolia*, Ashe. United States. See p. 1237, note 2.
Not yet introduced. Leaves similar to the five- to seven-lobed form of *Q. cuneata*, but covered beneath with a silvery white tomentum; stalk $1\frac{1}{2}$ to 2 in. long.
- (b) *Leaves, with scattered stellate pubescence over the whole of the lower surface.*
12. *Quercus velutina*, Lamarck. United States. See p. 1239.
Branchlets with scattered stellate pubescence. Leaves shining dark green above; lower surface with rusty pubescent axil-tufts; 5 to 9 in. long, 4 to 5 in. wide; stalk 1 to 3 in. long.
13. *Quercus Kelloggii*, Newberry. California, Oregon. See p. 1241.
Branchlets glabrescent. Leaves without axil-tufts beneath, 3 to 6 in. long, 2 to 4 in. broad; stalk 1 in. long.

(c) *Leaves glabrous beneath, except for tufts of pubescence in the axils.*

Branchlets glabrous.

14. *Quercus rubra*, Linnæus. North America. See p. 1242.
Leaves with axil-tufts inconspicuous or absent, dull green beneath, turning dull red or reddish brown in autumn, 5 to 8 in. long, 4 to 6 in. broad. Buds $\frac{1}{4}$ in. long, reddish, pubescent only at the tip.
15. *Quercus coccinea*, Muenchhausen. North America. See p. 1247.
Leaves with axil-tufts inconspicuous or absent, shining green on both

¹ *Quercus nigra* (See No. 6), in the form with obovate leaves, would be found here.

- surfaces, turning scarlet in autumn, 3 to 6 in. long, $2\frac{1}{2}$ to 4 in. broad. Buds $\frac{1}{8}$ to $\frac{1}{4}$ in. long, whitish pubescent in their upper half.
16. *Quercus palustris*, Muenchhausen. United States. See p. 1250.
Leaves with conspicuous axil-tufts, turning scarlet in autumn, 4 to 6 in. long, 2 to 4 in. wide. Buds $\frac{1}{8}$ in. long, pale brown, glabrous.
17. *Quercus Schneckii*, Britton. United States. See p. 1251.
Not distinguishable with certainty in the absence of fruit from *Q. palustris*.
*** *Leaves ovate, with ten or more sharp triangular teeth or lobes.*
18. *Quercus Ægilops*, Linnæus. Greece, Asia Minor. See p. 1268.
Leaves tomentose beneath, margin and bristles ciliate, 3 to 4 in. long, $1\frac{1}{2}$ to 2 in. broad. Branchlets tomentose. Buds with persistent stipules.
- C. *Leaves serrate, each serration ending in a long projecting bristle or spine.*
19. *Quercus serrata*, Thunberg. Himalayas, China, Japan. See p. 1275.
Branchlets glabrescent. Leaves oblong-lanceolate, with ten to sixteen pairs of lateral nerves, each ending in a serration; green and glabrous beneath, except for slight axil-tufts; 4 to 8 in. long, 1 to 2 in. wide.
20. *Quercus variabilis*, Blume. China, Japan. See p. 1276.
Similar to the last, but with leaves covered beneath with a dense white tomentum.
21. *Quercus Libani*, Olivier. Syria, Asia Minor, Armenia. See p. 1274.
Branchlets pubescent or glabrescent. Leaves lanceolate, with nine to twelve pairs of lateral nerves, each ending in a serration; wrinkled in margin, glabrous beneath except on the midrib and nerves; 3 in. long, $\frac{3}{4}$ in. wide.
22. *Quercus semecarpifolia*, Smith. Himalayas. See p. 1297.
Branchlets stellate-pubescent. Leaves¹ subevergreen, elliptical, with six to ten pairs of lateral nerves, forking before reaching the spinose-serrate margin; 3 in. long, 2 in. broad.
- D. *Leaves lobed or toothed, each tooth or lobe ending in a projecting short mucro.*
* *Axillary buds without persistent stipules.*
23. *Quercus macedonica*, De Candolle. Macedonia, Albania, Montenegro, Herzegovina, and south-eastern Italy. See p. 1273.
Branchlets with scattered pubescence. Leaves lanceolate, 2 in. long, subsessile, broad and auricled at the base, with nine to twelve pairs of nerves each ending in a serration; margin wrinkled.
24. *Quercus glandulifera*, Blume. China, Korea, Japan. See p. 1327.
Branchlets glabrescent. Leaves obovate, 3 to 5 in. long, with eight to eleven pairs of nerves, all but the lowest one or two pairs, ending in a mucronate serration; lower surface appressed pubescent, and usually glaucous.
25. *Quercus Turneri*, Willdenow. A hybrid. See p. 1288.
Branchlets stellate-pubescent. Leaves subevergreen, obovate, 3 to 5 in. long, with five to eight pairs of nerves, all but the lowest one or two pairs,

¹ The leaves on old trees are entire or slightly undulate and without spines.

- ending in a sinuate mucronate tooth;¹ lower surface green, with scattered stellate pubescence.
26. *Quercus pontica*, Koch. Western Caucasus and Lazistan. See p. 1321.
Branchlets glabrous. Leaves elliptic, 6 in. long, 3 in. broad, with fifteen to twenty pairs of nerves, each ending in an incurved mucronate serration; lower surface glaucous, pilose on the midrib and nerves, elsewhere glabrous.
- 26A. *Quercus lusitanica*, Lamarck. See No. 50.
** *Axillary buds surrounded by long filiform stipules.*
27. *Quercus castaneæfolia*, Meyer. Algeria, Caucasus, north Persia. See p. 1271.
Branchlets pubescent. Leaves oblong, 3 to 6 in. long, $1\frac{1}{2}$ to $2\frac{1}{2}$ in. wide, with eight to fourteen pairs of nerves, each ending in a mucronate triangular tooth; lower surface pale green, covered with a minute tomentum.
28. *Quercus Lucombeana*, Sweet. A hybrid. See p. 1259.
Branchlets tomentose. Leaves subevergreen, variable in size and shape, 2 to 5 in. long, with rather irregular mucronate lobes or teeth, densely white or grey tomentose beneath.
- E. *Leaves lobed or toothed, without projecting bristles or points.*
* *Branchlets glabrous or glabrescent.*
(a) *Leaves regularly toothed, or shortly lobed with shallow sinuses.*
† *Leaves obovate.*
29. *Quercus bicolor*, Willdenow. North America. See p. 1307.
Leaves white tomentose beneath and velvety to the touch, with six to eight pairs of rounded, rarely acute teeth; 5 to 6 in. long, 2 to 4 in. wide; petiole $\frac{1}{2}$ in. long.
30. *Quercus prinoides*, Willdenow. United States. See p. 1311.
Leaves white or pale beneath with a minute scattered pubescence; with four to seven pairs of rounded, rarely acute teeth; 4 in. long, 2 in. wide; petiole $\frac{1}{4}$ to $\frac{1}{2}$ in. long.
31. *Quercus Mirbeckii*, Durieu. Portugal, Algeria. See p. 1318.
Leaves glaucous and glabrous beneath, except for brown flocculent tomentum along the midrib; with nine to fourteen pairs of rounded or acute teeth; 4 to 6 in. long, 3 in. wide; petiole $\frac{1}{2}$ to $\frac{3}{4}$ in. long.
32. *Quercus Prinus*, Linnæus. North America. See p. 1309.
Leaves pale beneath with a minute pubescence disappearing in summer; with nine to fourteen pairs of rounded teeth; 6 in. long, 3 in. wide; petiole $\frac{1}{2}$ to 1 in. long.
33. *Quercus Michauxii*, Nuttall. North America. Not now in cultivation.
Leaves (see Plate 336, Fig. 34), lower surface green or whitish, covered with conspicuous stellate tomentum; with twelve to seventeen pairs of small triangular teeth; 6 in. long, 3 in. wide; petiole $\frac{1}{2}$ to $1\frac{1}{2}$ in. long.
34. *Quercus grosseserrata*, Blume. Japan. See p. 1327.

¹ In var. *pseudoturneri* the mucro is often obsolete.

- Leaves, lower surface pilose on the midrib and veins, elsewhere glabrous; with twelve to fifteen pairs of regular triangular teeth; 4 to 6 in. long, 3 to $3\frac{1}{2}$ in. wide; subsessile, petiole not exceeding $\frac{1}{8}$ in.
‡ *Leaves lanceolate.*
35. *Quercus Muehlenbergii*, Engelmann. North America. See p. 1310.
Leaves narrower than in *Q. Prinus*, 6 in. long, 2 in. wide, with eight to fifteen pairs of inflexed, rounded or acute teeth; with a minute pubescence beneath, often disappearing in summer; petiole $\frac{3}{4}$ to $1\frac{1}{2}$ in. long.
(b) *Leaves irregularly toothed, or with conspicuous lobes and deep sinuses.*
† *Leaves quite glabrous beneath.*
36. *Quercus obtusata*, Humboldt and Bonpland. Mexico. See p. 1312.
Leaves subevergreen, falling in March, obovate, 4 to 5 in. long, narrowed and auricled at the base, margin with irregular callous-tipped teeth; petiole $\frac{1}{4}$ to $\frac{3}{8}$ in.
37. *Quercus pedunculata*, Ehrhart. Europe. See Vol. II. p. 282.
Leaves deciduous in autumn, obovate, auricled at the base, with four to six pairs of mostly entire irregular lobes; 3 to 6 in. long; lateral nerves ending both in the lobes and in the sinuses; petiole usually less than $\frac{1}{4}$ in.
†† *Leaves pubescent beneath.*
38. *Quercus sessiliflora*, Salisbury. Europe. See Vol. II. p. 291.
Leaves obovate, cuneate at the base, with four to six pairs of mostly entire irregular lobes; nerves ending in the lobes; 3 to 5 in. long; lower surface green with scattered pubescence, densest on the midrib and nerves; petiole $\frac{1}{2}$ to 1 in. long.
39. *Quercus alba*, Linnæus. North America. See p. 1301.
Leaves obovate, cuneate at the base, with seven to nine irregular, mostly entire lobes; upper lateral lobes smaller than those in the middle; lower surface pale or glaucous, uniformly covered with a very minute pubescence; 5 to 7 in. long; petiole $\frac{1}{2}$ in. long.
40. *Quercus lyrata*, Linnæus. United States. See p. 1303.
Leaves obovate, cuneate at the base, with five to nine irregular triangular lobes, the upper two lateral lobes broad and emarginate and larger than the lower lobes; lower surface pale, with a minute pubescence throughout; 7 to 8 in. long; petiole $\frac{1}{4}$ to $\frac{3}{4}$ in.
** *Branchlets pubescent.*
(a) *Terminal and axillary buds surrounded by persistent stipules.*
41. *Quercus Cerris*, Linnæus. Southern Europe, Asia Minor. See p. 1254.
Leaves oblong or oval, about 5 in. long, with seven or eight pairs of entire or toothed lobes; lower surface green or greyish, covered with a minute stellate pubescence.
42. *Quercus macranthera*, Fischer and Meyer. Caucasus, north Persia. See p. 1322.
Leaves obovate, 4 to 5 in. long, with seven to eleven pairs of short, usually entire lobes; lower surface densely tomentose.

(b) Only the terminal buds surrounded by persistent stipules.

† Leaves large, more than 4 in. long.

43. *Quercus conferta*, Kitaibel. South-eastern Europe. See p. 1316.

Leaves obovate, 5 to 8 in. long, with six to eight pairs of regular, entire or sinuately toothed deep lobes, with sinuses extending half-way to the midrib; under surface green or greyish, covered with a thin minute stellate pubescence. Branchlets with scattered pubescence.

44. *Quercus Toza*, Bosc. France, Spain, and Portugal. See p. 1313.

Leaves obovate, 5 to 8 in. long, with five to six pairs of irregular, entire or sinuately toothed deep lobes; under surface greyish or whitish, covered with a dense soft tomentum. Branchlets densely tomentose.

45. *Quercus macrocarpa*, Michaux. N. America. See p. 1304.

Leaves obovate, 6 to 12 in. long, usually with five to seven lobes, the terminal lobe large and crenately lobulate, lateral lobes small with deep sinuses; under surface pale with a deciduous minute appressed pubescence.

46. *Quercus dentata*, Thunberg. China, Manchuria, Korea, Japan. See p. 1277.

Leaves obovate, 6 to 12 in. long, with six to nine pairs of shallow regular rounded, usually entire lobes; lower surface pale with a scattered minute stellate pubescence.

47. *Quercus stellata*, Wangenheim. North America. Not now in cultivation. See Plate 336, Fig. 32.

Leaves oblong obovate, 4 to 5 in. long, five-lobed, with deep sinuses; upper surface with conspicuous stellate hairs; lower surface densely pubescent.

† Leaves small, not exceeding 4 in. long.

48. *Quercus lobata*, Née. California. See p. 1306.

Leaves obovate, 3 in. long, with seven to eleven irregular lobes, the lateral lobes broad at their apex; both surfaces stellate-pubescent.

49. *Quercus lanuginosa*, Thuillier. S. Europe. See Vol. II. p. 294.

Leaves obovate, 3 to 4 in. long, with four to eight pairs of rounded, usually entire lobes; wrinkled in margin; under surface tomentose.

50. *Quercus lusitanica*, Lamarck. Mediterranean region. See p. 1322.

A very variable species, with leaves 2 to 4 in. long, obovate or oblong; margin wrinkled with regular or irregular teeth, with or without a mucro; lower surface covered with a dense grey tomentum.

51. *Quercus infectoria*, Olivier. Cyprus, Asia Minor, Turkey. See p. 1325.

Mainly distinguished from *Q. lusitanica* by the glabrescent under surface of the leaf.

- 51A. *Quercus Turneri*. See No. 25.

II. Leaves evergreen, persisting more than one year on the branchlets.

A. Leaves entire on margin, or occasionally undulate-crenate towards the apex.

52. *Quercus glabra*, Thunberg. Japan. See p. 1332.

Leaves lanceolate or elliptical, 4 to 5 in. long, acute or cuspidate at the

apex, tapering at the base and prolonged as a narrow wing on each side of the petiole; under surface glabrous. Branchlets glabrous.

53. *Quercus acuta*, Thunberg. Japan. See p. 1330.

Leaves similar to those of *Q. glabra*, but with a long acuminate apex. Young branchlets covered at first with a brown tomentum, which quickly disappears, some, however, remaining near the tip of the branchlets or above the insertion of the leaves.

54. *Quercus cuspidata*, Thunberg. China, Japan, Formosa. See p. 1332.

Leaves elliptical, 2 to 3 in. long, with a long acuminate apex; lower surface glabrous. Branchlets slender, scaly.

55. *Quercus crassipes*, Humboldt and Bonpland. Mexico. See p. 1254.

Leaves oblong, 2 to 3 in. long, with a bristle point at the apex, brown tomentose beneath. Branchlets pubescent.

- 55A. *Quercus Ilex*. See No. 56.

B. Leaves distinctly toothed in margin, and plainly pubescent on the lower surface.

* Leaves white or grey beneath.

(a) Leaves not lanceolate.

56. *Quercus Ilex*, Linnæus. Mediterranean region. See p. 1281.

Leaves very variable, ovate or oval, 1 to 3 in. long; margin entire or spinose-dentate; lower surface covered with a dense greyish or whitish tomentum; lateral nerves, seven to ten pairs; stipules long, linear, persistent around the terminal bud.

57. *Quercus Suber*, Linnæus. Mediterranean region. See p. 1292.

Leaves ovate or oblong, about 2 in. long, usually concave; margin with small mucronate teeth; lower surface covered with a dense greyish tomentum; lateral nerves, five to seven pairs; stipules short, linear-obovate, occasionally persistent, but inconspicuous around the terminal bud.

58. *Quercus alnifolia*, Poech. Cyprus. See p. 1278.

Leaves orbicular or obovate, 1½ to 2 in. long, usually concave; margin with minute mucronate teeth; lower surface covered with a dense yellowish grey tomentum; lateral nerves, five to eight pairs, very prominent.

(b) Leaves lanceolate

59. *Quercus incana*, Roxburgh. Himalayas. See p. 1298.

Leaves elliptic-lanceolate, acuminate at the apex, 3 to 6 in. long; nerves, ten to fifteen pairs, each ending in a mucronate triangular serration; lower surface densely white tomentose.

60. *Quercus glauca*, Thunberg. Himalayas, China, Japan. See p. 1328.

Leaves ovate-lanceolate, acuminate, about 3 in. long; nerves, about ten pairs; mucronate-serrate in the upper half; lower surface white, with scattered appressed silky hairs.

** Leaves green beneath.

61. *Quercus glabrescens*, Benth. Mexico. See p. 1300.

Leaves obovate-oblong, 2 to 2½ in. long, with a few gland-tipped teeth in

the upper half; lateral nerves, seven or eight pairs; lower surface yellowish green with a scattered stellate pubescence.

62. *Quercus chrysolepis*, Liebm. Oregon, California, Lower California. See p. 1299.

Leaves very variable; on young trees, oblong-ovate, 2 in. long, with eleven to twenty-one spine-tipped, small, triangular teeth; lower surface pubescent with scattered yellow appressed hairs and dotted with minute shining glands.

- C. *Leaves distinctly toothed in margin, glabrous or nearly so on the lower surface.*

* *Leaves over 3 in. long.*

63. *Quercus Vibrayeana*, Franchet and Savatier. China, Japan. See p. 1329.

Leaves lanceolate, 3 to 4 in. long, acuminate; lateral nerves, nine to twelve pairs, inconspicuous; margin mucronate-serrate in the upper half; lower surface glaucescent. Branchlets glabrous.

64. *Quercus densiflora*, Hooker and Arnott. Oregon, California. See p. 1331.

Leaves oblong, 3 to 4 in. long, acute at the apex; lateral nerves, about twelve pairs, very prominent; margin serrate; lower surface whitish, glabrous or with rusty pubescence on the midrib at the base. Branchlets stellate-tomentose.

** *Leaves less than 3 in. long.*

65. *Quercus agrifolia*, Née. California. See p. 1252.

Leaves ovate or orbicular, $1\frac{1}{2}$ to 2 in. long, with seven to thirteen spine-tipped teeth; lateral nerves, four to five pairs, prominent; lower surface glabrous, except for conspicuous reddish axil-tufts.

66. *Quercus phillyraeoides*, A. Gray. China, Japan. See p. 1298.

Leaves oval or obovate, $1\frac{1}{2}$ to 2 in. long, with seven to twenty serrations in the upper half or two-thirds; lateral nerves, about eight pairs, very slender, scarcely raised; lower surface glabrous, except for dense pubescence on the midrib at the base, continuous with that on the petiole.

67. *Quercus coccifera*, Linnæus. Mediterranean region. See p. 1279.

Leaves oval or oblong, 1 to $1\frac{1}{2}$ in. long; margin wrinkled, with nine to seventeen spine-tipped teeth; lateral nerves, five to ten pairs, inconspicuous. Buds ovoid, obtuse, $\frac{1}{10}$ in. long.

68. *Quercus Wislizeni*, A. de Candolle. California, Lower California. See p. 1253.

Leaves similar to those of *Q. coccifera*, but darker green in colour. Buds conical, pointed, $\frac{1}{8}$ in. or more in length. (A. H.)

CULTIVATION OF THE AMERICAN OAKS

Though many of the American Oaks have been for at least a century in this country, and have been repeatedly introduced at various times, yet very few have established themselves in popular favour as ornamental trees; and none can be said to have any economic value, which would justify their being

planted as forest trees. The most valuable in America, the white oak, seems unable to live for more than a few years in any part of this country; and none of the group to which it belongs, so far as we know, have ever attained a size which would justify our advising them for general cultivation.

Q. virginiana, Miller, the live oak of North America, which is widely spread in the southern United States and in Mexico, differs only slightly in botanical characters from *Q. Ilex*; but is not hardy in England, although Loudon,¹ who refers to it as *Q. virens*, Aiton, states that there was a tree of it at Kew, 40 to 50 ft. high, in 1838. This tree was no doubt *Q. Ilex*. There is no specimen now at Kew; and Mr. Bean² reports that living plants imported in recent years have died even in mild winters. Bunbury³ says that one planted at Barton, Suffolk, was speedily killed.

Though several of the Californian oaks⁴ have been introduced, and a few are living at Kew, Tortworth, and elsewhere, they do not grow with the same vigour which many of the conifers of the west coast of America have shown, and probably require a much warmer and drier summer climate. *Q. Garryana*, Hooker, *Fl. Bor. Am.* ii. 159 (1839), is a large and picturesque tree, found along the Pacific slope, from British Columbia, Vancouver Island, and Washington, where it is the only species known, through Oregon to the Santa Cruz mountains in California. So far as we know, it has never been tried in England, which is remarkable, considering how easy it would be to procure acorns. It might possibly succeed well in our climate. According to Schneider, *Laubholzkunde*, i. 206 (1904), who mentions a plant in the Darmstadt Botanic Garden, it was recently introduced into Germany by C. A. Purpus.

Of the group, known as the red and black oaks, several have been fairly successful; and though, with the exception of *Q. rubra*, not often planted at the present time, they are well worth more attention than they receive, on account of the beautiful colour of their leaves in autumn.

Most of the American oaks which were grown by Loddiges and other English nurserymen seventy to eighty years ago, were propagated by grafting on the common oak close to the ground; but now that acorns can be procured so much more quickly through the post, it would seem better to raise them from seed. Although the practice of grafting is not to be recommended for many genera of trees, yet we have seen many instances of oaks grafted close to the ground on suitable stocks, which have produced fine and sometimes very large trees. The main points seem to be that the stock shall be a vigorous one, with good fibrous roots which have not been stunted in pots; and that the species selected for the stock should be suited to the scion, and to the soil. *Quercus pedunculata* is a good stock, on strong land, for species allied to it, *Q. sessiliflora* for lighter soil; *Q. Cerris* for the species with mossy cups; *Q. Ilex* for the evergreen oaks of the Mediterranean region; *Q. rubra* for the American

¹ *Arb. et Frut. Brit.* iii. 1918 (1838).

² *The Garden*, lxx. 386 (1904).

³ *Arboretum Notes*, 113 (1889).

⁴ *Q. Gambelli*, Nuttall, a small tree, rarely exceeding 25 ft. in height, is widely spread at high elevations in Colorado, Utah, Nevada, Arizona, Texas, and New Mexico. It does not appear to have been introduced into Europe (cf. Schneider, *Laubholzkunde*, i. 204). The leaves are figured in Plate 333, Fig. 7.

red or black oaks. I have noticed that a better union of stock and scion seems to be produced by saddle- or cleft-grafting, than when the scion is inserted on one side of the stock.

I collected acorns of a good many species about the end of September 1904, in the Arnold Arboretum and other places in North America; and found that by packing them in small tin boxes in slightly damp moss, they arrived here in good condition, though those of the white oak germinated on the voyage. Nearly all of those which I sowed in a cold frame germinated and grew well during the following summer; but when planted out, many of them became sickly and died, apparently from insufficient summer heat to ripen their wood.

Loudon says that at the Leyton Nursery, near Stratford, there were in the autumn of 1836 a great variety of American oaks, selected from the seed beds when two years old and planted in rows. The variety and beauty of these exceeded anything he ever saw, in spring when coming into leaf, in summer when in full foliage, and in autumn when the leaves were dying off of every shade of scarlet, yellow, and purple. They were mostly ten to twelve years from the acorn, and with few exceptions were 20 to 30 ft. high. Many of these were burnt for want of purchasers, but, no doubt some of them survive in old places round London, where there may be some uncommon trees that we have not been able to discover.

Though none of the English nurseries, as far as we know, now pay much attention to the American oaks, yet they may be procured from American nurseries at one or two years old, in autumn, when they travel safely, if well packed; but if older than this the roots are too large to transplant well. The Earl of Ducie has probably planted more species and paid more attention to them than any one in England, and at Tortworth there are young trees of 20 to 30 ft. high of *Q. imbricaria*, *nigra*, *Kelloggii*, and others, which are growing fairly well in a sheltered hollow. The majority seem to prefer a deep fertile soil, rather light than heavy, with little or no lime in it; and though we have little experience as to their tolerance of shade in this country, yet if they were planted in small clearings, in the shelter of a warm sunny wood, they would probably succeed better than when exposed to cold winds in a north or east aspect. The remarkable success of several American oaks at Lyndon near Oakham in an exposed situation, shows what may be done in places where the conditions are not specially favourable.

The ultimate success of exotic trees which ripen their young wood badly in youth, seems to be largely a question of the genial character of the first few summers after planting, for if badly checked in their youth, they recover vigour slowly or never. Care should be taken by judicious pruning when young, to train them into a good shape, for slow-growing oaks resent the pruning of large limbs.

The healthy condition of the oak collection at Kew, which is by far the most complete we know of, seems largely due to the care and skill which has been given to them by a succession of able arboriculturists.

CULTIVATION OF THE MEDITERRANEAN OAKS

Though the species of oaks found in various parts of the Mediterranean region are very numerous, few of them are fit for cultivation in England, as long experience has proved. In the warmest parts of the south and east coast, especially near the sea and on good deep soil in sheltered positions, some of them will attain very large dimensions, as our account of the cork tree and *Q. Ilex* proves; but the severe winters which occur at long intervals even in these favoured places, and the want of hot dry autumnal weather necessary to ripen their late growth, too often cripple them when young, and destroy them when old. At the same time, there are several which may, with care in planting and sheltering them during their early years, be well worth more extended trials than they have had; and now that modern means of communication has brought regions which were formerly remote within easy reach by post, I would advise those planters who like variety, to try such species as *Ægilops*, *Libani*, *alnifolia*, *pontica*, *lusitanica*, *macedonica*, and *Toza*, as well as those which we know to be capable of becoming fine trees like *Mirbeckii*, *conferta*, *castaneæfolia*, and perhaps *macranthera*.

CULTIVATION OF THE ASIATIC OAKS

Though several of the Chinese, Japanese, and Himalayan oaks have proved hardy in the warmer parts of England, and are more or less ornamental on account of their evergreen foliage; yet none, so far as we can judge at present, seem at all likely to attain timber size in this country, or to be worthy of cultivation except in botanic gardens. It is perhaps premature to condemn them until they have been tried for a longer period, but it is evident that they require climatic conditions which are rarely found. The same may be said of the Mexican oaks, many of which grow at high elevations and were introduced long ago, but of which only two or three species seem to have survived.

Acorns should be procured as fresh as possible, and sown at once in deep pots or boxes, which can be kept under glass for two or three years before planting out. If acorns of suitable species are established in the places where the trees are to be planted, to serve as stocks for grafting on, when the scions are large enough, a double chance of success will be had. But in these days too little care and attention is paid to the necessary pruning and training, which almost all kinds of hardwoods require to make them really ornamental trees, and unless this is attended to every two or three years for a considerable time, as at Kew, the side branches often become so strong that the main trunk is weakened, and the shape of the whole tree spoilt. The sooner this is done in reason the better, and as the individuals of most species seem to vary very much in their constitution and vigour, it is never wise to depend on one plant

of a species to get a good tree. If three or more are planted in the space which one will eventually fill, we get to some extent the same power of selection which always operates on seedlings in nature, in the struggle for existence.

As regards soil I have observed that most oaks grow better on red sandstone than on any other soil, and though some of the oriental and Mediterranean oaks naturally grow on limestone, they do not seem to need lime here.

From an economic point of view, I say without hesitation that there is no exotic species capable of competing either on heavy or light soil with our native oaks, and though the timber of the Ilex, the Lucombe, or the cork oak may be very valuable for decorative purposes when large enough, it can rarely be grown to a profit in this country.

In *Journ. Hort. Soc.* ix. 207 (1855) there is a long list of plants describing the effect of the winter of 1853-54, which was more destructive than any since 1838, the temperature registered at Chiswick having been 8° on 28th December, and 4° on 2nd January; near Nottingham, -4°; at Chatsworth, -6°; at Bicton, 15°; and at Dropmore on 3rd January, 4°. In the list of oaks we give the names as printed:—*Quercus*, Mexican, all killed, Chiswick. *Quercus sclerophylla*,¹ killed, Acton Green; injured, Bagshot; killed, Bicton. *Quercus Ilex*, much injured in 1838, Kew; not injured, Chiswick; large tree very much injured, Shifnal; some plants fifty years old dead, Nottingham. *Quercus Gramuntia*,² killed, Rolleston, Oulton; untouched, Chiswick. *Quercus Suber*, injured, Bromley; much injured, Nottingham. *Quercus Brantii*,³ and other Kurdistan oaks, not injured by the winter, but very much injured by the frost on 24th April, Chiswick; injured, Oulton; quite safe, Congleton. *Quercus dealbata*,⁴ uninjured, Bicton. *Quercus australis*,⁵ not injured, Chiswick. *Quercus Cookii*,⁶ leaves injured only, Chiswick. *Quercus glabra*, not affected, Bagshot; not hurt, Exeter or Bicton. *Quercus mongolica*,⁷ uninjured, Shifnal.

(H. J. E.)

QUERCUS PHELLOS, WILLOW OAK

Quercus Phellos, Linnæus, *Sp. Pl.* 994 (excluding vars.) (1753); Loudon, *Arb. et Frut. Brit.* iii. 1894 (1838); Sargent, *Silva N. Amer.* viii. 179, t. 435 (1895), and *Trees N. Amer.* 247 (1905).

A tree, attaining in America 80 ft. in height and 12 ft. in girth. Bark about ½ in. thick, smooth, except on old trunks, which are roughened by longitudinal

¹ A Chinese species, introduced by Fortune in 1846, not now in cultivation, so far as we know.

² A variety of *Q. Ilex*. Cf. p. 1282.

³ *Q. Brantii*, Lindley, in *Bot. Reg.* xxvi., *app.* 74 (1840), and *Gard. Chron.*, 1853, p. 263, was introduced from Kurdistan by Sir A. H. Layard about the year 1853; but, so far as we know, is not now in cultivation. The Earl of Ducie informed me that Lord Somers raised a tree at Eastnor Castle from Sir A. H. Layard's acorns, which had borne fruit before it was blown down.

⁴ *Q. dealbata*, Wallich, *List* 2769, is now identified with *Q. incana*, Roxburgh. Cf. p. 1298.

⁵ A form of *Q. lusitanica*. Cf. p. 1322.

⁶ Identified with *Q. Ilex*, var. *Gramuntia*. Cf. p. 1282.

⁷ Probably incorrectly named. Cf. p. 1328, note 1.

narrow slightly raised scaly ridges. Young branchlets slender, reddish brown, glabrous or glabrescent. Leaves (Plate 339, Fig. 75) deciduous, thin, membranous, lanceolate, 2½ to 5 in. long, about ½ in. wide, gradually narrowing at both ends, glabrous except for slight pubescence along the midrib beneath, entire or slightly undulate in margin, with a single bristle point at the apex; venation pinnate, the primary veins dividing and looping with those adjoining before reaching the margin; petiole ⅓ to ¼ in. long, pubescent. The leaves are revolute in the bud; and on young specimens are dentate or lobed.

Fruit ripening in the second year, sessile or with short stalks, usually solitary; acorn subglobose or hemispherical, pale pubescent, enclosed at the base by a thin saucer-shaped cupule, ½ in. wide, silky pubescent on the inner surface, and covered externally by thin ovate truncate hoary pubescent scales.

This oak is supposed to form hybrids with several species, as *Q. imbricaria*,¹ *Q. marylandica*,² *Q. ilicifolia*,³ *Q. cuneata*,⁴ and *Q. palustris*,⁵ none of which are in cultivation in this country. Under the name *Q. heterophylla* (see p. 1233) a tree is occasionally cultivated, which probably includes hybrids of *Q. Phellos*, with *Q. rubra* and *Q. velutina*.

The willow oak inhabits the banks of marshes and streams, and grows also in deep sandy tracts in the uplands; and, according to Sargent, is distributed from Staten Island, New York, through the Atlantic states, where it is usually confined to the maritime plain, as far southward as north-eastern Florida, extending westward through the Gulf states to the Sabine river, Texas, and ascending the lower Mississippi basin, through Arkansas and south-eastern Missouri to central Tennessee and southern Kentucky.

According to Catesby, this tree was introduced about 1723, when it was growing in the garden of Mr. Fairchild at Hoxton. It appears, from the singularity of its leaves, to have early attracted considerable notice; and Loudon mentions several trees of large size, some of which still survive. (A. H.)

It seems to succeed better in England than most of the American oaks, except *Q. rubra* and *Q. palustris*; and, though a lover of moisture in its own country, grows well in dry situations, as on gravel soil at Kew. So far as we know, however, none of the trees in cultivation have produced acorns.

The largest we have seen is at Whitton, which was mentioned by Loudon as being 70 ft. high by 7½ ft. in girth in 1838. It is now very large, about 100 ft. high by 12 ft. 4 in., but its trunk is attacked by fungus, and though the branches produced healthy foliage in 1905 it is evidently decaying rapidly. At Kew there are two fine healthy

¹ *Q. imbricaria* × *Phellos*, Zabel, *Laubholz-Benennung*, 65 (1903); *Q. Phellos*, var. *subimbricaria*, De Candolle, *Prod.* xvi. 2, p. 63 (1864). Found by Asa Gray in New Jersey. Leaves entire, broader and more obtuse than those of *Q. Phellos*, differing from *Q. imbricaria* in the deciduous pubescence on the under surface. This is included by Sargent under the next hybrid.

² *Q. Phellos* × *marylandica*, Sargent, *Silva N. Amer.* viii. 181, t. 437 (1895); *Q. Rudkiani*, Britton, in *Bull. Torrey Bot. Club*, ix. 13 (1882). Trees, discovered in 1881 near Cliffwood in New Jersey, and subsequently seen in other parts of New Jersey and on Staten Island. Leaves trilobed at the apex; acorns intermediate between *Q. Phellos* and *Q. marylandica*. Dr. MacDougal (*Bot. Gaz.* xliii. 53, fig. 4 (1907)) raised seedlings, all of which bore foliage like that of the parent tree.

³ *Q. Phellos* × *ilicifolia*, Peters, in *Bull. Torrey Bot. Club*, xx. 295 (1893). A tree found at May's Landing, New Jersey.

⁴ Cf. Small, in *Bull. Torrey Bot. Club*, xxii. 74, fig. 232 (1895).

⁵ *Q. Phellos* × *palustris*, Schneider, *Laubholzkunde*, 165 (1904); *Q. schochiana*, Zabel, *loc. cit.*, and *Mitt. deut. dend. Ges.*, 1896, p. 9.

trees, one near the Pagoda which is divided into two main stems, and measured 85 ft. by 7 ft. 9 in. in 1909; the other near the pond is a much more spreading and thicker tree, and now measures about 55 ft. by 11 ft. At Arley Castle there is a healthy tree free from branches to about 30 ft. up and measuring 70 ft. by 5 ft. 9 in. At Cobham Park there is a fine tree of the same type 86 ft. by 8 ft. 10 in. At Croome Court, Worcestershire, there is a tree grafted on the common oak, 65 ft. by 6 ft. 5 in. At Nuneham Park, Oxon, another was in 1906, 60 ft. by 8 ft. 3 in. At Barton, Bury St. Edmunds, a slender tree measured in 1908, 64 ft. by 4 ft. 2 in.; at Ampton Park, Suffolk, another, measured by Henry in 1909, is 40 ft. by 5 ft. 10 in. At Glendurgan, Cornwall, Mr. A. B. Jackson measured a thriving tree, 40 ft. by 4 ft. 2 in. in 1908. In the Knaphill Nursery, near Woking, there are two specimens of moderate size. I have also seen specimens at Milford House, near Godalming, and at West Dean Park.

In Scotland we know of no tree of this species; but in Ireland, at Fota, there is a thriving specimen, 45 ft. by 5 ft. 4 in. in 1907. (H. J. E.)

QUERCUS CINEREA, BLUE JACK

Quercus cinerea, Michaux, *Hist. Chênes Am.* No. 8, t. 14 (1801); Sargent, in *Bot. Gaz.* xlv. 226 (1907).

Quercus Phellos, var. *brevifolia*, Lamarck, *Dict.* i. 722 (1783).

Quercus humilis, Walter, *Fl. Car.* 234 (1788) (not Lamarck).

Quercus Phellos, var. *sericea*, Aiton, *Hort. Kew.* iii. 354 (1789); Loudon, *Arb. et Frut. Brit.* iii. 1895 (1838).

Quercus Phellos, var. *humilis*, Pursh, *Fl. Am. Sept.* ii. 625 (1814).

Quercus brevifolia, Sargent, *Silva N. Amer.* viii. 171, t. 431 (1895), and *Trees N. Amer.* 250 (1905).

A tree, attaining in America 50 ft. in height and 5 ft. in girth, but usually smaller. Bark about an inch thick, dark brown or nearly black, divided into small square scaly plates. Young branchlets slender, coated with white stellate tomentum, most of which disappears in the course of the summer. Buds minute, ovoid, obtuse, chestnut brown, glabrous. Leaves (Plate 339, Fig. 72) deciduous, membranous, 2 to 3 in., occasionally 5 in. long, $\frac{1}{2}$ to $\frac{3}{4}$ in. broad, oblong-lanceolate, rounded or cuneate at the base, acute or rounded and with a bristle at the apex, entire and undulate in margin; upper surface dark green, shining, glabrescent; lower surface coated with thick greyish-white tomentum, disappearing in part in summer; petiole about $\frac{1}{4}$ in. long, tomentose.

Fruit ripening in the second year, sessile or shortly stalked; acorn ovoid, about $\frac{1}{2}$ in. long, hoary pubescent at the apex; cupule variable in shape, saucer or cup-like, pale pubescent within, and covered externally by thin imbricated ovate tomentose scales.

This species,¹ which appears to be a variety of *Q. Phellos*, adapted by its

¹ *Q. pumila*, Walter, which resembles this species, is shrubby in habit, ripens its acorns in one year, and is practically evergreen, carrying its leaves until the new ones appear in the following spring. Cf. Sargent, *Silva N. Amer.* viii. 115, t. 404 (1895).

tomentose leaves and branchlets to drier ground than that species, grows on sandy barren soil and on upland ridges, from North Carolina southward to Cape Malabar and Peace Creek, Florida, and westward to the Brazos river, Texas, usually not penetrating inland more than forty or fifty miles from the coast, though in Texas it has been found as far as Dallas, about lat. 33°.

Q. cinerea is extremely rare in cultivation, the only specimen which we have seen being a healthy tree, about 30 ft. high, growing on the mound in the oak collection in Kew Gardens. (A. H.)

QUERCUS IMBRICARIA, SHINGLE OAK

Quercus imbricaria, Michaux, *Hist. Chênes Am.* No. 9, tt. 15, 16 (1801); Loudon, *Arb. et Frut. Brit.* iii. 1898 (1838); Sargent, *Silva N. Amer.* viii. 175, t. 432 (1895), and *Trees N. Amer.* 251 (1905).

Quercus Phellos, Linnæus, var. *imbricaria*, Spach, *Hist. Veg.* xi. 160 (1842).

A tree, attaining in favourable localities in America 100 ft. in height and 12 ft. in girth, but usually considerably smaller. Bark on young trees thin, smooth, and shining; on old trunks fissuring into broad, flat, scaly ridges. Young branchlets slender, quickly becoming glabrous. Leaves (Plate 339, Fig. 73) deciduous, oblong-lanceolate, 4 to 6 in. long, 1 to 2 in. broad, entire,¹ with slightly undulate margin, rounded or acute at the bristle-pointed apex, cuneate at the base; upper surface dark green, shining; lower surface greyish green, covered with a stellate tomentum; nerves pinnate, dividing and looping before reaching the margin; petiole pubescent, about $\frac{1}{2}$ in. long.

Fruit usually solitary, on stout short stalks, ripening in the second year; acorn nearly globose, obscurely striate, enclosed for one-third its length in a thin shallow turbinate cupule, brown and shining internally, and covered with thin ovate pubescent reddish brown, closely imbricated scales.

This oak is supposed to form hybrids with *Q. marylandica*,² *Q. rubra*,³ *Q. palustris*,⁴ and *Q. velutina*. The hybrid with the last species, the only one known in cultivation in this country, is dealt with under the name *Q. Leana* (see p. 1232).

(A. H.)

This species is a native of fertile soil, growing both on high land and in alluvial flats, and ranges from Pennsylvania westwards through southern Michigan and Wisconsin to northern Missouri and north-eastern Kansas, extending southwards along the Alleghany mountains to northern Georgia, Alabama, middle Tennessee,

¹ The leaves on very vigorous branchlets are sometimes three-lobed at the apex.

² *Q. imbricaria* × *marylandica*, Sargent, *Silva N. Amer.* viii. 176, t. 433 (1895); *Q. nigra*, var. *tridentata*, De Candolle, *Prod.* xvi. 2, p. 64 (1864); *Q. tridentata*, Engelm., in *Trans. St. Louis Acad.* iii. 539 (1877). A single tree, now dead, found by Engelm., near St. Louis.

³ *Q. imbricaria* × *rubra*. Cf. Bush, in *Garden and Forest*, viii. 33 (1895).

⁴ *Q. imbricaria* × *palustris*, Engelm., in *Trans. St. Louis Acad.* iii. 539 (1877). A single tree found near St. Louis. Meehan raised five seedlings from its acorns, which agreed in every respect with the parent tree.

and northern Arkansas. It is comparatively rare in the east, being most abundant in the basin of the lower Ohio and in the State of Missouri, and attains its largest size in southern Indiana and Illinois. Ridgway says that with the possible exception of *Q. alba* it is the most abundant and generally distributed species in Wabash Co., Ill., where it is the most slender of all the oaks; trees 100 ft. high and 50 ft. to the first branch being only 6 to 7 ft. in girth. On poorer soil, however, where it is more abundant, it does not usually much exceed half this size. According to Sargent, it is occasionally planted in the northern states, being hardy as far north as Massachusetts.¹

Although introduced into cultivation by John Fraser in 1786, it was a rare species in Loudon's² time, and no old trees exist, so far as we know, in this country. There are, however, two at Bayfordbury, supposed to have been planted with other American oaks in 1836, one of which measured 52 ft. high and 4 ft. 8 in. in girth in 1909; the other was 40 ft. by 4 ft. 9 in.

At Tortworth there is a healthy tree, about 35 ft. high. There is a well-grown tree in Mr. Young's nursery at Milford, near Godalming, which in 1909 was 60 ft. by 4½ ft., with a bole 20 ft. long. We have also identified trees of this species growing at Westonbirt, Kew, Beauport, Aldenham, and Yattendon Court near Newbury.

(H. J. E.)

QUERCUS LEANA

Quercus Leana, Nuttall, *Sylva*, i. 13, t. 5 bis (1842); Hill, in *Bot. Gaz.* xix. 171 (1894); Sargent, *Trees N. Amer.* 252 (1905).

Quercus imbricaria × *coccinea*, Engelmann, in *Trans. St. Louis Acad.* iii. 539 (1877).

Quercus imbricaria × *velutina*, Sargent, *Silva N. Amer.* viii. 176, t. 434 (1895).

A large tree. Young branchlets stout, reddish, with scattered stellate pubescence. Leaves (Plate 334, Fig. 10) oblong, lanceolate, 5 to 7 in. long, 2 to 2½ in. wide, with three to five pairs of short triangular bristle-pointed lobes, which in some cases are minute or absent; acute and mucronate at the apex, rounded or cuneate at the base; upper surface shining, dark green, with scattered, stellate, mostly deciduous pubescence; lower surface duller and paler, with persistent stellate pubescence, scattered between the veins, but densely crowded in tufts in the axils and in bands along the midrib; venation similar to that of *Q. heterophylla*; petiole, ½ to 1 in. long, with scattered stellate pubescence.

Fruit sub-sessile or on a short stalk, usually solitary; acorn sub-globose, enclosed to near the middle in a turbinate hemispherical cupule resembling that of *Q. velutina*, which is covered with ovate loosely imbricated pubescent scales.

¹ *Q. laurifolia*, Michaux, a more southerly species, is closely allied to *Q. imbricaria*, and is figured in Plate 339, Fig. 74. It is said to have been introduced in 1786; but is apparently not in cultivation at present, and is probably unsuitable for our climate.

² Loudon only mentions one tree, which was growing in the Horticultural Society's garden at Chiswick.

This tree was discovered about 1830 by Mr. T. G. Lea near Cincinnati, Ohio, and has since been found scattered as isolated specimens over a wide area, extending from the district of Columbia and western North Carolina to southern Michigan, central and northern Illinois, and south-eastern Missouri. (A. H.)

The large tree near the Director's Office, Kew Gardens, which has long been labelled *Q. heterophylla*, appears to belong to this hybrid. It was probably planted by Sir W. J. Hooker, though its age and history are unknown. It measured in 1909 60 ft. high and 7½ ft. in girth. A smaller tree in the oak collection at Kew about 25 ft. high, obtained from Smith of Worcester in 1877 under the name *Q. villosa*, is very similar, and is certainly one of the hybrids of *Q. imbricaria*.

A tree was growing in 1903 at Devonhurst, Chiswick, formerly part of the Horticultural Society's garden, which Henry measured as 72 ft. by 6 ft. 8 in. It was cut down shortly afterwards.

At Ham Manor, Sussex, the seat of Sir H. Fletcher, there is a fine tree. When I measured it in June 1907 it was 62 ft. by 7 ft. 2 in., forking at 7 ft., and appeared to be grafted on a stock of the common oak, like the large one at Kew. A smaller tree also exists at Orton Hall.

(H. J. E.)

QUERCUS HETEROPHYLLA, BARTRAM'S OAK

Quercus heterophylla, Michaux f., *Hist. Arb. Am.* ii. 87, t. 16 (1812); Loudon, *Arb. et Frut. Brit.* iii. 1894 (1838); Engelmann, in *Woods and Forests*, 1884, pp. 735, 736; Sargent, *Trees N. Amer.* 248 (1905).

Quercus aquatica, var. *heterophylla*, Aiton, *Hort. Kew.* v. 290 (1813).

Quercus nigra, var., Cooper, in *Smithsonian Rep.*, 1858, p. 255 (1859).

Quercus Phellos × *coccinea*, Engelmann, in *Trans. St. Louis Acad.* iii. 541 (1877).

Quercus Phellos × *velutina*, Sargent, *Silva N. Amer.* viii. 180, *adnot.*, t. 436 (1895).

Quercus Phellos × *rubra*; *Quercus Hollickii*, Schneider, *Laubholzkunde*, 165 (1904).

A tree, occasionally attaining 80 ft. in height. Young branchlets glabrous. Leaves (Plate 334, Fig. 16) deciduous, lanceolate or narrow-elliptic, acute at the apex, cuneate at the base, 3 to 6 in. long, 1 to 2 in. wide; with usually three to five pairs of triangular bristle-pointed lobes, separated by wide sinuate sinuses; glabrous on both surfaces, except for axil-tufts beneath; nerves pinnate, those ending in the apices of the lobes more prominent than the intervening nerves, which divide and loop before reaching the margin; petiole ½ to 1½ in. long, slightly pubescent.¹

The above description is drawn up from a tree in Kew Gardens, about 30 ft. high, which was obtained from the Arnold Arboretum in 1877. Much variation, however, occurs in the shape of the leaves on wild trees, which are often only slightly lobed, and resemble those of *Q. Phellos*; but in all cases, as Engelmann points out,² the elongated petiole will serve to distinguish Bartram's oak from *Q. Phellos* or

¹ The fruit, which I have not seen, is said to be sparingly produced on trees in America, and in some cases is like that of *Q. rubra*, and in other cases similar to that of *Q. velutina*.

² In *Woods and Forests*, 1884, pp. 735, 736.

Q. nigra, two species which have often lobed leaves on young trees and on vigorous barren branchlets of older trees. In these species the petioles are inconspicuous, or merely 1 to 2 lines long. *Q. imbricaria*, which has long petioles, is readily distinguished in all its forms and hybrids by the pubescent leaves.

This oak was first described from a solitary tree¹ growing on the farm of John Bartram, near Philadelphia, on the banks of the Schuylkill, where it was discovered at some time previous to 1750. What appears to be the same tree has since been discovered at a considerable number of stations² from New Jersey to Texas.

Much discussion has arisen as to the relationship of Bartram's oak, and of the individuals that have been found like it; and Engelmann, who had not, however, seen flowers or fruit, considered it to be a distinct species, and not a variety of either *Q. Phellos* or *Q. nigra*, nor a hybrid of any of these oaks. The hybrid origin of *Q. heterophylla* was, however, definitely settled by an experiment of Dr. D. T. MacDougal.³ In October 1905 he collected seventy-five acorns from a tree growing on Staten Island, which had foliage similar to that of Bartram's oak; and fifty-five seedlings were obtained, which exhibited foliage of three kinds. Some of the seedlings had lanceolate entire leaves like those of *Q. Phellos*; others had broad lobed leaves like those of *Q. rubra*, while the remainder were intermediate and resembled the parent tree. In this case the parents may be assumed to be *Q. Phellos* and *Q. rubra*;⁴ but in other cases, though one of the parents is almost certainly *Q. Phellos*, the other, judging from the fruit, may be *Q. coccinea* or *Q. velutina*.

This oak appears to be very rare in cultivation, the only specimen which we have seen in England being the tree at Kew, mentioned above. Loudon says: "Said to have been introduced, but we do not know where it is to be obtained." Older trees, bearing this name, are usually *Q. Leana*. There is, however, a large tree of *Q. heterophylla* at Les Barres,⁵ about 66 ft. by 9 ft., which bears fruit regularly, but in small quantity, and is said to be very hardy. This tree was planted⁶ in 1822. Another tree at Verrières,⁶ probably of the same origin, but with slightly different foliage, measures 73 ft. by 8 ft., and bears a tuft of mistletoe on one of its large branches.

(A. H.)

¹ Otto of Berlin, in Loudon, *Gard. Mag.* xvii. 380 (1841), states that he saw *Q. heterophylla*, a tree 40 ft. high, growing in Bartram's botanic garden at Philadelphia, which was founded in 1717.

² A complete history of the occurrence of these trees is given by Arthur Hollick, in *Bull. Torrey Bot. Club.* xv. 303 (1888).

³ Cf. *Bot. Gaz.* xliii. 49, figs. 2, 3 (1907). Mehan, in *Gard. Chron.*, 1866, p. 365, speaks of two seedlings from the original tree, one a perfect *Q. Phellos*, the other like *Q. heterophylla*.

⁴ *Q. Hollickii*, Schneider, *loc. cit.*, who attempts to divide this form into three sub-varieties.

⁵ Cf. Pardé, *Arb. Nat. des Barres*, 299 (1906).

⁶ *Hortus Vilmoriniannus*, 55 (1906). A specimen branch procured by Elwes shows imperfect acorns.

QUERCUS NIGRA, WATER OAK

Quercus nigra, Linnæus, *Sp. Pl.* 995 (1753); Sargent, *Silva N. Amer.* viii. 165, t. 428 (1895), and *Trees N. Amer.* 246 (1905); Britten,¹ in *Journ. Bot.* xlvii. 349 (1909).

Quercus nigra aquatica, Lamarck, *Encyc.* i. 721 (1783).

Quercus uliginosa, Wangenheim, *Nordam. Holz.* 80, t. 6, f. 18 (1787).

Quercus aquatica, Walter, *Fl. Car.* 234 (1788); Loudon, *Arb. et Frut. Brit.* iii. 1892 (1838).

Quercus hemisphærica, Willdenow, *Sp. Pl.* iv. 443 (1805).

A tree, attaining in America 80 ft. in height and 10 ft. in girth. Bark about $\frac{1}{2}$ in. thick, covered with closely appressed scales. Young branchlets slender, glabrous. Leaves (Plate 334, Fig. 9) deciduous, late in the season, very variable in shape and size; on old trees obovate or oval, cuneate at the base, and enlarged at the broad, rounded, entire or three-lobed apex, about 3 in. long and 2 in. broad at the widest part; on vigorous and sterile branches on young trees longer and narrower, about 4 in. long by 1 in. broad, acute at the apex, cuneate at the base, with three to seven short triangular oblique bristle-pointed lobes; thin, membranous, glabrous, except for axil-tufts beneath; petiole short, $\frac{1}{8}$ to $\frac{1}{4}$ in. long.

Fruit solitary, short-stalked, ripening in the second year; acorn broad and flat at the base, rounded at the pubescent apex, enclosed for one-fourth its length in a thin saucer-shaped cupule,² about $\frac{1}{2}$ in. wide, tomentose within, and covered with ovate acute appressed pubescent scales.

The Water Oak, as its name implies, grows naturally on moist alluvial ground, and on the sandy borders of swamps and streams; and ranges from southern Delaware southward to Cape Malabar and the shores of Tampa Bay, Florida, extending inland to the base of the southern Alleghany Mountains, and westward through the Gulf states to the Colorado river, Texas, and the eastern part of Indian Territory, ascending the Mississippi basin to Arkansas, south-eastern Missouri, central Tennessee and Kentucky. On account of its rapid growth when young, and the facility with which it can be transplanted, it is used extensively as a shade tree in the cities and towns of the southern States.

According to Loudon, it was cultivated in England in Fairchild's nursery as early as 1723. Like many other interesting trees, it has scarcely been planted in this country of late years, though it is worthy of a place in all collections on account of the long persistence of the leaves, which remain fresh and green on the specimens at Kew and Tortworth till January or February, or even later in some seasons. Apparently this species does not produce fruit in England; but we have received a specimen with fully developed acorns from Mille Ivoy, Geneste, near Bordeaux.

(A. H.)

¹ Britten, in the article quoted, explains how the name *Q. nigra*, L., was erroneously transferred at an early date to *Q. marylandica*. The proper usage of the names for these two oaks was restored by Sargent.

² *Q. microcarya*, Small, *Flora S. East. States*, 350 (1903), is a form with smaller acorns, surrounded by a cup-shaped and not saucer-shaped cupule. This was found growing on granite rocks on the Little Stone Mountain in Georgia.

There are several good specimens in Kew Gardens, the largest being a tree near the main entrance, which measured, in 1909, 49 ft. by 4 ft. 5 in. This tree belonged to the old arboretum, and must be older than 1841.

At Beauport, Sussex, a tree, seen by Henry in 1904, measured nearly 50 ft. in height by 3 ft. 11 in. in girth. Another at Lyndon Hall (Plate 312) is 56 ft. by 4½ ft. There is also a smaller tree on the lawn at Tortworth. (H. J. E.)

QUERCUS MARYLANDICA, BLACK JACK

Quercus marylandica, Muenchhausen, *Hausvater*, v. 253 (1770); Sargent, *Silva N. Amer.* viii. 161, t. 426 (1895), and *Trees N. Amer.* 245 (1905); Britten, in *Journ. Bot.* xvii. 351 (1909).

Quercus nigra, var. β , Linnæus, *Sp. Pl.* 996 (1753).

Quercus nigra, Wangenheim, *Beschreib. nordam. Holzart.* 133 (1781); Walter, *Fl. Carol.* 234 (1788); Michaux, *Hist. Chênes Am.* No. 12, tt. 22, 23 (1801); Loudon, *Arb. et Frut. Brit.* iii. 1890 (1838) (not Linnæus).

Quercus nigra latifolia, Lamarck, *Encyc.* i. 721 (1783).

Quercus ferruginea, Michaux f., *Hist. Arb. Am.* ii. 92, t. 18 (1812).

A tree, attaining in America 50 ft. in height and 5 ft. in girth, but usually considerably smaller. Bark about an inch thick, divided into dark brown or nearly black, scaly, square plates. Young branchlets at first covered with a short stellate pubescence, gradually disappearing in the course of the summer; branchlets of the second year glabrous. Buds ovoid, ¼ in. long, covered with rusty brown pubescence. Leaves (Plate 334, Fig. 11) deciduous, averaging 5 to 7 in. in length and breadth, thick and coriaceous, very variable in shape, obovate, with a narrow rounded base, (*a*) with the apex broad, rounded, and indistinctly three-lobed or entire, with or without bristles, or (*b*) with the upper part of the leaf divided into three large oblong lobes, each with one to three bristle-pointed teeth; upper surface dark shining green, with quickly deciduous scattered minute stellate hairs; lower surface often brownish, with numerous stellate hairs in dense tufts in the axils and along the midrib and lateral nerves; petiole stout, ½ in. long, covered with short stellate hairs.

Fruit ripening in the second year, solitary or in pairs, shortly stalked; acorn sub-globose, ¾ in. long, with the shell lined with dense yellowish tomentum, enclosed for ½ to nearly ⅔ its length, in a thick turbinate cupule, covered by loosely imbricated tomentose scales.

This species usually grows on dry sandy barren land, though occasionally it is seen in the south-west on heavy clay soil; and is widely distributed in the United States, from Long Island, New York, southward to Tampa Bay, Florida, and westwards to south-eastern Nebraska, central Kansas, Indian Territory, and the valley of the Nueces river, Texas. Rare or local and poorly developed in the northern part of its range, it is abundant southward, often forming west of the Mississippi, a great part of the forest growth on sterile soils, and attaining its largest size in southern Arkansas and eastern Texas. (A. H.)

This tree, though introduced, according to Loudon, sometime before 1739, is rare in cultivation, and is usually short-lived in our climate. It scarcely attains the dimensions of a forest tree, but is worth a place in collections, on account of the large and curiously shaped leaves, which turn a brownish colour in autumn. It seldom has a healthy appearance, owing to the failure of the wood to ripen in autumn, and should be planted on a dry sandy soil in a warm and sheltered situation.

The largest tree we have seen is one at Lyndon Hall, Rutland, 40 ft. by 4½ ft. in 1908. There are younger trees at Tortworth, Bicton, Aldenham, and Kew. (H. J. E.)

QUERCUS CUNEATA, SPANISH OAK

Quercus cuneata, Wangenheim, *Nordam. Holzart.* 78, t. 5, f. 14 (1787); Sargent, in *Bot. Gaz.* xlv. 226 (1907).

Quercus rubra, var. *hispanica*, Castiglioni, *Viag. Stati Uniti*, ii. 347 (1790).

Quercus falcata, Michaux, *Hist. Chênes Am.* No. 16, t. 28 (1801); Loudon, *Arb. et Frut. Brit.* iii. 1882 (1838).

Quercus triloba, Michaux, *Hist. Chênes Am.* No. 14, t. 26 (1801).

Quercus elongata, Willdenow, in *Neue Schrift. Gesell. Natfr. Berlin*, iii. 400 (1801).

Quercus discolor, Spach, *Hist. Vég.* xi. 163 (1842) (not Aiton).

Quercus nigra digitata, Marshall, *Arb. Am.* 121 (1785).

Quercus digitata, Sudworth, in *Garden and Forest*, v. 98 (1892); Sargent, *Silva N. Amer.* viii. 147, tt. 420, 421 (1895), and *Trees N. Amer.* 242 (1905).

A tree, attaining in America 80 ft. in height and 9 ft. in girth. Bark divided by shallow fissures into broad scaly ridges. Young branchlets covered with a dense short stellate pubescence. Buds ovoid, ⅓ to ¼ in. long, with ciliate scales. Leaves (Plate 334, Fig. 14) deciduous in autumn, about 5 to 7 in. long and 3 to 4 in. wide, variable in shape; either (*a*) cuneate at the base, and divided into three large bristle-pointed lobes above, the terminal lobe longest and oblong, the lateral lobes shorter and ovate, each lobe entire or with one or two teeth; or (*b*) rounded or cuneate at the base, oblong-obovate, pinnately divided into five or seven entire or dentate, ovate, bristle-pointed lobes; upper surface dark green, shining, glabrescent; lower surface densely covered with dull grey minute stellate tomentum; petiole ¾ to 1 in. long, tomentose.

Fruit¹ ripening in the second year, sessile or shortly stalked; acorn sub-globose or ellipsoid, about ½ in. long, enclosed in a saucer-shaped or a deep turbinate cupule, covered with thin obtuse closely appressed scales.

This oak,² which was named Spanish oak by the early settlers from a fancied

¹ The small trees in England have not produced fruit. This species ripens its fruit at Geneste, near Bordeaux.

² *Q. pagodefolia*, Ashe, in *Bot. Gaz.* xxiv. 375 (1897); Sargent, *Silva N. Amer.* xiv. 51, t. 722 (1902), and *Trees N. Amer.* 244 (1905), was formerly considered to be a variety of *Q. cuneata*, from which it differs in the bark and in the shape of the leaves (see Plate 334, Fig. 12), which are always silvery white beneath. Specimens were gathered by Elwes in 1904 at Mt. Carmel, Illinois; but the tree has not yet been introduced. It has much the same distribution as *Q. cuneata*, but is always found in rich land along rivers liable to floods, whereas *Q. cuneata* is confined to the dry uplands. It is very abundant in the river swamps of the Yazoo basin, Mississippi, and of eastern Arkansas.

This is the form mentioned by Ridgway as a rare tree in the bottoms of the White River, where he measured a specimen 14 ft. in girth and estimated at 130 ft. high. It is unlikely to succeed in Great Britain.

resemblance probably to *Q. Cerris*, is an abundant tree on dry sterile hills in the south Atlantic and Gulf states, extending as far westward as the Bragos river, Texas, and ascending the Mississippi basin, through Arkansas, Missouri, Tennessee, and Kentucky to southern Indiana and Illinois. It is rare in the north Atlantic states, where it is only met with near the coast, reaching its most northerly point in southern New Jersey. It is one of the trees which grows, but not in great abundance, in the southern maritime pine belt.

This species was introduced in 1763 by Mr. Murdoch Murchison, and re-introduced in 1800 by Messrs. Fraser. It is extremely rare in cultivation, the only trees which we have seen being two in Kew Gardens, about 25 feet high, which are vigorous and healthy; and a small specimen at Aldenham. (A. H.)

QUERCUS ILICIFOLIA, BEAR OAK

Quercus ilicifolia, Wangenheim, *Nordam. Holzart.* 70, t. 6, f. 17 (1787); Loudon, *Arb. et Frut. Brit.* iii. 1893 (1838); Sargent, in *Bot. Gaz.* xlv. 227 (1907).

Quercus Banisteri, Michaux, *Hist. Chênes Am.* No. 15, t. 27 (1801).

Quercus rubra nana, Marshall, *Arbust. Am.* 123 (1785).

Quercus nana, Sargent, in *Garden and Forest*, viii. 93 (1895), *Silva N. Amer.* viii. 155, t. 424 (1895), and *Trees N. Amer.* 241 (1905).

A shrub or small tree, scarcely exceeding 20 ft. in height. Bark thin and scaly. Young branchlets covered with a minute dense pubescence, glabrous in the second year. Buds minute, ovoid, obtuse, glabrous, $\frac{1}{8}$ in. long. Leaves (Plate 334, Fig. 13) deciduous, about 3 in. long and 2 in. wide, coriaceous, obovate-oblong, cuneate at the base; divided by wide shallow sinuses into five short broad bristle-pointed acute lobes, the terminal lobe usually largest and often with one or two teeth; upper surface dark green, shining, with quickly deciduous minute stellate pubescence; lower surface greyish tomentose; petiole slender, $\frac{1}{2}$ in. long, tomentose.

Fruit ripening in the second year, sessile or stalked; acorn ovoid, about $\frac{1}{2}$ in. wide and long; cupule thick, turbinate, covered with closely appressed, thin, slightly pubescent scales, the minute free tips of the upper rank forming a fringe.

This species grows on dry sandy barren ground and on rocky hill-sides from Maine to eastern Pennsylvania, and along the Alleghany mountains to southern Virginia.

This oak was discovered in Virginia by the missionary John Banister, and was included in his catalogue of Virginian plants published by Ray¹ in 1688. It was introduced in 1800 by Messrs. Fraser, and is a thriving shrub at Tortworth, where it produces acorns freely; and is possibly of some value on that account for planting in game coverts as food for pheasants. There are specimens also at Kew, Westonbirt, and Liphook. At Les Barres in France it grows vigorously, and sows itself, being looked upon as good pheasant covert. (A. H.)

¹ Ray, *Hist. Plant.* ii. pp. 1926-8. It was called *Q. pumila* by Banister.

QUERCUS VELUTINA, BLACK OAK, QUERCITRON OAK

Quercus velutina, Lamarck, *Dict.* i. 721 (1783); Sargent, *Silva N. Amer.* viii. 137, tt. 414, 415 (1895), and *Trees N. Amer.* 237 (1905).

Quercus nigra, Du Roi, *Harbk. Baumz.* ii. 272 (excl. syn.), t. 6, f. 1 (1772) (not Linnæus).

Quercus discolor, Aiton, *Hort. Kew.* iii. 358 (1789).

Quercus tinctoria, Michaux, *Hist. Chênes Am.* No. 13, tt. 24, 25 (1801); Loudon, *Arb. et Frut. Brit.* iii. 1884 (1838); Bentley and Trimen, *Med. Plants*, iv. 251, t. 251 (1880).

Quercus coccinea, Wangenheim, vars. *nigrescens* and *tinctoria*, A. de Candolle, *Prod.* xvi. 2, p. 61 (1864).

A tree, attaining in America 150 ft. in height and 15 ft. in girth, but usually considerably smaller. Bark of young trees smooth, yellowish within; on old trunks divided into broad rounded scaly ridges. Buds ovoid, $\frac{1}{8}$ to $\frac{1}{4}$ in. long, angled, obtuse or pointed, pubescent. Young branchlets, with a scattered minute stellate pubescence, most of which falls off in summer. Leaves (Plate 333, Fig. 5) deciduous in autumn, turning a dull red or dark brown, variable in size and shape, but similar to those of *Q. rubra*, often very large, 9 in. long and 6 in. broad, with five to seven triangular lobes with bristle-pointed teeth; sinuses wide and rounded, variable in depth; upper surface glossy, dark green, with scattered stellate hairs, disappearing in summer; lower surface paler, with stellate hairs scattered between the nerves, and forming dense reddish brown axil-tufts; petiole 1 to 3 in. long, with deciduous or partly persistent stellate pubescence. The inner bark of young branches is bitter when chewed, and gives a yellow tinge to the saliva.

Fruit ripening in the second year, sessile or shortly stalked, solitary or in pairs; acorn¹ ovoid, $\frac{1}{2}$ to $\frac{3}{4}$ in. long, often striated, and sometimes pubescent, enclosed for about half its length in a turbinate cupule, slightly pubescent within, and covered with scales, often lacerate in margin, closely appressed towards the base of the cupule, loosely imbricated above, forming a fringe-like border to its rim.

This species is readily recognised by the bright yellow colour of the inner bark, by the more or less deciduous stellate pubescence on the leaves, petioles, and branchlets, and by the pubescent buds.

Var. *missouriensis*, Sargent, *Trees N. Amer.* 239 (1905), is a more pubescent form, growing in drier situations from western Missouri to north-western Arkansas.

The black oak grows commonly on ridges and on dry gravelly uplands, and is one of the most abundant and widely distributed of North American oaks. It occurs in southern and western Ontario, and throughout the Atlantic States from southern Maine to northern Florida, being one of the commonest oaks on gravelly drift in southern New England and in the middle states; and is generally scattered throughout the maritime pine belt of the south Atlantic

¹ The flesh of the acorn is orange in colour.

coast and of the Gulf states, extending westward to eastern Texas, Indian Territory, eastern Kansas, south-eastern Nebraska, Iowa, and central Minnesota. It forms a large part of the forest growth on the foothills of the southern Alleghany mountains, and is abundant in all parts of the Mississippi basin, attaining its largest size in the valley of the lower Ohio river. (A. H.)

REMARKABLE TREES

This species was introduced, according to Loudon, in 1800; but is much less commonly seen than *Q. rubra*; and though it appears to grow well in southern England, it rarely ripens its acorns.

The finest tree which we know of is growing at Bayfordbury (Plate 313), where it was planted in 1841 under the name *Q. rubra macrophylla*. It was 80 ft. high by 6 ft. 10 in. in girth in 1905.

At Arley Castle there are two fine trees,¹ planted probably about 1820, one of which measured in 1903, 80 ft. by 7 ft. 2 in.; the other, in the following year, was 70 ft. by 6 ft. 6 in.

At Beauport, a tree growing in a rather crowded position, and apparently decaying at the top, is from 60 to 65 ft. in height, and 7 ft. 3 in. in girth. At Lyndon Hall, Rutland, the seat of E. W. P. Conant, Esq., there are two trees, the larger nearly 50 ft. high and 5 ft. 3 in. in girth. At Henham Hall, Suffolk, the seat of the Earl of Stradbroke, there is a tree, measuring in 1909, 53 ft. by 5½ ft. There are also specimens at Syon, Kew, and Tortworth, where it was found labelled *Q. nigra*; and at Liphook, Westonbirt, and Orton Hall.

In the south-west it seems to grow well, as there are healthy trees at Killerton, about 50 ft. by 5 ft. in 1906, and a smaller one at Bicton. At Pixton Park there is a fine tree in the park by the Dulverton Drive, which in 1909 was about 60 ft. by 5 ft. 4 in.

In Scotland, the only tree we know of is one at Castle Kennedy, which Henry found in 1906, bearing the name of *Q. macrocarpa*.

TIMBER AND BARK

Its timber is said by Michaux to be the best of the oaks of this section, but is not distinguished in commerce, and judging from the examples in Hough's work, is very similar in appearance to that of *Q. rubra*. It is largely used for staves and furniture.

The bark is extensively used for tanning, and gives a valuable yellow dye known as *quercitron*, which, according to Loudon, is equal to weld² in the brilliancy of the yellow which it gives, and was at that time largely imported in England. According to Bentley and Trimen, it is used in Europe for dyeing silk and wool.

(H. J. E.)

¹ Cf. R. Woodward, Jun., *Hortus Arleyensis*, 11, 46 (1907).

² Loudon says "woad," evidently a mistake for "weld," *Reseda Luteola*, which yields a yellow dye, much used formerly.

QUERCUS KELLOGGII, CALIFORNIAN BLACK OAK

Quercus Kelloggii, Newberry, in *Pacific R. R. Rep.* vi. 28, f. 6 (1857); Sargent, in *Bot. Gaz.* xlv. 226 (1907).

Quercus tinctoria, Michaux, var. *californica*, Torrey, in *Pacific R. R. Rep.* iv. part i. 138 (1856).

Quercus rubra, Bentham, *Pl. Hartweg.* 337 (1857) (not Linnæus).

Quercus californica, Cooper, in *Smithsonian Report*, 1858, p. 261 (1859); Sargent, *Silva N. Amer.* viii. 141, t. 416 (1895), and *Trees N. Amer.* 239 (1905).

Quercus sonomensis, A. de Candolle, *Prod.* xvi. 2, p. 62 (1864).

A tree, occasionally attaining 100 ft. in height and 12 ft. in girth, frequently smaller, and at high elevations becoming a shrub. Bark of young trees smooth; on old trunks divided into thick irregular oblong scaly plates. Young branchlets quickly becoming glabrous. Buds ovoid, pointed, ¼ in. long, pubescent at the tip; scales pale brown, with dark brown ciliate margins. Leaves (Plate 333, Fig. 2) deciduous in autumn, turning yellow or brown before falling, 3 to 6 in. long, 2 to 4 in. broad, oblong or obovate, with usually seven (rarely five or nine) oblong lobes with bristle-pointed teeth; sinuses usually deep, narrow, and rounded at the base; upper surface shining, glabrous, dark green; lower surface paler, with scattered minute stellate pubescence, and without axil-tufts; petiole about 1 in. long, quickly becoming glabrous.

Fruit, ripening in the second year, solitary or clustered on short stout stalks; acorn ovoid, about an inch long, pubescent; enclosed for about half its length in a deep cupule, covered by thin ovate-lanceolate slightly pubescent scales, which in the lower ranks are closely appressed and swollen on the back, and towards the rim of the cupule are loosely imbricated with thin erose margins.

Q. Morehus, Kellogg, in *Proc. Calif. Acad.* ii. 36 (1863); Sargent, *Silva N. Amer.* viii. 120, t. 407 (1895); a small tree with subevergreen foliage, occurring in a few localities in California, is believed to be a hybrid between *Q. Kelloggii* and the evergreen *Q. Wislizeni*.

Q. Kelloggii is a native of Oregon and California, where it ranges from the basin of the Mackenzie river in western Oregon southwards through the coast ranges and along the western slopes of the Sierra Nevada to the San Bernardino, San Jacinto and Cuyamaca mountains, attaining towards the south 7000 to 8000 ft. altitude. It is mainly found in valleys and on mountain slopes, and is rare in the immediate vicinity of the ocean.

I saw this species in 1906, at about 3000 ft. elevation, on the dry hills of the Siskiyou range, where it is associated with *Q. Garryana*, one of the Californian white oaks. Both species attained about 70 ft. in height with short trunks up to 4 ft. in diameter, dividing into wide-spreading branching limbs. The bark of *Q. Kelloggii* is rather dark in colour, contrasting strongly with the remarkably white bark of the other species. Mr. F. R. S. Balfour, who visited the same district, saw larger trees in the valley of the Illinois river, Oregon, and in the

King's river cañon in California, where their trunks rose tall and straight amongst *Libocedrus decurrens* and *Pinus ponderosa*. In late autumn the foliage turns to fine yellow and crimson colours.

This tree was discovered by Hartweg in 1846 near Sonoma, among the foot-hills of the Californian Sierras; and is named after Dr. Albert Kellogg, the pioneer botanist of California, who was one of the founders of the Californian Academy of Sciences, and Curator of the Herbarium in San Francisco. According to Lemmon,¹ it is generally known as the Kellogg oak.

This species is little known in cultivation; and Schneider doubts if it exists on the continent. It appears to have been first introduced by the Earl of Ducie, who has at Tortworth two fine specimens about 30 ft. high by 2 ft. 3 in. which were raised from acorns obtained from San Francisco in 1878. These are making rapid growth.

There is a smaller specimen at Kew which ripened acorns in 1907.

(A. H.)

QUERCUS RUBRA, RED OAK

Quercus rubra, Linnæus, *Sp. Pl.* 996 (1753); Michaux, *Hist. Chênes Am.* No. 20, tt. 35, 36 (1801); Loudon, *Arb. et Frut. Brit.* iii. 1877 (1838); Sargent, *Silva N. Amer.* viii. 125, tt. 409, 410 (1895), and *Trees N. Amer.* 230 (1905).

A tree, attaining in America 150 ft. in height and 12 ft. in girth. Bark on young trees smooth, thin, grey; becoming on old trunks about an inch in thickness and divided on the surface into small scaly plates. Young branchlets glabrous, dark red, with white lenticels. Buds ovoid, acute, about $\frac{1}{4}$ in. long, reddish brown, often pubescent at the tip; scales glabrous, with ciliate margins. Leaves (Plate 333, Figs. 3 and 8) deciduous, membranous, 5 to 8 in. long, 4 to 6 in. broad, oval or obovate, cuneate or rounded at the base, acute or acuminate at the apex, usually divided about half-way to the midrib, by wide oblique sinuses, into seven to eleven ovate or triangular lobes, broad at the base, and with one to three bristle-pointed teeth at the apex; upper surface dark green, glabrous; lower surface dull or pale green, glabrous, except for slight axil-tufts of pubescence; petiole 1 to 2 in. long, glabrous.

Fruit ripening in the second year, solitary or in pairs, sessile or stalked; acorn ovoid, $\frac{3}{4}$ in. to 1 in. long, broad at the base, rounded at the apex, enclosed only at the base in a thick, shallow, saucer-like cupule, $\frac{3}{4}$ in. to 1 in. in diameter, pubescent within, and covered externally with closely appressed, thin, ovate, minutely pubescent scales.

The red, scarlet, and pin oaks are often confused; but may readily be distinguished by the characters of the buds and leaves, given for each species in the Key, Nos. 14, 15, and 16. See also, under *Q. coccinea*, p. 1248, and *Q. palustris*,

¹ *Oaks of Pacific Slope*, 14 (1902).

p. 1250. Both *Q. rubra* and *Q. palustris* have saucer-like or flat acorn-cupules, those of the former being large and thick; those of the latter species thin and small. The cupules of *Q. coccinea* are deep and turbinate, with a peculiar scaly stalk.

DISTRIBUTION¹

The red oak is one of the largest and most common trees in the eastern parts of Canada and the United States. It is abundant in southern Nova Scotia, New Brunswick, Quebec, and Ontario, and in the northern and central States, attaining its largest size in the region north of the Ohio river. Its western limit is marked by a line drawn from lake Namekagon in Burril County, Wisconsin, through eastern Minnesota, eastern Nebraska, and the Blue river in Kansas. Its southern and south-western limits are not clearly defined, as it is replaced to the southward by *Q. Schneckii*, which has hitherto been generally confounded with it. Its occurrence in Indian Territory, eastern Texas, southern Missouri and Arkansas is doubtful. It is common in the mountainous parts of Kentucky and Tennessee, and reaches its most southerly point, so far as is known, in the Red Mountains near Birmingham, Alabama, where a few isolated stunted specimens have been found. On the Atlantic slope it is common everywhere in New England, except in the mountains, in New York outside the Adirondacks, and throughout New Jersey and Pennsylvania. Farther south it extends along the Alleghanies as far as northern Georgia. Towards the north it is confined to altitudes below 500 ft., in Kansas and Missouri below 1000 ft., while in Virginia it ascends to 3500 ft., and in western North Carolina to 5000 ft.

The red oak thrives best where the rainfall is considerable, 32 to 53 in. annually being registered over its area of distribution. It ceases to grow west of the 90th meridian, where the rainfall falls below 30 in. The climate in which it flourishes is characterised by great extremes of temperature, the thermometer often falling during the long winter to -30° Fahr., and attaining in summer a maximum of 90° to 95° Fahr. It grows well on porous sandy, or on gravelly clay soils, which are well-drained; and is not found on very wet or on very dry ground. It is intolerant of shade, except when quite young. It is not subject to disease or serious insect attacks, and is rarely overthrown by the wind.

In the forest it is usually associated with numerous other species, as other kinds of oak, chestnut, lime, elms, and hickories; and where the canopy is dense and a good layer of humus exists attains a greater height than any other American oak, and in a shorter time, trees 150 ft. high and 5 ft. in diameter being not uncommon in favourable situations; but on drier and poorer soil it does not exceed 100 ft. The stems of forest-grown trees are usually buttressed at the base, and are exceptionally straight and of uniform diameter, and are often free of branches to 40 or 50 ft. The red oak, on account of its abundance over a wide area, and its rapidity of growth, producing timber of commercial value quicker than any other

¹ Compiled in part from notes by Professor C. Mohr, in the Bureau of Forestry, Washington, D.C.

black oak, takes a prominent place among the supplies of hardwood timber east of the Mississippi river, particularly in their northern area.

Isolated trees in the open in Massachusetts do not appear to attain as great a height as they do in England, those mentioned¹ as noteworthy for size being the Charlemont oak, 58 ft. by 14½ ft., the Beaman oak, 70 ft. by 17 ft. 8 in. The Caster oak, the height of which is not stated, growing at Lancaster in this state is 18 ft. 5 in. in girth.

The red oak reproduces freely from coppice shoots, which often attain 6 ft. in their first season. Where natural regeneration cannot be relied on, or where new land is being planted, in America, acorns are sown *in situ*, as the seedling is not easy to transplant, on account of its long tap-root. (A. H.)

CULTIVATION

The red oak has been tried as a forest tree on a considerable scale on the Continent. In Prussia² the area under cultivation at thirty-two different experimental stations was about 100 acres in 1900; and it has shown very rapid growth in youth, averaging 7 to 10 ft. high at five years old, 16 to 25 ft. at ten years old, 25 to 35 ft. at fifteen years, and 40 to 50 ft. at twenty years. It succeeds well on poor land, thriving even on soil considered to be third class for growing the common pine. It is used for underplanting pine woods, and for filling up gaps in broad-leaved plantations.

In Belgium thousands of trees of this species have been planted with the greatest success. Wesmael³ reported in 1890, that trees forty-five years old had attained on an average a height of 60 ft. and a girth of 5 ft. 11 in. He claimed for the tree that the wood was excellent for carriage-building and cabinet-work, and that it grew well on light porous soil, where the common European oak remained dwarfed and stunted. At Tervueren near Brussels M. Bommer showed me in 1909 a plantation of red oaks thirty years old, on fairly good sandy soil, the average height of which was about 50 ft., and the average girth 16 to 24 in. They formed a good cover with straight clean stems, and had recently been underplanted with beech.

Introduced into France as long ago as 1740, and grown by Miller in England in 1739, the red oak is the best known and the most generally successful of the American oaks in England. It ripens its acorns in the south, and self-sown seedlings are occasionally found on the warm light soils which it requires to enable it to become a large tree. It does not, however, seem to be a very long-lived tree, most of the oldest which we have seen already showing signs of decay.

The colour of its foliage in autumn is so beautiful that it should be planted in conspicuous places in all pleasure-grounds and parks, and if sheltered by other trees when young, and on deep well-drained soil, it grows rapidly and soon produces the best effect among other foliage. I have raised seedlings from a tree in Lord Ducie's

¹ In *Garden and Forest*, iv. 586 (1891).

² Schwappach, *Anbauvers. fremdl. Holzart.* 72 (1901).

³ Cf. *Garden and Forest*, iii. 129 (1890).

park, which grow fairly well on my soil, but like all American oaks, require good nursery cultivation when young.

REMARKABLE TREES

The largest that we have seen in England is a tree at Pains Hill on the edge of a belt near the kitchen garden, in light sandy soil. In 1908 this measured about 80 ft. high by 19 ft. in girth, with a short bole, and branches spreading over an area 38 yds. wide. Some self-sown seedlings were coming up near it. At Kew there is a fine old tree¹ near the Pagoda, which in 1909 was about 75 ft. by 13½ ft. with a bole 20 ft. high. This tree a few years ago was decaying, but its vigour has been much increased by cutting out the dead branches, and top-dressing the roots with good soil.² The tallest trees that I have measured are one at Oakly Park, Ludlow, which in 1908 was about 100 ft. by 11½ ft., and one at Brockett Hall, Herts, which in 1905 was 97 ft. by 8½ ft. At Cassiobury in the same county, Henry measured a fine tree in 1904, 90 ft. by 14½ ft. with a clean bole about 20 ft. long. At Whitton there is a tree, probably 150 years old, which in 1903 was 90 ft. by 7 ft. 10 in., with a trunk 40 ft. high.

In the midland counties the best specimens we have seen are at Coombe Abbey, 85 ft. by 11 ft. 9 in. in 1908, and on the lawn at Kedleston, near Derby, a well-shaped tree (Plate 314) measuring in 1909, 90 ft. by 11 ft. with a bole of 30 ft.

In the south-western counties there are good-sized trees at Melbury and at Endsleigh. At Pixton Park, Dulverton, the seat of the Dowager Countess of Carnarvon, there are several fine tall trees in a wood called Puzzlecombe, the best of which was, as nearly as I could estimate, about 100 ft. high, with a clean straight trunk nearly 60 ft. high.

In Wales the finest known to us is at Stackpole Court, which in 1906 was about 90 ft. by 9½ ft. At Margam there is also a good-sized tree of this species. Besides the above we have seen and measured red oaks in a great many other places, many of which are known as scarlet oaks.

In Scotland it has not been planted as generally as in England, but succeeds well in those parts which have a warm summer. The best that I know of are at Brahan Castle, Ross-shire, which was about 80 ft. by 7½ ft. in 1907; and at Murthly, where there are several good trees, 70 to 80 ft. high, in the Birnam Drive. These bore no acorns in 1906, and the forester told me that the leaves were much eaten by the larva of *Tortrix viridana*, which I have noticed also in England.

In Ireland it is comparatively scarce, the largest we have measured about 60 ft. by 7 ft. 8 in. in 1909, being in the Lakeside Drive at Muckross, Killarney. A specimen from a tree at Carton, Maynooth, measuring 50 ft. by 8 ft. 3 in. is preserved in the Kew Herbarium.

¹ This tree bears a single branch, with leaves creamy-white in colour. Efforts to propagate this shoot were not successful.

² A similar instance of the regeneration of the American white oak is shown by Prof. Sargent in two illustrations of a tree in the Arnold Arboretum, one taken before its treatment, the other twelve years afterwards, and the results are certainly very striking.

On the Continent it succeeds even better than in England, and is commonly planted in the parks and pleasure grounds of France, Germany, and Belgium. The largest tree I have seen is at the Château de Longchamps in Belgium, where Baron de Selys Longchamps showed me a splendid tree grafted on the common oak at about 4 ft. from the ground, and measuring no less than 110 ft. by 12 ft. in 1908.

TIMBER

Though the wood of this tree is not highly valued in the United States in comparison with that of the white oak, on account of its want of durability, yet for interior work it seems a good timber, on account of its delicate pinkish colour and handsome silver grain when quartered. Owing to the increased scarcity of white oak it is now largely imported to this country, and often mixed with parcels of boards of other species and sold as American oak. So little is known about its true qualities, that at a recent trial in London, an architect stated in evidence that it was grown in swamps and was subject to dry rot. The former statement is certainly incorrect, and for the latter we can find no foundation; though no doubt badly-seasoned wood of this tree would rot like any other if put into damp buildings. The wood of a tree which was grown at Woolbeding in Sussex, and kindly given me by Archdeacon Elwes, was very easy to rend on account of its straight grain, and had the same pink tinge as the American-grown wood.

We abstract the following from a paper by Prof. Mohr:¹ The heartwood of the red oak is reddish, porous, and of coarse grain. The wide pores in the cross-section mark the annual rings in three or four rows. The medullary rays are conspicuous, but comparatively few. The wood is heavy, strong, and hard, inclined to shrink and check when drying. The structure of the wood not being homogeneous, the wood in drying parts with its moisture unequally, the water being retained in some parts much more than in others. The wood thus retains moisture, and when dried readily reabsorbs moisture; and this explains its liability to decay. In strength the wood is scarcely inferior to white oak, but its want of durability prevents its application for many purposes. Perfectly dried red oak has a specific gravity averaging 0.652, varying from 0.540 to 0.748; and a cubic foot of air-dry wood weighs 40.75 lb. In its mechanical properties, it compares favourably with the more valuable hardwoods. In its resistance to longitudinal compression, it is equal to white oak. In elasticity it surpasses white oak; and in ultimate strength (resistance to transverse pressure) it is slightly superior to white oak. In hardness, *i.e.* resistance to indentation, it falls far below white oak; and this want of hardness renders red oak unfit for cross-ties. Nails exposed to its acid watery juice easily rust, and this sometimes prevents its use in construction.

The wood is very desirable for interior finish and furniture. When sawn on the quarter it has a beautiful grain, and is little less valuable than white oak for cabinet-work.

Red oak timber has been used extensively from the time of the earliest settle-

¹ MS. in the Bureau of Forestry, Washington, D.C.

ments for clap-boards, for the interior finish of houses, and for dry cooperage. Of late years it had been increasingly used for making a cheap class of furniture, as chairs, tables, and other articles. Its very objectionable defect, that of shrinking and checking badly when drying, has been in a large degree overcome by treatment in the dry kiln. Its additional uses are: shipbuilding (to a limited extent), house-building, agricultural implements, baskets, wood alcohol, acetate of lime, and shingles. (H. J. E.)

QUERCUS COCCINEA, SCARLET OAK

Quercus coccinea, Muenchhausen, *Hausv.* v. 254 (excl. *b*) (1770); Loudon, *Arb. et Frut. Brit.* iii. 1879 (1838); Sargent, *Silva N. Amer.* viii. 133, tt. 412, 413 (1895), and *Trees N. Amer.* 236 (1905).

A tree attaining in America 80 ft. in height and 10 ft. in girth. Bark smooth and thin on young trees; on old trunks divided by shallow fissures into scaly ridges. Young branchlets shining, glabrous, with white lenticels. Buds ovoid, acute, $\frac{1}{8}$ to $\frac{1}{4}$ in. long, covered above the middle with whitish pubescence. Leaves (Plate 333, Fig. 6)¹ deciduous late in autumn, turning brilliant scarlet before they fall, 3 to 6 in. long, $2\frac{1}{2}$ to 4 in. broad, obovate or oval, very variable in shape, as a rule more deeply lobed than *Q. rubra*, the sinuses often extending to near the midrib; usually with seven to nine spreading oblong, often falcate lobes, each with two to five bristle-tipped teeth towards the apex; base truncate or cuneate; shining and glabrous on both surfaces, except for occasional inconspicuous axil-tufts beneath; petiole slender, glabrous, $1\frac{1}{2}$ to $2\frac{1}{2}$ in. long.

Fruit ripening in the second year, solitary or in pairs, sessile or short-stalked; acorn $\frac{1}{2}$ to $\frac{3}{4}$ in. long, ovoid, rounded at the base and apex; enclosed for half its length in a deeply turbinate thin cupule, $\frac{1}{2}$ to $\frac{3}{4}$ in. broad at the rim, covered with closely appressed ovate acute slightly pubescent scales. The base of the cupule is formed by a narrow prolongation, resembling a thickened stalk, but differing from a true peduncle in being covered with scales.

Quercus ambigua, Michaux f., *Hist. Arb. Am.* ii. 120, t. 24 (1812); Loudon, *Arb. et Frut. Brit.* iii. 1881 (1838).

Quercus borealis, Michaux f., *N. Amer. Sylva*, i. 98, t. 26 (1819); Britton, *Man. Fl. N. States*, 334 (1901); Small, *Flora South-eastern U.S.* 1322 (1903).

Quercus coccinea, var. *ambigua*, Asa Gray, *Manual*, 454 (1867).

Described by the younger Michaux as a large tree with the leaves of *Q. rubra* and the fruit of *Q. coccinea*. It was first seen by his father on the banks of the St. Lawrence near Quebec, and was found by himself in Maine, New Hampshire,

¹ The figure is drawn from a wild specimen, and represents an extreme form of the leaf. Many wild specimens and most of the trees in cultivation have leaves more like *Q. rubra* in lobing.

Vermont, and Nova Scotia, where it was known as the grey oak. Britton and Small, who consider it to be a distinct species, extend the distribution to New York and Pennsylvania, and as far south as the mountains of North Carolina, and describe the leaves as like those of *Q. rubra*, seven- to thirteen-lobed to the middle or somewhat beyond. Sargent¹ refers to *Q. ambigua* as a form of *Q. rubra*, having fewer lobes to the leaves, and smaller fruits with turbinate cups; but states that these extreme forms are so intermixed and inconstant that it does not seem practicable to consider them even varieties. All this evidence goes to prove that this name covers a series of hybrids² between *Q. coccinea* and *Q. rubra*.

At Arley Castle, trees of typical *Q. rubra*, which freely bear fruit with large flat shallow saucer-like cupules, invariably have leaves turning dull reddish brown and falling off early in autumn. Other trees, with smaller acorn-cups, which though shallow are not quite flat at the base, but prolonged into a short scaly stalk, are deciduous late in the season, and their leaves turn a brilliant scarlet before falling. Such trees correspond to the description given of *Q. ambigua*, and are in all probability hybrids of *Q. rubra* and *Q. coccinea*.

Q. coccinea bears fruit only rarely in England; and we have seen no fruiting specimens of Waterer's *Q. coccinea splendens*, which turns a brilliant crimson in autumn; but this tree is probably true *Q. coccinea*.

In the absence of fruit, *Q. coccinea* is best distinguished by the buds, white-pubescent in their upper half; and by the leaves, shining beneath, more deeply lobed than in *Q. rubra*, falling late in the season, after turning a brilliant scarlet or crimson. Trees with the foliage of *Q. rubra*, dull beneath, but turning scarlet in autumn, and late in falling, may be assigned to *Q. ambigua*.

The scarlet oak is the most ornamental species in North America, on account of its deeply cut foliage, shining green in summer and brilliant scarlet in autumn. The leaves are retained late in the autumn, after most of the other oaks have withered and fallen.³ It attains its northern limit in southern Ontario, and is widely distributed through the northern parts of the United States from south-eastern Nebraska eastward through central Minnesota and Michigan, southern New York, Vermont, and southern New Hampshire to the valley of the Androscoggin river in Maine. It is very abundant on the coast region from Massachusetts to New Jersey, where it is generally found on light dry usually sandy soil; but is less common in the interior, where it grows on dry gravelly uplands, and on the prairies of the west. It extends to northern Illinois and the District of Columbia, and along the Alleghany Mountains to North Carolina. It is occasionally planted in the north-eastern states in towns, but is said to be undesirable for streets, as young trees are disposed to be wide-spreading and unsymmetrical. Its timber is not distinguishable from that of the red oak in commerce, and is identical with it in appearance and quality.

(A. H.)

¹ *Silva N. Amer.* viii. 127, note.

² Baenitz, in *Allg. bot. Zeitschr.*, 1903, p. 85. has, under the name *Q. Benderi*, described similar hybrids growing at Breslau.

³ Cf. Hough, *Trees N. States and Canada*, 147 (1907).

REMARKABLE TREES

The scarlet oak was introduced very early, as a plant is said to have been growing in Bishop Compton's garden in 1691. Loudon states that the largest tree which he had seen and knew with certainty to be this species, was at Syon, 77 ft. high and 2 ft. 9 in. in diameter in 1838. This tree is no longer living. He mentions a considerable number of other trees, of which he had received reports; but we believe that their identification was in many cases erroneous. The scarlet oak does not appear in England to grow so large or attain as great an age as *Q. rubra*; and we have seen only a few trees of considerable size.

The finest is perhaps a tree¹ at Arley Castle, 78 ft. high and 6 ft. 3 in. in girth in 1904. At West Dean Park, Chichester, there are four trees, 63 ft. by 3 ft. 8 in., 59 ft. by 3 ft. 6 in., 60 ft. by 4 ft. 8 in., and 48 ft. by 1 ft. 10 in., two of which bore fruit in 1909. These are considerably smaller than two specimens of *Q. rubra* which were probably planted at the same time, though the date is unknown.

At Stoke Park, Stoke Pogis, Bucks, there is a tree, which was still bearing foliage, scarlet in colour, on 18th November 1909, which Mr. E. H. Wilding reports to be 55 ft. high by 6 ft. 9 in. in girth. At Brocklesby, a tree measured 66 ft. by 3 ft. 9 in. in 1909. At Kew, a tree in the oak collection, about 25 ft. high, bore good fruit in 1907, but died in 1909. At Terling Place, Essex, there is a small tree, turning brilliant scarlet in autumn and about 25 ft. high, which was raised from acorns sent by Asa Gray in 1885. At Syon, there is a thriving young tree, about 30 ft. high, which bore acorns in 1907. This was pronounced by Prof. Sargent to be the best specimen which he had seen in England. At Ponfield, Herts, a small tree 35 ft. by 2 ft. 4 in., planted in 1883, bore fruit in 1909. At Tortworth and Westonbirt there are specimens of this species, none of which appear to have ever borne fruit. At Escot there is a tree rather crowded in a shrubbery, whose leaves, when I saw it on 27th October 1909, had mostly fallen, but which we believe to be of this species. It measures about 70 ft. by 6 ft.

There are probably other trees which we have not seen. But those which I have raised from American acorns, as well as those which I have imported as seedlings, will not grow on my soil; and I believe that it is better to graft scions selected from the best coloured trees on stocks of *Q. rubra*, than to plant this tree on its own roots.

(H. J. E.)

¹ This tree is No. 23 in Mr. Woodward's catalogue, and was probably planted about 1820. It has long borne the name *Q. palustris*. Fruit has not been noticed on this tree.

QUERCUS PALUSTRIS, PIN OAK

Quercus palustris, Muenchhausen, *Hausv.* v. 253 (1770); Loudon, *Arb. et Frut. Brit.* iii. 1887 (1838); Sargent, *Silva N. Amer.* viii. 151, tt. 422, 423 (1895), and *Trees N. Amer.* 232 (1905).
Quercus rubra dissecta, Lamarck, *Dict.* i. 720 (1783).
Quercus rubra ramosissima, Marshall, *Arbust. Am.* 122 (1785).

A tree, attaining in America 120 ft. in height and 15 ft. in girth, but usually considerably smaller. Bark of young trees smooth, shining, light brown tinged with red; on old trunks about an inch thick and covered with small scales. Branches more or less pendulous, with drooping branchlets, which in the first year are slender, glabrous, shining, with white lenticels. Buds ovoid, about $\frac{1}{8}$ in. long, pointed, with glabrous pale brown ciliate scales. Leaves (Plate 334, Fig. 17) deciduous, 4 to 6 in. long, 2 to 4 in. wide, obovate, cuneate at the base, divided about half-way to the midrib by rounded wide sinuses into usually seven, occasionally nine, symmetrical, bristle-pointed, oblong-triangular, entire or two- to three-toothed lobes; the terminal lobe acuminate, the lateral lobes spreading or directed forwards; shining above and below, glabrous except for conspicuous brown axil-tufts on the lower surface; petiole slender, glabrous, $\frac{1}{2}$ to 2 in. long.

Fruit ripening in the second year, short-stalked, solitary or clustered; acorns hemispherical, $\frac{1}{2}$ in. in diameter, enclosed at the base only by a thin saucer-shaped cupule, covered by thin closely appressed ovate minutely pubescent scales.

This species is readily distinguished, apart from the shape of the leaves with their characteristic conspicuous axil-tufts, by the drooping habit of the branches and branchlets.

The pin oak is found on deep rich soil on the borders of swamps and in alluvial land, in company with *Liquidambar*, *Nyssa sylvatica*, *Acer rubrum*, *Populus heterophylla*, and hornbeam, but thrives well when transplanted to drier situations. It is widely distributed in the United States from Massachusetts southwards to Virginia, and westwards through Kentucky, Tennessee, and northern Arkansas to the eastern borders of Indian Territory, Missouri, and Illinois, attaining its largest size on the banks of streams in the basin of the lower Ohio. It is also very common on the coast plain south of the Hudson river, but is rare and of small size in New England.

(A. H.)

CULTIVATION

Though introduced on the Continent prior to 1770, this species does not seem to have been known in England until 1800, when it was introduced¹ by Messrs. Fraser. It is one of the most beautiful American oaks, on account of the varied colour of its leaves both in spring and autumn. As a rule it grows better in England than any American oak except perhaps *Q. rubra*, and seems to prefer a

¹ Aiton, *Hort. Kew.* v. 292 (1813).

deep sandy soil, and a position well sheltered from wind by other trees. As a rule it is easily recognised by the number of small, rather pendulous branches, which it throws out among the larger ones, and by its upright habit. It grows fast on good soil, and Loudon says that in Loddiges' nursery in 1837 he saw some which at seven years from the acorn were 15 ft. high. It rarely ripens fruit in England, but I raised some plants from acorns grown at Kew in 1901, which I believe to be of this species, and which are growing well at Colesborne.

The largest trees that we know of are in Windsor Park, near China Island, one of which in 1910 was 97 ft. by 10 ft. 11 in. (Plate 315). Not far off, there is another tree that has been carefully measured by Mr. Squires, who finds it to be 113 ft. by 10 $\frac{1}{2}$ ft. Another in the Rhododendron Drive was 100 ft. by 7 ft. 8 in. in 1909. At Kew there is a tree at the south end of the Temperate House, which has had its top broken some years ago, and now measures 57 ft. by 10 ft. At Arley Castle there are two trees, of which the finest (No. 189 in Mr. Woodward's catalogue) was 80 ft. by 6 ft. 4 in. in 1905. One at Bayfordbury, planted in 1840, was 71 ft. by 6 ft. 8 in. in the same year.

At Canford Manor there is a very fine tree 80 ft. by 8 ft. in 1906; at Oakly Park, Ludlow, another, 75 ft. by 8 ft. in 1908; at Milford House, Godalming, a well-shaped tree 84 ft. by 7 ft. 9 in. in 1909; and at Deepdene, Surrey, Henry measured a tree, which was perfectly sound, 70 ft. by 9 ft. 10 in. in 1905.

In Scotland and Ireland we know of no trees of any size. (H. J. E.)

QUERCUS SCHNECKII

Quercus Schneckii, Britton, *Manual*, 333 (1901).
Quercus texana, Sargent, *Garden and Forest*, vii. 514, ff. 81, 82 (1894), *Silva N. Amer.* viii. 129, t. 411 (1895), and *Trees N. Amer.* 235 (1905) (not Buckley).¹

A tree, the tallest² of the American oaks, attaining 180 ft. in height, and 8 ft. in diameter above the much enlarged and buttressed base. It is with difficulty distinguishable in the absence of fruit from *Q. palustris*, though the leaves³ (Plate 334, Fig. 15) are broader in proportion to their length than in that species, but have the same conspicuous axil-tufts, while the buds and branchlets are identical.

Fruit, ripening in the second year, stalked; acorn ovoid, about an inch long, pubescent; cupule hemispherical, $\frac{3}{4}$ in. in diameter, covered with closely appressed tomentose scales.

¹ According to Small, *Q. texana*, Buckley, in *Proc. Phil. Acad.*, 1860, p. 444, is a small tree or shrub, occurring in dry and rocky places in Texas, and distinct from *Q. texana*, Sargent, which is now correctly named *Q. Schneckii*, Britton.

² Ridgway says in *Proc. U.S. Nat. Mus.* p. 83, that in the bottoms of southern Illinois, trees straight as an arrow 5 or even 6 ft. in diameter above the spurs, and 50 to more than 70 ft. clear, were formerly not at all rare, but most of them had even then been cut for clapboards or barrel staves. The largest that he had measured was 23 ft. in girth round the top of the stump, with a trunk 76 ft. long and 3 ft. in diameter at the top. At 120 ft. from the ground the limbs were more than a foot in thickness. Assuming the taper of this tree to have been regular, the log would have contained about 1200 cubic ft. by quarter girth measure. Ridgway speaks of these trees as *Q. rubra*; but Sargent considers them to be his *Q. texana*, referred now to *Q. Schneckii*.—(H. J. E.)

³ Figured by us from excellent fruiting specimens, collected by Elwes on Mt. Carmel, Illinois.

This species is widely spread, in wet swampy land, along the borders of streams in the Mississippi basin.

A small tree at Kew, about 12 ft. high, raised from seed sent by Meehan in 1901, under the name *Q. texana*, may be *Q. Schneckii*; but this species, inhabiting a region which is very hot in summer, is not likely to succeed in England.

(A. H.)

QUERCUS AGRIFOLIA, CALIFORNIAN LIVE OAK

Quercus agrifolia, Née, in *Ann. Cienc. Nat.* iii. 271 (1801); Loudon, *Arb. et Frut. Brit.* iii. 1894 (1838); Sargent, *Silva N. Amer.* viii. 111, t. 403 (1895), and *Trees N. Amer.* 256 (1905).

Quercus oxyadenia, Torrey, *Sitgreave's Report*, 172, t. 17 (1853).

Quercus berberidifolia, Liebmann, in *Overs. Dansk. Vidensk. Selsk. Forhandl.* 172 (1854).

Quercus acroglandis, Kellogg, in *Proc. Cal. Acad.* i. 23 (1855).

A large tree, or occasionally a shrub, in California. Bark of young trees thin, smooth; on old trunks 2 to 3 in. thick, and divided into broad scaly ridges. Young branchlets, with a dense stellate pubescence, either quickly deciduous, or retained till the second year. Leaves (Plate 338, Fig. 57) persistent for two years, coriaceous, $1\frac{1}{2}$ to 2 in. long, about $1\frac{1}{2}$ in. broad, ovate or orbicular, acute or rounded at the apex, rounded or slightly cordate at the base; with seven to thirteen spine-tipped teeth, variable in size; lateral nerves very prominent, four or five pairs, reaching the margin; upper surface dark green, shining, glabrescent or with scattered minute pubescence; lower surface glabrous, with conspicuous reddish brown axil-tufts of pubescence; petiole $\frac{1}{4}$ to $\frac{1}{2}$ in. long, stellate-pubescent.

Fruit, ripening in the first year, sessile or sub-sessile, solitary or in pairs; acorn elongated, and gradually narrowing to an acute apex, about an inch long, surrounded at the base by a turbinate cupule, about $\frac{1}{2}$ in. broad, silky pubescent within, and covered with thin glabrous ciliate scales.

This species is readily distinguished from all the other oaks with holly-like foliage, by the conspicuous axil-tufts on the leaves beneath. (A. H.)

In California this is a common oak, extending from Mendocino County southwards to Lower California, less common in the north, very abundant and attaining its greatest dimensions in the valleys south of San Francisco, where it is the largest and most generally distributed oak on the foot-hills between the mountains and the sea. On the coast it often covers the sandy dunes with its semi-prostrate and contorted stems, and in a bushy form ascends the dry slopes in the San Geronio pass to about 2800 ft.

Sargent describes it as a low round-topped tree, sometimes attaining 80 to 90 ft. high, with a thick short trunk from 3 to 6 ft. in diameter, which often divides into great spreading limbs resting on the ground, and covering an area 120 to 150 ft. in diameter.

Excepting for fuel the timber is little used, though in the narrative of Vancouver's voyage it is related that some knees were cut in 1793 from the holly-leaved

oak at Santa Barbara to repair his ship the *Discovery*. The Indians used to consume the acorns for food, preferring them to those of any other oak.

This species was introduced by Hartweg in 1849, when a few miserable living plants, sent home by him, were reported¹ to be growing in the Horticultural Society's Garden at Chiswick. As I can find no further allusion to this species, I suppose that these are the trees which we have found growing in two places in England, and which seem of similar age, namely, at Kew, where it has now attained a height of 30 ft.; and at Killerton, where there are two trees above the house close to the deer-park fence. In 1908 the best of these measured 45 ft. by 7 ft., and forks at 6 ft. from the ground. On April 18, it was budding, and the old leaves were still green. At Tortworth there is a small tree which seems to be younger, and was probably raised in 1878 from American acorns at the same time as *Q. Kelloggii*.

(H. J. E.)

QUERCUS WISLIZENI

Quercus Wislizeni, A. de Candolle, *Prod.* xvi. 2, p. 67 (1864); Sargent, *Silva N. Amer.* viii. 119, t. 406 (1895), and *Trees N. Amer.* 253 (1905).

Quercus parvula, Greene, *Pittonia*, i. 40 (1887).

A tree or shrub, similar to *Q. agrifolia* in habit, size, and bark. Young branchlets with scattered stellate pubescence. Leaves (Plate 338, Fig. 58) deciduous in the second year, variable in shape and size, mostly oblong-lanceolate, averaging $1\frac{1}{2}$ in. long and $\frac{2}{3}$ in. wide, coriaceous, acute at the apex, broad and rounded or truncate at the base, with 9 to 13 spine-tipped teeth in the wrinkled margin, which in rare cases is entire; both surfaces shining, glabrous, with a conspicuous network of fine veinlets; petiole $\frac{1}{8}$ in. long, stellate-pubescent.

Fruit ripening in the second year, sessile or stalked; acorns ovoid, about 1 in. long, acute at the apex, enclosed to a variable height in a turbinate or tubular cupule, slightly pubescent within, and covered by thin lanceolate pubescent scales.

This species, in the absence of fruit, is with difficulty distinguishable from *Q. coccifera*, which has, however, foliage of a lighter tint of green. The buds in *Q. Wislizeni* are long, spindle-shaped, and pointed at the apex; while those of *Q. coccifera* are smaller, ovoid, and obtuse.

Q. Wislizeni, which is closely related to *Q. agrifolia*, is widely spread throughout California, and is also found on the San Pedro Martir mountain in Lower California. It is most abundant and of its largest size in the valleys of the coast range of central California and on the foothills of the Sierra Nevada. It is common in a shrubby form in the cañons of the desert slopes of the mountains in the southern part of the state.

Introduced into Kew by Mr. H. N. Bolander, who sent acorns in 1874, it was only $6\frac{1}{2}$ ft. high in 1897, but of late years is more thriving, and now forms a bushy tree about 15 ft. in height. We have seen no specimens in cultivation elsewhere.

(A. H.)

¹ *Journ. Hort. Soc.* vi. 158 (1851). A figure is given, showing the long narrow pointed acorns.

QUERCUS CRASSIPES

Quercus crassipes, Humboldt and Bonpland, *Pl. Æquin.* ii. 37, t. 83 (1813); Loudon, *Arb. et Frut. Brit.* iii. 1943 (1838); De Candolle, *Prod.* xvi. 2, p. 73 (1864); Hemsley, *Biol. Cent. Amer. Bot.* iii. 170 (1882).

Quercus mexicana, Bentham, *Pl. Hartw.* 56 (1839) (not Humboldt and Bonpland).

A tree of moderate size. Young branchlets slender, covered with a dense minute pubescence. Buds minute, globose. Leaves (Plate 335, Fig. 24) coriaceous, persistent for two years, 2 to 3 in. long, $\frac{1}{2}$ to $\frac{3}{4}$ in. wide; oblong; rounded or acute at the apex, which usually bears a short mucro or bristle; rounded or subcordate at the base; entire or rarely undulate in margin; upper surface dark green, papillose, glabrescent; lower surface grey or brownish tomentose; lateral nerves about 20 pairs, dividing and looping before reaching the margin; petiole $\frac{1}{8}$ to $\frac{1}{4}$ in. long, densely pubescent.

Fruit ripening in the second year, solitary or in pairs, on short stout stalks; acorn ovoid, surrounded about half its length by a turbinate cupule, $\frac{1}{2}$ to $\frac{3}{4}$ in. in diameter, covered with appressed slightly pubescent ovate scales.

This species was discovered by Humboldt near Santa Rosa and Ario in southern Mexico, at 6000 to 8000 ft. elevation, and was said to be a small tree about 20 ft. high, with smoothish grey bark. It was also collected by Hartweg at Tlalpujahuá, and found by Bourgeau in the valley of Mexico.

It was raised¹ in 1839 in the Chiswick Garden of the Horticultural Society from acorns collected by Hartweg near Real del Monte.

The only specimen which we know to be now living in this country, is an unhealthy tree at Carclew, 64 ft. by 5 ft. 4 in. in 1908. A small tree of this species is cultivated in M. Allard's arboretum at Angers, where it is labelled *Q. crassifolia*. A specimen in the Kew Herbarium, collected by Gay at Leroy's nursery, Angers, in 1847, is labelled *Q. confertifolia*. (A. H.)

QUERCUS CERRIS, TURKEY OAK

Quercus Cerris, Linnæus, *Sp. Pl.* 997 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1846 (1838); Willkomm, *Forstliche Flora*, 421 (1887); Mathieu, *Flore Forestière*, 363 (1897).

Quercus crinita, Lamarck, *Encyc.* i. 718 (1783).

Quercus echinata, Salisbury, *Prod.* 393 (1796).

A tree attaining 120 ft. in height and 20 ft. in girth. Bark thick, greyish, divided by vertical and horizontal fissures into oblong rounded ridges. Young branchlets covered with a dense grey tomentum, retained in part in the second year. Buds (Plate 78, Fig. 3) ovoid, with a few pubescent ovate-acuminate scales, and

¹ Cf. Gordon, in Loudon, *Gard. Mag.* xvi. 636 (1840).

surrounded by a whorl of long linear-subulate tomentose stipules. Leaves (Plate 335, Fig. 22) coriaceous, deciduous in autumn, 5 to 6 in. long, 2 to 3 in. broad, oblong to oval, acute at the apex, cuneate or rounded and unequal at the base; variously lobed, with deep or shallow sinuses; lobes, seven or eight pairs, unequal in length, oblong or triangular, entire or with one or two teeth, acute at the apex, which is cartilaginous, without a clearly projecting mucro; upper surface dark green, with numerous minute stellate hairs; lower surface greyish or dark green, covered with a minute stellate pubescence; midrib and nerves reddish with more conspicuous longer pubescence; petiole $\frac{1}{2}$ to $\frac{3}{4}$ in. long, tomentose.

Staminate catkins tomentose, 2 to 3 in. long; calyx tomentose, stamens four. Pistillate flowers, one to four on a short stout tomentose peduncle, only one as a rule developing; stigmas four, reflexed, sessile.

Fruit ripe in the second autumn, one to four on the branchlet of the preceding season, which may or may not have developed a leafy branch of the second year; each solitary on a short stout tomentose stalk; acorn variable in length, averaging one inch, depressed and slightly pubescent at the apex, glabrous elsewhere; cupule hemispherical, $\frac{1}{2}$ to $\frac{3}{4}$ in. in diameter, densely covered with long linear grey tomentose scales, all reflexed and curved or hooked, except those in the upper zone, which are erect and inflexed, forming a loose fringe around the margin of the cupule, closely surrounding the acorn.

VARIETIES AND HYBRIDS

In the wild state there is considerable variation in the shape of the leaf.

1. Var. *austriaca*, Loudon. *Quercus austriaca*, Willdenow, *Sp. Pl.* iv. 454 (1805).

Leaves with regular triangular entire lobes, greyer beneath than in the typical form. This variety is prevalent in south-eastern Europe.

2. Var. *pseudocerris*, Boissier, *Flora Orient.* iv. 1171 (1879).

Leaves deeply divided into linear, entire or three- to five-lobulate segments. This variety occurs occasionally in Greece and Asia Minor.

Several forms have arisen as sports in the seed-bed.

3. Var. *laciniata*, Petzold and Kirchner, *Arb. Musc.* 636 (1864).

Leaves deeply and irregularly lobed, the sinuses extending to near the midrib, some of the leaves only $\frac{1}{2}$ in. wide.

4. Var. *variegata*, Loddiges, ex Loudon.

Leaves variegated with white blotches. This is said¹ to have originated as a sport at Woburn Abbey, where good specimens of it are now growing.

5. Var. *pendula*, Neill, ex Gilpin, *Forest Scenery*, i. 73 (1834).

Branches pendulous. Loudon mentions a remarkable weeping tree at Hackwood Park. This variety² does not seem to be propagated at the present time.

The hybrids are described under *Q. Lucombeana*, p. 1259.

¹ *Gard. Chron.*, 1873, p. 1046.

² It is mentioned as well known in *Gard. Chron.*, 1871, p. 1321.

DISTRIBUTION

The Turkey oak is a native of southern Europe, Asia Minor, and northern Syria. It occurs in central and northern Spain. In Italy it grows in the Apennines mixed with the common oak, occasionally descending into the region of the olive and ascending into that of the beech, reaching its most southerly points in Calabria and Sicily. In France it is a rare and doubtfully wild tree in the Jura, in Vienne, Brittany, Anjou, and in Provence near Grasse; but in the department of Doubs it is very abundant in some of the oak forests, notably that of St. Vit, where it is the dominant tree over an area of 250 acres. It is unknown in the Swiss and French Alps, and in the Tyrol; but is scattered as an isolated and rare tree throughout Croatia, Dalmatia, Istria, Carniola, Styria, and Austria, reaching its northern limit at St. Pölten, west of Vienna, and the Polauer mountain in Moravia.

It becomes much more abundant in Hungary, where it is common in the hilly land and on mountain slopes, extending eastward through Banat to Transylvania. It is perhaps the commonest broad-leaved tree in many parts of the Balkan states, where it either forms pure woods at the higher elevations, or occurs on the lower hills in mixture with *Q. conferta* and *Q. sessiliflora*. In these regions its wood is never exported, and is little used except for firewood. (A. H.)

CULTIVATION

It is uncertain when this tree was first introduced, for though mentioned by Evelyn, it seems doubtful whether he really knew the tree, as he says, "we shall say little of the *Cerris* or *Ægilops*, goodly to look on, but for little else." In Miller's¹ time, however, about 1740, it was in cultivation; and in the latter half of the eighteenth century was largely planted in the south and south-west of England.

Though it is perfectly hardy, and according to Moullefert,² endured at Grignon in the winter of 1879-80 a temperature of -26° Cent., which injured many of the common oaks, it only attains its best dimensions in the warmer parts of England on deep and fertile soils. It endures lime, but prefers a warm sandy soil. It has a long tap root with few fibres, and, as Loudon remarks, is therefore not easy to transplant. When sown in the open the young immature shoots are often injured by frost, and require some protection during the first winter.

This tree grows faster than the common oak on dry sandy soils, and in consequence has been planted in the southern counties more commonly than it deserves to be; for though it is a handsome ornamental tree, yet its timber is so inferior to that of the pedunculate and sessile oaks that it has little market value, as many landowners have found to their loss when the tree is felled. It ripens seed freely in most seasons, and the seedlings, though not so hardy as those of the common oak,

¹ Miller mentions a large tree growing at Ragnal, near Tuxford, Nottinghamshire, which was supposed by Loudon to be a form of the Turkey oak.

² *Essences Forestières*, 93 (1903).

come up freely on sandy soils, and in a few years shoot up rapidly. Loudon says that near London the length of the annual shoot is from 18 in. to 3 or 4 ft., and that at Knedlington in Yorkshire plants of only seven years from seed were 12 ft. high. At Colesborne, however, the growth is very much slower than this, the soil and climate being too poor and cold for this species, which rarely attains any great size in the northern counties. It transplants perhaps better in spring than in autumn, and ripens its wood late, the leaves usually lasting longer than those of the common oak. Its trunk has a tendency to grow straight, and the branches have a peculiarity never seen in common oaks, of thickening close to the trunk. This is shown conspicuously in all the old specimens of the original Lucombe oak, and convince me that its parent was a *Q. Cerris*. It sometimes grows very tall without forming many branches; a young tree standing alone in a grass field at Cuffnells was 80 ft. high, with a girth of only 5 ft.

REMARKABLE TREES

The largest Turkey oaks that we have seen or heard of are at Mamhead Park near Exeter, which seems to have exactly the soil and climate best suited not only for this species, but also for the Ilex and cork oaks. Here there are several trees, of which one is the tallest recorded anywhere, and measures at least 120 ft. high, with a trunk almost free from branches to about 50 ft. and 13 ft. 8 in. in girth in 1908. It grows at an elevation of 500 to 600 ft. in a sheltered ravine facing east above the house, and is well protected by other tall trees (Plate 317). Another tree remarkable for its immense spread, is on the north side of the entrance-drive below the house, and is about 85 ft. high, with a short bole 18 ft. 9 in. in girth, spreading at the ground, where it measures over 40 ft. round (Plate 318). The total circumference of the branches was no less than 140 paces in 1908, being in this respect only surpassed in England by a wonderful Cedar of Lebanon at Langley Park Bucks, the seat of Sir R. Harvey, which I had not seen when Vol. III. was published, and which measures 146 paces round the branches. Besides these grand trees there are two more in the park below the house, one of which is about 115 ft. by 13 ft., with a clean bole 40 ft. long, and the other about 105 ft. by 18 ft. 4 in. Three of these trees are mentioned by Loudon (p. 1861) as having been planted by Lucombe, who is said to have been gardener at Mamhead, and this may have been about 1760, as he raised the original Lucombe oak about 1765; and I could find none of the latter now at Mamhead. Their dimensions are given by Loudon as 100 ft. by 12 ft., 90 ft. by 15 ft., and 80 ft. by 14 ft. 1 in. All of them are still in good health, and show no signs of decay in the branches.

Another very fine tree, though its habit is not at all typical of its kind, is in the deer park at Belton (Plate 316). It measures about 100 ft. high by 18½ ft. in girth, with a short bole of about 12 ft., which in 1905 was attacked by fungus (*Polyporus*), and will, I fear, decay. It is growing on a red sandy loam.

Another is a fine tree at Gatton Park, which measures 108 ft. by 12 ft. 8 in.,

with a bole of about 20 ft. Nearly as tall and even better in its habit, is one at Leeds Castle, Kent, which in 1902 I found to be 105 ft. by 11½ ft., with a clean straight stem over 50 ft. long. At Badminton Park there is a tree about 100 ft. by 10 ft. 4 in. which is known as the "Raglan Oak." At Bayfordbury, a well-shaped tree measures 96 ft. by 11 ft.

At Corsham Court there is a tree with very drooping branches which spread on the grass, and measure 78 paces round. Miss Woolward tells me of a very fine tree at Boughton Malherbe Rectory near Maidstone, which in 1908 was 85 ft. by 17½ ft., and has a spread of 100 ft. At Stratton Park and at Hackwood Park in Hants there are very large Turkey oaks which I have not measured. In the north of England the best I know is a tree in Ray wood at Castle Howard, which has been drawn up by surrounding beeches to a height of 98 ft., with a bole 40 ft. long, girthing 10½ ft.

In Wales by far the largest I have seen is at Dynevor Park, which was carefully measured in 1906 by the Hon. W. Rice, who made it 103 ft. by 14 ft. 7 in., with a spread of 103 ft.

In Scotland the Turkey oak is seldom seen. The largest mentioned by Loudon were at Hopetoun House, 50 ft. by 6 ft. 9 in., and at Brahan Castle, 50 ft. by 6 ft. The last tree may probably be the same as one which I measured in the dell below that beautiful place, and which, in July 1907, was no less than 90 ft. by 10 ft. 4 in., by far the finest of its sort that I have seen in Scotland. At Bruach burn, near Beaufort Castle in the same county, a large Turkey oak is growing in a sheltered situation, which has a short bole 11 ft. 9 in. in girth, and a wide-spreading top.

TIMBER

The timber of this tree has a bad reputation in the trade in England, because it will not stand weather, or alternations of wet and dry, like the common oak; and is therefore useless for outside work. Laslett, who was sent to Asia Minor in 1859 to search for oak suitable for the navy, says that in the valleys near Brussa *Q. Cerris* was found, and that this and the common oak were used by the Turks for naval shipbuilding, but he goes into no details. I have been told by boat-builders in Cornwall that it is excellent for keels; but whatever may have been its value in French shipbuilding formerly, as stated by Bosc and others, it is now, according to Mouillefert, little used in France except for firewood.

Atkinson states¹ that the doors of the principal rooms in the Marquess of Downshire's house at East Hampstead, near Wokingham, were made of the wood of Turkey oaks cut down there about 1828, and that the wood is finer in the grain and takes a better polish than British or foreign wainscot oak, and is more beautiful than any oak he had seen. But the Marquess of Downshire informs me that as the present mansion was built about 1857 it is doubtful whether they still exist.

(H. J. E.)

¹ *Trans. Hort. Soc. Lond.* i. 338 (1835).

QUERCUS LUCOMBEANA, LUCOMBE OAK

Quercus Lucombeana,¹ Sweet, *Hort. Brit.* 370 (1827).*Quercus Cerris*, Linnæus, var. *Lucombeana*, Loudon, *Arb. et Frut. Brit.* iii. 1851 (1838).*Quercus exoniensis*, Loddiges, ex Loudon, *loc. cit.**Quercus hispanica*, var. β, *chêne à feuilles d'Égilops*, Lamarek, *Encyc.* i. 723 (1783).*Quercus agylopiifolia*, Persoon, *Syn.* ii. 570 (1807).*Quercus Pseudosuber*, var. *agylopiifolia*, De Candolle, *Prod.* xvi. 2, p. 44 (1864).

The original Lucombe oak, in habit, vigour of growth, and branchlets, is similar to *Q. Cerris*; but differs in foliage, stipules, and fruit.

Leaves (Plate 335, Fig. 23) smaller than in *Q. Cerris*, never exceeding 5 in. long and 2 in. broad, usually smaller, subevergreen, falling early in the following year, usually in January and February, mostly² oblong ovate, acuminate at the apex, unequal at the base; with about seven pairs of regular triangular entire large teeth, each of which ends in a projecting mucro; lower surface covered with a dense whitish tomentum, different from the green or greyish under surface of *Q. Cerris*. The stipules around the lateral buds are shorter, and fall earlier than in *Q. Cerris*.

Fruit ripening in the second year; cupule turbinate, smaller in diameter than, and not hemispherical as in *Q. Cerris*, with grey tomentose scales shorter and broader than in that species, both reflexed and erect irregularly, not showing the definite arrangement of *Q. Cerris*, in which the upper marginal fringe of erect loose scales is clearly separated from the regularly reflexed scales of the rest of the cupule; acorn not depressed at the apex.

The original Lucombe oak was first described by Holwell in a letter³ dated Exeter, February 24, 1772, which states that "About seven years past," *i.e.* about 1765, "Mr. Lucombe sowed a parcel of acorns saved from a tree of his own growth of the iron or wainscot species; when they came up, he observed one amongst them that kept its leaves throughout the winter. Struck with the phenomenon, he cherished and paid particular attention to it, and propagated by grafting some thousands from it."

Holwell's account is repeated, with some additions, in the *Gentleman's Magazine*, 1773, p. 446, where William Lucombe is described as "an ingenious gardener in the environs of Exeter." There is no doubt that the iron or wainscot oak is a local name in south Devon and Cornwall for *Q. Cerris*, and that Lucombe was at this time owner of the garden, which afterwards developed into the famous nursery at Exeter.⁴ The Lucombe oak is said⁵ to have been common in 1773 about St. Thomas's, a suburb of Exeter, and to have been cultivated with great success by the neighbouring farmers.

Holwell's account is substantiated by Loudon, who was informed by Mr. Pince

¹ Sweet used this name for the first time. Holwell, who is often credited with it, gives no scientific name, and simply speaks of the tree as the Lucombe oak.² All specimens show some irregularly lobed leaves, which also appear in all the descendants of this tree. The leaves are described above from the tree at Carclew.³ Published in *Phil. Trans.* lxii. 128 (1772).⁴ According to the heading of a bill of Lucombe, Pince, and Company, preserved at Kew, the nursery was founded in 1720.⁵ *Gentleman's Magazine*, xliii. 357 (1773).

in 1838 that it was raised about seventy-five years previously (*i.e.* in 1763, a trifling discrepancy in the date) by "Lucombe, who was founder of the Exeter Nursery, from seed gathered by him off a specimen tree of *Q. Cerris* which grew in his nursery, near to one of *Q. Suber*."

The additional fact in Pince's account, which was derived from the younger Lucombe, who perfectly recollected the raising of the Lucombe oak in his father's nursery, is the existence of a cork oak, which must have pollinated one of the flowers of the parent Turkey oak. The botanical characters of *Q. Lucombeana*, which are partly those of *Q. Cerris* and partly those of *Q. Suber*, are thus satisfactorily accounted for; and, as is often the case in first crosses, the original Lucombe oak is remarkable for its vigour of growth.

From Hargham, in Norfolk, Sir Hugh Beevor sends us specimens of a natural seedling, about twenty-four years old, which originated in a similar manner from the acorn of a *Q. Cerris*, situated about 40 yds. to the westward of a *Q. Suber*. This tree, which is taller than a pure *Q. Cerris* of the same age beside it, has not yet borne acorns, but it resembles *Q. Lucombeana* in foliage. The leaves are similar in shape, having acute, triangular, strongly mucronate teeth; but it is only of late that their under surface has begun to develop the dense white tomentum that is so characteristic of the mature Lucombe oak.

The Lucombe oak was always propagated at the Exeter Nursery by grafting it upon *Q. Cerris*. The original tree was cut down when it was about twenty years old; but a grafted tree in the Exeter Nursery, planted in 1802, had attained 50 ft. in height and 8½ ft. in girth in 1837, and is figured¹ by Loudon, who mentions older trees² at Killerton and Carclew, the former eighty years old, and the latter seventy years old in 1834.

SEEDLINGS OF THE LUCOMBE OAK

The original Lucombe oak, and the trees propagated from it by grafts, must be carefully distinguished from its seedlings, the history of which was clearly given to Loudon by Pince. These were raised by the younger Lucombe from acorns gathered from one of the grafted Lucombe oaks in 1792. As usually is the case, when the seed of a first cross is sown, a great number of varieties resulted, of which three were selected and propagated in the Exeter Nursery by grafting on *Q. Cerris*. Two other seedlings were reared at a later period, about 1830. None of these varieties appear to have been as vigorous³ as the parent, and all had very corky bark, and kept their leaves till late in the season. These varieties all agree with the parent in the character of the branchlets and the mucronate points on the teeth or

¹ *Arb. et Frut. Brit.* iii. figs. 1712, 1713. The measurement given under fig. 1712 is erroneous; it is correctly stated on p. 1855, where Loudon quotes a letter from Pince, dated 4th April 1837, describing the tree.

² The ages are given in round numbers, and are not strictly accurate, as none of the trees can be so old as 1763 or 1765, the dates given by Holwell and Pince for the original tree.

³ The comparative rate of growth is shown by the following measurements of the trees in the Exeter Nursery, which were taken in 1837—

	Years old.	Height in feet.	Girth in feet.
Original—grafted Lucombe	35	50	8½
Seedling—var. <i>crispa</i>	45	63	9
„ var. <i>suberosa</i>	45	45	7½
„ var. <i>incisa</i>	45	45	7

lobes of the leaves, but differ in the shape of the leaves and in the characters of the fruit. The five seedlings, raised in the Exeter Nursery, were named by Loudon:—

1. Var. *suberosa*, Loudon. Smaller trees, with very corky bark, raised in 1792. Stipules short and quickly deciduous. Leaves (Plate 339, Fig. 64) smaller than in the original Lucombe oak, 2 to 2½ in. long, 1 in. broad; ovate; broad, rounded, and unequal at the base; acute at the apex, white tomentose beneath, usually with five to seven pairs of rounded or sinuate sharply mucronate teeth; some of the leaves, however, with fewer teeth, and one to three deep sinuses extending half-way to the midrib. Fruit ripening in the second year; cupule turbinate, with short broad grey tomentose scales, reddish at the tips, mostly erect.

2. Var. *heterophylla*, Loudon. Raised about 1830. Leaves oblong-lanceolate, 3 to 4 in. long, 1 to 1½ in. broad, acute at the apex, irregularly and deeply lobed, with the middle part of the leaf occasionally reduced to a narrow fringe on each side of the midrib. Cupules of the fruit turbinate; most of the scales short, ovate, ending in red acuminate tips; a few towards the margin of the cupule, linear-lanceolate, irregularly erect, and reflexed.

3. Var. *crispa*, Loudon, who calls it the new Lucombe oak. This was raised in 1792, and has very corky bark. Leaves subevergreen, falling in March and April, similar to those of *Q. Lucombeana*, but smaller in size and wrinkled in margin, 2 to 3 in. long, oblong-ovate, acute at the apex, unequal at the base, with six to eight pairs of acute triangular mucronate teeth; densely white tomentose beneath. Cupule scales reddish at the tips; those towards the margin long and directed upwards; those below short, some appressed, others reflexed. Acorn scarcely depressed at the apex, which is tipped with a short conical tomentose umbo.

4, 5. Var. *incisa* and var. *dentata*, Loudon, with large leaves, more deeply lobed than those of the preceding forms, are scarcely distinguishable from the original Lucombe oak, except in having more corky bark. Var. *incisa* was raised in 1792, and var. *dentata* about 1830. *Q. Cerris*, var. *cana major*, Loudon, *op. cit.* 1849, the origin of which is unknown, is very similar to these varieties.

In addition to the original Lucombe oak and its selected seedlings there remain a few forms the history of which is unknown, but which have undoubtedly arisen from the same parentage of *Q. Cerris* and *Q. Suber*. It is most convenient to name these as vars. of *Q. Lucombeana*.

6. Var. *fulhamensis*.

Quercus Cerris, var. *fulhamensis*, Loudon, *Arb. et Frut. Brit.* iii. 1850 (1838).

Quercus Cerris, var. *dentata*, Watson, *Dend. Brit.* ii. t. 93 (1825).

Quercus hispanica, a, *chêne de Gibraltar*, Lamarck, *Encyc.* i. 723 (1783).

Quercus Pseudosuber, var. *gibraltaria*, De Candolle, *Prod.* xvi. 2, p. 44 (1864).

Trees with less vigorous branches than *Q. Lucombeana*, forming a rounded head of foliage; bark moderately corky. Branchlets grey tomentose. Stipules around the

¹ Lamarck applied the name *Q. hispanica* not to a Spanish oak, but to three trees cultivated at the Trianon, which were specimens of the Lucombe, Fulham, and Turner's oaks. The first of these was erroneously supposed to grow wild in the neighbourhood of Gibraltar.

axillary buds short and early deciduous. Leaves (Plate 335, Fig. 21) usually deciduous in January and February, ovate, broader in proportion to their length, and smaller than those of *Q. Lucombeana*, about 3 in. long and $1\frac{1}{2}$ in. wide; broad, rounded, and unequal, or occasionally auricled at the base; acute at the apex; with 5 to 8 pairs of sinuate mucronate teeth; white tomentose beneath.

Fruit ripening in the second year; cupule hemispheric, smaller than in *Q. Cerris*, with lanceolate acuminate grey tomentose scales, red at the tips, usually all reflexed, except a few erect and curving inwards at the margin of the cupule, but not forming a regular fringe as in the Turkey oak; acorn not depressed at the summit, which bears a stout short tomentose umbo.

The original Fulham oak grew in Whitley and Osborne's nursery at Fulham, and was,¹ in 1835, 75 ft. high and $11\frac{1}{2}$ ft. in girth. Loudon supposed it to be a seedling; but in 1840 it sent forth a branch from the base, which proved it to have been grafted on *Q. pedunculata*.² It appears to have been always reproduced in the Fulham Nursery by grafting on the common oak. The origin of this tree is unknown; but an oak of apparently the same age, which was 80 ft. high and $4\frac{1}{2}$ ft. in diameter at a foot from the ground in 1835, is said by Pince³ to have been planted by Lucombe at Mamhead. This tree cannot now be identified, if it still exists. We can only conjecture that the Fulham oak, like a large *Q. Lucombeana* which grew beside it in the Fulham Nursery, was procured from Lucombe. Different in foliage and in fruit from the original Lucombe oak, it is possibly one of its earliest seedlings, of which no record was kept.

There are two trees, which we believe to be of this origin, at Kew, growing near the No. 3 Museum; one (Plate 319) measures 69 ft. by $7\frac{1}{2}$ ft.; the other, 63 ft. by 7 ft. 1 in.

7. Var. *fulhamensis latifolia*.

The original Fulham oak produced acorns freely from which many plants were raised, differing greatly in appearance from one another, and from the parent. About 1838, Messrs. Osborne selected a seedling with leaves broader and less dentate than usual, which they propagated under the name *Q. fulhamensis latifolia*. Specimens⁴ corresponding to this description from Westonbirt, Abbotsbury, and Liphook differ from all the other oaks of this series, in having leaves rounded and not acute at the apex, elliptical, about $3\frac{1}{2}$ in. long, and $2\frac{1}{2}$ in. broad, grey tomentose beneath, with 7 or 8 pairs of lateral nerves, each ending in the mucronate apex of a broad shallow sinuate tooth. Fruit not seen.

8. Var. *diversifolia*.

Quercus Ilex, var. *diversifolia*, Nicholson, in *Kew Handlist of Trees*, 189 (1896).

A small tree, with remarkably ascending branches, and thick corky bark.

¹ Loudon, *Gard. Mag.* xi. 128 (1835). Watson, *Dend. Brit.* ii. t. 93 (1825), gives its measurements in 1825 as bole 10 ft., total height 60 ft., diameter 2 ft. 3 ins.

² W. K., in *Gard. Chron.*, 1842, p. 111. There are also specimens at Kew of the original Fulham oak, collected by Nicholson in 1881, which show a branch of *Q. pedunculata*, found growing from the stock.

³ In Loudon, *Gard. Mag.* xi. 128 (1835).

⁴ A small tree outside the garden at Mamhead has foliage very similar, only differing in being somewhat narrower, but with identical nervation and shallow teeth.

Branchlets grey tomentose; stipules early deciduous. Leaves (Plate 339, Fig. 71) about 2 in. long, not exceeding $\frac{3}{4}$ in. in width, very variable in outline, the central part usually reduced to a narrow fringe on each side of the midrib, basal part with one to four mucronate lobes, apical part expanded; rounded or acute at the apex; entire or toothed and mucronate; dark shining green above, white tomentose beneath.

Fruit ripening in the second year; cupule hemispherical, about $\frac{1}{2}$ in. in diameter, with grey tomentose scales, red at the tips, irregular in size, the shorter ovate and appressed, the longer lanceolate-acuminate and slightly spreading, less numerous than the others and irregularly disposed; acorn depressed at the apex, with a conical tomentose umbo.

This peculiar variety, the history¹ of which is unknown, has leaves similar in form, but smaller and more coriaceous than those of var. *heterophylla*, from which it differs strikingly in habit and in fruit. Two trees, about 20 ft. high, in Kew Gardens were procured from Smith of Worcester in 1877.

9. *Quercus Pseudosuber*,² Santi, *Viaggio al Montamiata di Giorgio Santi*, i. 150, t. 3 (Pisa, 1795).

Quercus Fontanesii, Gussone, *Index Sem. Hort. Boccadifalco*,³ 10 (1826).

Under these names a number of wild trees, which so far as we can learn, only occur sporadically in the neighbourhood of their supposed parents, have been described, which are probably hybrid forms between *Q. Suber* and *Q. Cerris*. The original tree, described by Santi, was found near Florence; others were seen by Gussone in Sicily and Calabria. Kotschy mentions isolated trees in Istria, at Pisino-Corridaro, Carpizza, and near Capo d'Istria. It is also recorded from the neighbourhood of Grasse, in Provence. Specimens from Italy in the British Museum resemble in foliage *Q. Lucombeana*, var. *suberosa*. Both *Q. Pseudosuber* and *Q. Fontanesii* were said to have been introduced into cultivation in Loudon's time; but if any survive, we see no means by which they can be distinguished from the seedling forms of *Q. Lucombeana*. (A. H.)

Q. Pseudosuber has been treated by some French botanists as a species, whilst others consider it to be a hybrid between *Q. Suber* and *Q. Cerris*. In order to solve this question I visited the district in which it has been found, near Grasse, in January 1910, and after some inquiry found the only two trees known to M. Richard, the forest officer of Montauroux. One of these grows by the side of a rivulet close to the house of Mr. Nelson, manager of the Mine de Vaux, a coal mine which is being worked by an English company about three miles south of Montauroux, on the road to Frejus. The largest of these is a tree about 55 ft. by 3 ft. 3 in., with an upright habit, differing from all the other oaks which grew near it, namely the cork oak and *Q. lanuginosa* (locally known as *Chêne blanc*). The bark, of which I took a specimen, is corky, but much thinner than that of the cork oak; the leaves are hardly distinguish-

¹ Its corky bark and acorns ripening in the second year exclude it from being a variety of *Q. Ilex*. It is incorrectly identified in *Kew Handlist of Trees*, loc. cit., with var. *incisa*.

² *Q. Pseudosuber*, Desfontaines, is of totally different origin, being the hybrid between *Q. Mirbeckii* and *Q. Suber* which is found in Algeria. See p. 1319.

³ Boccadifalco, where there was formerly a Royal Garden, is near Palermo.

able from those of the Lucombe oak,¹ and are subevergreen, though many of those near the top of both trees had fallen. The other tree, about 50 yds. to the north of the same house, is also by a rivulet, and resembles the first precisely in habit and bark, though the leaves differ slightly.² I could find no trees of *Q. Cerris* anywhere in the neighbourhood, and was inclined to believe that *Q. lanuginosa* and not *Q. Cerris* is the other parent. The tree is known in the Provençal patois of the district as *Drouin*. M. Pardé³ spells this name *Drouis* or *Drouino*.

M. Coufourier, a botanist of Hyères, gave me a specimen from another tree growing in the "Fond des Gavôts" between Montauroux and Grasse, where he said he had seen no *Quercus Cerris*, though it is reported to occur in the district. He afterwards sent me acorns from the same place which confirm the opinion that *Q. Cerris* and not *Q. lanuginosa* is the parent.

During a visit to Italy and Sicily in March 1910, I saw in the herbarium of M. Sommier of Florence, a number of specimens identified with *Q. Pseudosuber* from various places in Tuscany and other parts of Italy. These varied extremely in their foliage. In the Botanic Garden at Florence there is a fine tree about 60 ft. by 6 ft. named *Q. Pseudosuber*.

In Sicily I was directed by Signor Lojacano⁴ to a place called Ficuzza about 25 miles south-east of Palermo where there is a large oak wood in which a few specimens of *Q. Pseudosuber* or *Fontanesi* are found. The forest guard, who knew them under the name of *falso-sughero* (False-cork), guided me to a spot about two miles from the village, where five or six trees were growing scattered in a wood mainly composed of *Q. sessiliflora*, here called *robore*; with some trees of *Q. Ilex (ilice)*, *Q. Suber (sughero)*, and *Q. Cerris (Cerro)*. He considered the two latter to be the parents of the *falso-sughero*, and said that the hybrids produced acorns rarely. The largest tree was very similar in habit to the French trees above mentioned, about 60 ft. by 5 ft., with a hard but slightly corky bark, of which I took a specimen. The leaves were still mostly green on March 3rd, at an elevation of about 1500 ft.

REMARKABLE TREES

All the original Lucombe oaks are extremely uniform in their habit, bark, and foliage; they show no resemblance in their bark to the cork oak; and all are characterised by a peculiar swelling at the base of the limbs, which I have only seen in the Turkey oak, and by an extremely vigorous growth and an upright habit. I formerly

¹ A microscopical examination of the leaves of these trees by Mr. Boodle of the Kew Laboratory shows no evidence of the influence of *Q. lanuginosa*, which has four (sometimes only two) ray-cells in the stellate hairs on the under side of the leaf, whereas in *Q. Pseudosuber* and *Q. Suber* there are seven to twelve ray-cells.

² The specimens from the three trees near Montauroux—two seen by Elwes and one observed by Coufourier—all differ in foliage, showing that all three are probably descendants of the first cross between *Q. Suber* and *Q. Cerris*. The acorn-cupules, sent by Coufourier, are slightly different from any that I have seen on English trees; and have long reflexed marginal scales and short and spreading basal and median scales. The acorns are depressed at the apex, which bears a minute tomentose umbo.—(A.H.)

³ *Arb. Nat. des Barres*, 296 (1906). M. Pardé informs me that the trees here mentioned at Les Barres cannot now be found.

⁴ The oaks of Sicily have been most carefully studied and described by Signor Lojacano, who recognises in his *Flora Sicula*, iv. pp. 364-389 (1904), no less than thirty-three species and hybrids, specimens of which I examined in the herbarium of the Botanic Garden at Palermo. In this garden there is a good-sized tree of *Q. Pseudosuber*, and in the Botanic Garden at Catania another fine tree about 50 ft. by 4 ft. which produces large acorns freely.

supposed the tree from which they were propagated, to have been, as Holwell states,¹ a very vigorous seedling of the Turkey oak which, in the climate of south Devon and Cornwall, where alone this form can be seen at its best, kept its leaves in winter; and I have raised from acorns of the large Turkey oak, growing near the pond at Kew, two seedlings which up to the age of five years have this subevergreen habit. The seedlings of the original Lucombe oaks, of which the two largest specimens grew near the entrance of the old Exeter Nursery and are now both cut down, had a different habit and much more corky bark, and with the exception of a tree near the chapel at Killerton which, however, is not nearly as large, I have seen no others which could compare with them. None of those propagated later ever seem to have attained the size or vigour of the original Lucombe oak, and none of the seedlings which are on their own roots, show any promise of rivalling the original grafted trees in height or girth. There is no doubt that the original Lucombe oaks which I mention as follows, are among the finest ornamental trees in Great Britain, and deserve to be propagated by grafting in the same way as Lucombe did. For none of those we have seen which have been sold by nurserymen in the last century as Lucombe oaks, can be compared in size or vigour with the originals.

In Cornwall the largest I have seen are at Carclew. One of these in a walk leading to the gardens, was believed by Sir Charles Lemon, who formerly owned Carclew, to have been an original Lucombe oak, and from his notebook, which the late Colonel Tremayne showed me, I took the following measurements:—

In 1823	.	.	74½ ft. by 6 ft. 11 in. at 4 ft. from ground.
In 1851	.	.	" 9 " 1 " " "
In 1853	.	.	" 9 " 8 " " "

When I saw it in 1903 it was about 100 ft. high by 13 ft. I have not seen any of its acorns, which, Mr. Simmons, the gardener, told me, are rarely produced. At Carclew, in the park, there are four other trees of similar appearance and grafted in the same way which measure from 90 to 100 ft. by 10 to 12 ft. in girth.

Mr. Napper states that a very fine one stands by the Lodge Gate at Trebarrick, St. Austell; and I am informed by Mr. J. P. Rogers that there are at Penrose, near Helston, some large Lucombe oaks planted about 1773 and grafted on the Turkey oak, which are no doubt original.

In Devonshire the tree by the gardens at Killerton (Plate 321) in 1908 measured about 100 ft. by 12 ft. 11 in. At Powderham in the deer park two trees measured in 1906, 92 ft. by 14 ft. 4 in. and 90 ft. by 13 ft. 4 in. At Ugbrooke Park, Devon, the seat of Lord Clifford of Chudleigh, there are four fine trees in the park near the house, of which the largest in 1908 measured 80 ft. by 16 ft.; another about 80 ft. by 14 ft. At Castle Hill, Devon, a tree on the lawn, which I am told by the Hon. J. W. Fortescue was planted in 1770, in 1905 measured 80 ft. by 15 ft. 8 in. (Plate 320). At Sharpham, near Totnes, just below the house, a rather spreading tree was 90 ft. by 13 ft. 4 in. in 1907. At Kingston Lacy, Dorsetshire, there is a tree 90 ft. by 8 ft.,

¹ Cf. *Gard. Chron.* xxxii. 195, 221 (1902). The original Lucombe oak appears, however, to have been a chance hybrid of *Q. Cerris* with *Q. Suber*, and not a seminal sport of the Turkey oak.

with a clean bole about 40 ft. long. At Sherborne Castle, Dorsetshire, a tree measures about 75 ft. high, and 12 ft. 9 in. in girth at 3 ft. At Corsham Court, Wilts, there are two trees, one 80 ft. by 6 ft. 9 in., which is grafted on the common oak, the other 80 ft. by 7 ft. with a straight clean bole of 40 ft. At Longleat, Wilts, Col. Thynne measured one in 1903, 78 ft. by 11 ft. 10 in. At Bowood, Wilts, I saw a handsome tree in 1906, 92 ft. by 9 ft. At Croome Court a tree 74 ft. by 10½ ft., which on 4th June 1906 still bore some leaves of the previous year, showed no graft mark at the ground, which indicates that it may be a seedling of more recent origin. At White Knights, Berks, in the grounds of the Wilderness, a tree of moderate size is grafted on the common oak. At Kew a very fine tree, which also appears to have been grafted on the common oak, measured, in 1907, 74 ft. by 12 ft. 3 in.

In Wales the only tree that I know is at Stackpole Court. It measured in 1906, 76 ft. by 6 ft. 8 in.

In Scotland I have seen one tree which looks like an original Lucombe oak; it grows in the park at Dunkeld, near the Abbey ruin, and measured in 1904, 62 ft. by 7 ft. 9 in.

In Ireland the only tree I have seen which looks like an original, is one in the grounds of Kilmacurragh, said to have been purchased by Mrs. Acton over a hundred years ago; and when I saw it in 1908 was 78 ft. by 7 ft., with a clean bole of about 40 ft.

Loudon quotes a letter from Pince as follows: "When the original tree had attained 20 years' growth, and was about 3 ft. in circumference, Mr. Lucombe, being then far advanced in years, had it cut down for the purpose of making his coffin out of it. He, however, lived so much longer than he anticipated, that several years before his death, he had another much larger and older tree cut down, sawn into planks, and carefully deposited under his bed in readiness for the above purpose; and inside those planks, over which for many years he had reposed, he was at length put to rest, at the advanced age of 102 years." Of this tree I possess a relic in the shape of a corner piece, which I bought at a sale of the effects of Mrs. Woodman, a granddaughter of Mr. Pince, who told me that it was made with other furniture from the tree above mentioned. The wood is fine and close-grained, showing a good deal of figure, and of a pale yellowish brown. It has not shown the least symptoms of warping or decay, and is untouched by wood-boring beetles.

The seedlings of the original Lucombe oak are quite different in habit, bark, and character, and show their origin very clearly in the corky nature of the bark. The two largest trees of this kind that existed, so far as I know, grew on each side of the entrance of the old Exeter Nursery. One, stated by Napper to be the original var. *crispa*¹ of Loudon, was 12 ft. in girth in 1891. I am informed by Mr. Robert Veitch, of Exeter, that it was cut down some years ago, and I could find no trace of it. The second, when I visited Exeter in 1902, was standing on the west side of the nursery gate, and measured about 60 ft. by

¹ Cf. Loudon, fig. 1718, who gives its dimensions in 1838 as 63 ft. high and 9 ft. in girth. It was raised, as above stated, as a seedling in 1792.

10 ft. with a straight clean bole of 22 ft. This, according to Napper, was the original var. *suberosa* of Loudon. It was cut down the year afterwards, when the nursery was sold for building, and I bought the log, containing about 80 ft. in the butt only, for £2. It turned out some very sound hard wood, which, when sawn on the quarter, showed a very varied and beautiful figure. A board from this tree, showing the bark, is now in the museum at Kew, and a cabinet which I had made from it is extremely handsome.

The only other large tree which I know of similar character, and almost certainly of the same origin, grows near the chapel at Killerton, and measures about 60 ft. by 8 ft., with a bole 15 ft. long; its bark is very corky, and it produces acorns much more abundantly than the larger original Lucombe oak at the same place; its leaves are smaller than those of the latter. I have raised a number of seedlings from this tree which vary a good deal, and are too tender to grow well on my soil, which does not suit either of the parents.

Another very fine tree which I believe to have been of the same origin, though its leaves resemble rather those of the Fulham oak, grows at Redleaf, near Penshurst, Kent, the seat of Mrs. E. Hills. This tree shows in its bark that the cork oak was one of its parents, and has no visible mark of having been grafted. It measures 86 ft. by 9 ft. 10 in., with a clean bole about 20 ft. long, and is a handsome and vigorous tree.

There are numerous seedling forms in cultivation, which vary considerably in their foliage, habit, and in the period which they shed their old leaves. Most of them are of very inferior size to the original tree, and the grafted plants, which are usually sold under the name of Lucombe oaks, are, so far as I have seen, slow growers even in the south-west of England. A good example of this may be seen at Powderham Rectory, the residence of the twelfth Earl of Devon, where an avenue of Lucombe oaks was planted, as he told me, about fifty years ago, which, though they came from Lucombe and Pince's nursery, will never rival their parent trees.

There are a number of trees at Syon, which appear in the old catalogue under various names, and which resemble the Lucombe or Fulham oak in their leaves and subevergreen character, but which are not typical of either in their habit. These are most probably seedlings from the Fulham Nursery, but one of them grafted on the common oak, is probably a graft from the original Fulham oak, and measures 81 ft. by 9 ft. 4 in.

The tree does not come true from acorns, as Mr. Napper says that he was in the habit of gathering them, and that they invariably produced what he knew as bastard oaks, more like the Ilex than anything else; and Lord Ducie, who has raised them, tells me the same thing. I found several pans of seedlings of a so-called Lucombe oak in the St. John's nursery at Worcester in 1902, one of which had made in the first year about 18 in. of growth, but this was not made in one uninterrupted shoot as described in the original, but in two separate periods of growth as usual in the English oak.

(H. J. E.)

QUERCUS ÆGILOPS, VALONIA OAK

Quercus Ægilops, Linnæus, *Sp. Pl.* 996 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1861 (1838).

Quercus ithaburensis, Decaisne, in *Ann. Nat. Sc.* iv. 348 (1835).

Quercus græca, Kotschy, *Eichen*, t. 30 (1862).

Quercus macrolepis, Kotschy, *Eichen*, t. 16 (1862); A. de Candolle, *Prod.* xvi. 2, p. 45 (1864).

Quercus Ungerii, Kotschy, *Eichen*, t. 13 (1862).

Quercus Vallonea, Kotschy, *Eichen*, t. 7 (1862); A. de Candolle, *Prod.* xvi. 2, p. 45 (1864).

A tree, attaining in the Levant, in good moist soil, about 80 ft. in height, but seldom reaching more than 30 to 40 ft. in arid situations. Bark deeply divided into small square scaly plates.

Young branchlets covered with a dense greyish tomentum, persistent in the second year. Buds ovoid-prismatic, about $\frac{1}{4}$ in. long, tapering to an acute or rounded apex, tomentose, usually surrounded by long linear pubescent stipules. Leaves (Plate 335, Fig. 19) deciduous late in autumn or in the following spring, 3 to 4 in. long, and $1\frac{1}{2}$ to 2 in. broad, oval or oblong; base usually broad and rounded, occasionally cuneate, subcordate, or auricled; apex acute; with five or six pairs of lateral nerves, prominent beneath, each ending in a large triangular bristle-pointed tooth or lobule; leaf margin and bristles ciliate; upper surface shining, with scattered short stellate pubescence; lower surface covered with a grey short tomentum, occasionally more or less deciduous between the nerves; petiole, $\frac{1}{4}$ to 1 in. long, tomentose.

Fruit ripening in the second year, sub-sessile, usually solitary; acorn sub-globose and scarcely exserted or cylindrical and projecting, $\frac{3}{4}$ to $1\frac{1}{2}$ in. long, depressed and whitish tomentose at the apex, chestnut brown and glabrescent elsewhere; cupule $\frac{1}{2}$ to 2 in. broad, variable in the shape and consistence of the scales, but broadly distinguishable into two varieties, which are connected by numerous intermediate forms.

1. Var. *macrolepis* (var. *græca*). Cupule hemispheric; scales loosely superposed, thin and ligulate, tomentose, $\frac{1}{4}$ to $\frac{3}{4}$ in. long, spreading or erect, often recurved. This form is prevalent in Greece and the adjoining islands.

2. Var. *Ungerii* (var. *ithaburensis*). Cupule sub-globose; scales fewer, thickened, pyramidal, tomentose, $\frac{1}{4}$ to $\frac{1}{2}$ in. long, spreading or erect, sometimes recurved. This form is prevalent in Asia Minor.

Quercus Pyrami, Kotschy, *Eichen*, t. 3 (1862), which is often considered to be a variety of this species—var. *Pyrami*, Boissier, *Fl. Orientalis*, iv. 1172 (1879)—differs considerably in foliage and is quite distinct for purposes of cultivation. As seen at Kew, where it is a small tree about 20 ft. high, the leaves (Plate 335, Fig. 20) are smaller, about $2\frac{1}{2}$ in. long and $1\frac{1}{2}$ in. broad, often indented below the middle with a deep sinus on one or both sides; lateral nerves six to eight pairs ending in short mucronate teeth. According to Kotschy, *Q. Pyrami* grows in the plain of Cilicia, forming large woods at the mouth of the river Pyramus. (A. H.)

DISTRIBUTION

This species is widely spread throughout Greece and the adjoining islands, either solitary or forming small woods. Mr. F. B. Wood, British Consul at Patras, informs us that in that district it is abundant and attains large dimensions. A tree of which he sends a sketch, is about 60 ft. high, and 13 ft. or more in girth at 3 ft. from the ground, above the spreading roots. The tree flourishes equally well in various soils. The forest in Elis grows in a plain of rich loam, where myrtle, arbutus, and lentisk are found in profusion. In late spring this oak forest with its carpet of bracken, mixed with asphodel, crocus, and countless wild flowers, is very beautiful. In Acarnania and Etolia the trees grow on rocky hill-sides, amongst wild sage and thorn. In Elis and Achaia a yellow-berried mistletoe (*Loranthus europæus*) is found on every second oak.

The Valonia oak is also widely spread throughout Asia Minor¹ and Crete. According to Sir Joseph Hooker,² "it is very gregarious in Syria, never forming a bush or growth of underwood, but rising on a stout gnarled trunk 3 to 7 ft. in girth, to the height of 20 to 30 ft. Wherever we saw it, as on the hills east of Nazareth, on Tabor where it is abundant, to the east of Caifa, and on the north-east flank of Carmel, it forms scattered, rather round-headed, densely leafy trees, giving an open park-like appearance to the landscape. The wood is said to be excellent. The acorn often attains a very large size, some we gathered were $2\frac{1}{2}$ in. long and 3 in. in girth, but they vary extremely on the same tree, some being so small that I have had difficulty in distinguishing between them and large ones of *Q. pseudococcifera*. I have examples which if they had not been taken by myself from an *Ægilops* tree which also bore large acorns, I should have attributed to hybridisation between the two. When fully ripe the gland is still green, and in this state it germinates, the pericarp never hardening. They may be seen in all the bazaars, raw and boiled, in which state they are eaten by Turks and Arabs."

Gay says that in the Jardin des Plantes on 14th November 1862, he found the acorns of a chestnut brown colour and with a nutty flavour; and this was the case with acorns from Greece which I tasted, and found slightly astringent, but quite edible.

CULTIVATION

According to Loudon this species was introduced as long ago as 1731, but it has always been a rare tree, and probably requires more summer heat than our climate affords. The acorns are often sent from the Levant, but seem to lose their vitality quickly. I received some of remarkably large size in January 1909 from Mr. Wood, which have made nice young seedlings in pots.

In Gay's herbarium, at Kew, there is a specimen from a tree growing in the

¹ Balansa in a note preserved in Gay's herbarium says that in the neighbourhood of Ushak (or Oushag or Uschak), this oak forms vast forests, and the collection of the cupules was an important industry. At that time they were worth about 2d. a pound, one tree producing about ten pounds.

² In *Trans. Linn. Soc.* xxiii. 385 (1862).

kitchen garden at Milford House, dated September 1859, and a note to the effect that it was introduced by P. Barker Webb. I visited this place in 1909, but could find no trace of this tree, though a small stunted tree exists in another part of the grounds.

At Abbotsbury there is a tree measuring 45 to 50 ft. high by 4 ft. 4 in. in girth, which in 1908 produced half-matured acorns. At Devonshurst, Chiswick, Henry found a branching tree of no great height, but 4 ft. 3 in. in girth.

At Hardwick, near Bury St. Edmunds, I found a small tree about 30 ft. by 4 ft.

At Tortworth a tree is growing on the lawn below the house, which was planted about 1846 by the late Lord Ducie and transplanted when about 10 ft. high to its present situation. It is now about 40 ft. high and produces abortive acorns almost every year, but once produced a ripe acorn which was sent to Kew. At Blenheim, Mr. A. B. Jackson measured a tree 37 ft. by 3 ft. 6 in. dividing into two stems at about 5 ft. from the ground.

Sir C. T. D. Acland has raised plants at Holnicote, which now vary from 1½ to 5 ft. high, from acorns gathered at Patras which were sown in 1899.

At Lyndon Hall, Rutland, there is a fine healthy tree, 30 ft. by 5 ft. in 1909 (Plate 322).

At Syon a tree was reported by Loudon in 1838 to be 22 ft. high and 3 ft. in girth; the only others in England known to him were at Llanbedr Hall, near Ruthin, and at Finborough Hall, Suffolk; all of these seem to have disappeared.

Loudon mentions¹ a tree at Oriel Temple, in Ireland, 55 ft. high in 1838; but I could find no trace of it in 1908.

In France it is hardy at Les Barres, where a specimen² 33 ft. high and 5 ft. in girth rarely produces fertile acorns.

The Valonia oak was introduced³ into Algeria about 1860 by M. Hardy, but though trees are to be found there about forty years old and flourishing, no plantations on a commercial scale appear to have been made. The credit of the introduction⁴ of this tree into Australia is due to Mr. George Cunnack, tanner at Castlemaine, Victoria, who imported from Smyrna in 1879 two Wardian cases, one containing rooted young plants and the other acorns covered with earth. They both arrived in good condition, the acorns having sprouted during the voyage, and produced some hundreds of plants.

VALONIA, MANNA

Valonia⁵ is the name for the cups of the acorns of *Q. Ægilops*, which for many years have been imported from the Levant for tanning.

According to Loudon who quotes M'Culloch, in 1831-32 the import amounted

¹ *Arb. et Frut. Brit.* i. 109 (1838).

² Figured by Pardé, *Arb. Nat. des Barres*, 293, t. 29 (1906). The specimen which we have of a tree called *Q. macrolepis* at Les Barres agrees well with *Q. Pyrami*. Albert et Jahandiez, *Plant. Vasc. du Var*, 447, note 1 (1908), state that *Q. Ægilops* is cultivated in the department of Var, and is occasionally found in woods there in a semi-wild state.

³ Trabut, *Le Chêne Vélani*, issued as Bull. 27 by the Agricultural Department of Algeria in April 1901.

⁴ Maiden, *The Valonia Oak, New South Wales, Dept. Agric. Misc. Public. No. 313* (1899).

⁵ Sir W. Thiselton Dyer tells us that *valonia* takes its name from Avlona or Valona, a port in Albania, whence it is exported.

to 7500 tons per annum, worth £12 to £15 per ton. Consul Wood of Patras informs me that though the export from Greece alone in 1896 was over 8000 tons, the price has now fallen to £7 or £8, which scarcely covers the cost of collecting and cleaning. In 1906 the export had fallen to 3900 tons, and it seems as though it would die out altogether. He adds that the figures apply to the cupule alone and not to the acorn also, which is discarded before shipment.

Professor Procter of Leeds University informs me that the import has diminished owing to the competition of oak and chestnut extracts, and other tanning materials in the extract form. Valonia extract is now made at Smyrna and may have a considerable future. Greek valonia is well known in the trade and usually averages lower in price than the Smyrna article. As a rule it is less in strength, but good samples of Greek are often better than anything but the best Smyrna. The ripe valonia, either Greek or Smyrna, consists of cups only; but Greek *camata* and *camatina*, are unripe varieties valued for their colour. In *camatina* the acorn is completely enclosed by the unopened cup; in *camata* the acorn shows, but cannot be removed. He cannot say definitely whether any import comes from Syra or Crete, but Greek island valonia is a well-known commodity and often good.

The Valonia oak and an allied species, *Q. persica*, Jaubert et Spach, yield a kind of manna in Kurdistan. These trees are visited in August by immense numbers of a small white *coccus*, from the puncture of which a saccharine fluid exudes and solidifies in little grains. This exudation is collected by the wandering tribes of Diarbekir, who use it as food. A complete account of this peculiar substance is given by Flückiger and Hanbury.¹ (H. J. E.)

QUERCUS CASTANEÆFOLIA, CHESTNUT-LEAVED OAK

Quercus castaneæfolia, Meyer, *Verz. kauk. Pflz.* 44 (1831); Mathieu, *Flore Forestière*, 367 (1897).
Quercus Afares, Pomel, *Nouv. Mat. Flore Atlantique*, 391 (1874).

A tree, attaining 100 ft. in height and 10 ft. in girth. Bark deeply divided into longitudinal slightly scaly ridges. Young branchlets covered with a minute dense pubescence. Buds (Plate 78, Fig. 4) ovoid, pubescent, those near the apex of the branchlet surrounded by persistent long filiform pubescent stipules. Leaves (Plate 337, Fig. 47) deciduous in autumn, oblong-elliptical, acuminate at the apex, rounded and unequal or cuneate at the base, 3 to 6 in. long, 1½ to 2½ in. wide; with 8 to 14 pairs of lateral nerves, each ending in a mucronate triangular tooth; upper surface dark green, shining, with deciduous minute white stellate hairs; lower surface paler, coated with a minute tomentum; petiole ½ to ¾ in. long, pubescent.

Fruit ripening in the second year, solitary or rarely in clusters of two to six, on a stout short pubescent peduncle; acorn ovoid-cylindrical, ¾ to 1¼ in. long, glabrous, rounded at the apex, which is crowned by the tomentose style; cupule hemispheric,

¹ *Pharmacographia*, 415 (1879). Virgil, *Ecl.* iv. 30, refers to honeydew on oak, and not to manna, as alleged by Hanbury.

$\frac{3}{4}$ to 1 in. wide, with tomentose scales, reflexed from near their bases, long and linear in the upper ranks, ovate and short elsewhere, but very variable in length and shape.

This species has a remarkable distribution, occurring both in Algeria and in the eastern Caucasus and northern Persia. The characters, upon which Pomel tried to separate the Algerian tree as a distinct species, are unreliable. As seen, however, in cultivation and described by travellers in the wild state, the Caucasian or typical form is characterised by its short trunk and widely spreading horizontal branches, with a bark darker in colour and smoother than in the Algerian form. The latter is narrowly pyramidal in habit, with ascending branches, and with a deeply furrowed whitish bark.

This species is restricted in the Caucasus to the province of Talysch, where it grows in the forests from sea-level to 4000 ft. In Persia it is met with in the mountains south of the Caspian Sea. In Algeria it is less widely spread than *Q. Mirbeckii*, being confined to the forests in the mountains near the coast from Kabylia to the borders of Tunis. This oak near El Snab forms a wood at 600 ft. above sea-level; but elsewhere it is usually a tree of higher levels, occurring in the Akfadou forest between 3700 and 5000 ft., where it is mixed with *Q. Mirbeckii*, but is less abundant (Plate 323). On the northern slope of Mt. Babor, *Q. castaneæfolia* grows in company with *Abies numidica* and *Cedrus atlantica*.

Q. castaneæfolia is the southern representative of *Q. Cerris* in the same way as *Q. Mirbeckii* replaces *Q. sessiliflora*; and the mixed oak forests in Algeria closely resemble, in their composition, the forests in Servia where the Turkey oak and the sessile oak are mingled together.

In the forest of Akfadou and elsewhere, on the line of contact between the cork oaks of the lower elevations and the mixed forest of *Q. Mirbeckii* and *Q. castaneæfolia* higher up, the latter species and *Q. Suber* form hybrids which are readily distinguishable in winter, as in that season *Q. castaneæfolia* has lost its leaves, while the hybrids are subevergreen and are different from *Q. Suber* in their inferior corky bark and in the shape of the leaves. These hybrids,¹ which bear a striking resemblance to those of the Turkey oak and *Q. Suber*, are very variable in the character of the bark, in the period of fall of the leaves, and in the stature and growth of the trees. Those which are closest to *Q. castaneæfolia* in these characters have been named *Q. numidica*, Trabut;² those nearest to *Q. Suber*, *Q. kabylica*, Trabut.² (A. H.)

CULTIVATION

We can find no reliable information as to when or by whom this oak was introduced into England, but it was not known to Loudon except from description.

The only large tree we know of in England is a fine specimen at Kew, near the Palm House, which measured in 1909 about 60 ft. by 9½ ft. It produces fertile

¹ Certain cork oaks in this forest which lose their leaves in winter are also probably hybrids.

² In *Bull. Assoc. France Avance. Sc.*, 1886, p. 506, and *Bull. Soc. Bot. France*, xxxvi. 58, 61 (1889).

acorns in good seasons, from which I have raised seedlings, and these, though they grow slowly, seem perfectly hardy. It is supposed to have been planted about 1843.

A smaller tree, growing beside this, is probably the Algerian form, and measures 47 ft. by 3 ft. 1 in. This is perhaps of the same origin as a very thriving narrow pyramidal tree¹ in the oak collection, measuring 34 ft. by 3 ft., which was raised from acorns sent by Playfair from Algeria in 1869.

Another tree at Beauport, near Grinstead's Cottage, is about 35 ft. by 4 ft. 9 in. and has a short bole with rather corky bark, and a very spreading crown.

Henry was informed in Algeria that the wood of this species is similar in its properties to that of *Q. Cerris*, as it has an abundant sapwood and fails in durability. It is hard, heavy, easy to rive, but difficult to work, and is rejected by the railway companies who have been urged in vain by the forestry department of Algeria to use it for sleepers. Up to the present time it has been mainly used for firewood.

(H. J. E.)

QUERCUS MACEDONICA

Quercus macedonica, A. de Candolle, *Prod.* xvi. 2, p. 50 (1864).

Quercus Grisebachii, Kotschy, *Eichen*, 3 (1862) (name only); Baldacci, *Riv. Coll. Bot. Alb.* 72 (1892).

Quercus Egilops, Grisebach, *Spicil. Fl. Rum.* 333, excl. syn. (1844) (not Linnæus).

Quercus ostryæfolia, Borbas, in *Erdesz. Lap.* xxvi. 932 (1887).

A small tree or large shrub. Young branchlets with a minute scattered pubescence. Buds ovoid, $\frac{1}{8}$ in. long, with glabrous ciliate scales. Leaves (Plate 337, Fig. 41) deciduous late in the season, coriaceous, about 2½ in. long and 1 in. broad, ovate-lanceolate, auricled at the broad base, acute or acuminate at the apex, with nine to twelve pairs of lateral nerves each ending in a short mucronate tooth; margin wrinkled, with the teeth inflexed; upper surface dark green, with minute deciduous scattered brown pubescence; lower surface paler, with a similar pubescence; petiole $\frac{1}{8}$ in. long, minutely pubescent.

Fruit ripening in the second year, solitary, or two to three together, on a very short stout pubescent peduncle; acorn pubescent at the tip, enclosed in the lower half in a hemispherical cupule, about 1 in. in diameter with pubescent scales, the lowest ovate and appressed; the middle scales linear, hooked, and recurved; the uppermost narrow, erect, or incurved.

This species was discovered by Grisebach in Macedonia, in the mountains near Vodena, and occurs in Epirus, Albania, Montenegro, southern Herzegovina, and in south-eastern Italy on the coast between Bari and Gallipoli.²

In Herzegovina³ it is a rare tree, growing in mixture with *Q. Cerris* and *Q. conferta*, in the Dobrava forest near Stolac and in a few other localities. Farther

¹ It measured 24 ft. by 2 ft. in 1897.

² Schneider, *Laubholzkunde*, i. 180 (1904).

³ Cf. Beck, *Veg. illyr. Land*, 211 (1901).

south it is more common, as in the mountains between Lake Scutari and the sea, and throughout Albania, where it grows above the zone of littoral vegetation, in the lower region of the deciduous oak forests up to 2000 or 3000 ft. It forms pure woods of small extent, or is mixed with *Q. Cerris*, *Q. conferta*, *Carpinus orientalis*, *Ostrya*, and *Fraxinus Ornus*.

This species only attains a moderate size, and can scarcely be expected to form a large tree in England, where the best specimen known to us is at Tortworth, which measured in 1907 about 25 ft. high and 1 ft. 11 in. in girth. The only others we have seen are small trees at Kew, about 10 ft. high, which were raised from acorns sent by Beccari in 1890. Elwes raised a lot of seedlings from acorns sent to Kew in 1905, which seem to thrive on oolite soil, and endured the severe frost of 1908-9 better than *Q. Ilex*. It appears to be perfectly hardy not only in England, but in Germany,¹ where young plants raised at Gotha from acorns gathered by Dr. Perona at Gallipoli are thriving. (A. H.)

QUERCUS LIBANI

Quercus Libani, Olivier, *Voy. Emp. Oth.* ii. 290, t. 32 (1807); De Candolle, *Prod.* xvi. 2, p. 49 (1864); Carrière, in *Rev. Hort.* 1872, p. 155, f. 18; Boissier, *Fl. Orient.* iv. 1173 (1879).

A small tree or large shrub. Young branchlets minutely pubescent. Buds ovoid, acute, $\frac{1}{8}$ in. long, with ciliate, glabrous, or pubescent scales. Leaves (Plate 337, Fig. 39) deciduous in autumn, about 3 in. long and $\frac{3}{4}$ in. wide, lanceolate, acuminate at the apex, rounded and unequal at the base, with nine to twelve pairs of lateral nerves, each ending in a bristle-tipped inflexed² serration; both surfaces at first pubescent, usually becoming glabrous in summer, except on the midrib and nerves, where some pubescence is retained; petiole $\frac{1}{2}$ in. long, pubescent.

Fruit ripening in the second year, solitary on short stout pubescent stalks, very variable in size; acorn globose and only slightly projecting beyond the cupule, or cylindrical and half-enclosed by the cupule, depressed and tomentose at the apex; cupule campanulate, $\frac{3}{4}$ to $1\frac{1}{4}$ in. in diameter, covered with appressed tomentose ovate-rhombic scales.

This species is extremely variable³ in the amount of pubescence on the branchlets and leaves, and in the size of the acorn cup, which shows much variation in the size and shape of the scales. Leaves with irregular deep lobes sometimes occur on vigorous young branchlets; and extreme forms of this are *Q. squarrosa*, Kotschy,⁴ founded possibly on coppice shoots. *Q. Libani*, which was discovered by Olivier on Mt. Lebanon, is widely spread throughout the mountains of Syria, Asia Minor, and Armenia.

¹ Schneider, *Laubholzkunde*, i. 180 (1904).

² The margin is wrinkled on account of the inflexed teeth, but less so than in *Q. macedonica*.

³ *Quercus regia*, Lindley, *Bot. Reg.* t. 73 (1840); *Q. vesca*, Kotschy, *Eichen*, t. 11 (1862); and *Q. Tchihatchewi*, Kotschy, in Tchihatcheff, *As. Min.* ii. 468, t. 40, f. 1 (1860), are united with *Q. Libani* by Boissier, and are perhaps extreme forms of this very variable species.

⁴ Ex De Candolle, *Prod.* xvi. 2, p. 108 (1864).

The oldest plants in Europe were apparently raised at Paris, from acorns sent by Balansa in 1855. A healthy tree in the Jardin des Plantes at Paris produces acorns; and it is quite hardy at Les Barres. This species is extremely rare in England. The best is a grafted tree at Kew, about 25 ft. high, with a good leader, which was obtained under the name *Q. serrata pendula*, from Lee's nursery in 1880. A smaller tree, about 15 ft. high, obtained from Paris in 1883, bore a few acorns in 1909. There are also specimens at Tortworth, Grayswood, and Aldenham. The latter, a healthy young tree, produced ripe fruit in 1908. (A. H.)

QUERCUS SERRATA

Quercus serrata, Thunberg, *Fl. Jap.* 176 (1784); Franchet et Savatier, *Enum. Pl. Jap.* i. 447 (1875); Hooker, *Fl. Brit. India*, v. 601 (1888); Skan, in *Journ. Linn. Soc. (Bot.)* xxvi. 520 (1899); Shirasawa, *Icon. Ess. Forest. Japon*, text 51, t. 26, figs. 1-12 (1900); Gamble, *Indian Timbers*, 673 (1902).

A tree, attaining usually about 40 ft. in height. Young branchlets silky pubescent when young, soon becoming glabrescent; smooth and shining in the second year. Leaves (Plate 337, Fig. 46) deciduous in autumn, 4 to 8 in. long, 1 to 2 in. wide, oblong-lanceolate, acuminate at the apex, cuneate or rounded at the base, with ten to sixteen pairs of lateral nerves, each ending in a bristle-tipped serration; upper surface glabrescent; lower surface green, with deciduous appressed pubescence, glabrous in summer except for slight stellate-pubescent axil-tufts; margin non-ciliate; petiole $\frac{1}{2}$ to 1 in. long, with scattered pubescence.

Fruit ripening in the second year, solitary or in pairs, sub-sessile; acorn ellipsoid, glabrous, scarcely longer than the hemispherical cupule, which is $\frac{3}{4}$ to $1\frac{1}{4}$ in. in diameter, covered with tomentose scales, those at the base ovate-oblong, those above linear, $\frac{1}{2}$ to 1 in. long, more or less spreading.

This species is widely distributed, occurring in Japan, China, the Shan and Khasia Hills, and in the Himalayas, through Bhutan and Sikkim to eastern Nepal. In Japan, Sargent saw it growing on dry soil near the coast behind Yokohama, and on the foothills of central Hondo. Gamble states that it has been largely planted at the cinchona plantations near Darjeeling and succeeded admirably. It has also done well at Dehra Dun, where a tree felled in the garden of the Forest School showed a growth of two to three rings per inch of radius.

Gay¹ states that four plants of this species, about 3 ft. high, were growing in 1861 at Verrières, near Paris, where they had been raised from acorns sent from Manchuria by Montigny; but these do not appear to have survived.² Maximowicz in 1864 introduced *Q. serrata* from Japan into the St. Petersburg Botanic Garden.³

It is probable that this species was introduced into England by Oldham, who collected in Japan, China, and Korea in 1861-64, as a small tree in Kew Gardens, about 20 ft. high, is labelled with his name. Younger specimens, received from

¹ Note in Kew Herbarium.

² In *Hortus Vilmorinianus*, 55 (1906), mention is only made of young plants of this species, raised from Chinese acorns, obtained a few years ago.

³ Bretschneider, *Hist. Europ. Bot. Disc. China*, 609 (1898).

Veitch in 1893, appear to be more vigorous. At Beauport, Sussex, there is a good specimen, which measured about 40 ft. by 3 ft. 3 in. in 1905. At Bickton, a healthy specimen is about 35 ft. by 5 ft. There is also a good tree in Coombe Wood.

This is one of the oaks in China on which some species of wild silkworm feed; but Mayr,¹ who says that it is not hardy at Grafrath, states that the great expectations of its successful cultivation in southern Europe as food for the silkworm of *Saturnia Yama-mai* have not been fulfilled. (A. H.)

QUERCUS VARIABILIS

Quercus variabilis, Blume, in *Mus. Bot. Lugd. Bat.* i. 297 (1849); Shirasawa, *Icon. Ess. Forest. Japon*, text 54, t. 28, figs. 1-11 (1900); Mayr, *Fremdländ. Wald- u. Parkbäume*, 510 (1906).

Quercus chinensis, Bunge, *Enum. Pl. China*, 61 (1835) (not Abel); De Candolle, *Prod.* xvi. 2, p. 50 (1864).

Quercus acutissima, Carruthers, in *Journ. Linn. Soc. (Bot.)* vi. 33 (1861).

Quercus Bungeana, Forbes, in *Journ. Bot.* xxii. 83, 85 (1884); Skan, in *Journ. Linn. Soc. (Bot.)* xxvi. 508 (1899).

Quercus serrata, Thunberg, var. *chinensis*, Wenzig, in *Jahrb. bot. Gart. Berlin*, iv. 221 (1886).

A tree, attaining 80 ft. in height and 10 ft. in girth. Bark grey, thick, corky. Young branchlets as in *Q. serrata*. Leaves (Plate 337, Fig. 40) similar to those of that species, but covered beneath with a dense white tomentum. Fruit with smaller cupules, which have thicker shorter scales.

This species, which is very closely allied to, if not a mere variety of *Q. serrata*, is spread through Japan, Korea, and China, where it is very common about Peking, attaining in the western hills a height of 60 to 80 ft. The acorn-cups are used in China for dyeing purposes, and yield a considerable amount of tannin.

This tree produces cork very similar to that yielded by *Q. Suber* in Europe; and the Japanese have commenced to utilise its bark for this purpose. Mayr strongly recommends its cultivation for cork in localities where the common chestnut thrives.

Fortune,² in 1861, procured a large quantity of acorns at Peking, from which Standish raised young plants at Bagshot; but we have found no trees of this origin.

It was afterwards introduced by Dr. Bretschneider,³ who sent acorns from Peking, where the tree is very common, to Prof. Sargent in 1881, and to Kew in 1882, where there is a good specimen about 20 ft. high and growing vigorously. A smaller tree, raised from acorns sent by Regel, is probably of Japanese origin. Sargent⁴ says that this species is very hardy in the Arnold Arboretum, U.S.A., and of rapid growth, the leaves turning a bright yellow in November. He⁵ also collected acorns in Japan in 1892, from which young plants were raised.

(A. H.)

¹ *Fremdländ. Wald- u. Parkbäume*, 510 (1906).

² *Yedo and Peking*, 382 (1863), and in *Gard. Chron.*, 1863, p. 872.

³ *Hist. Europ. Bot. Disc. China*, 1061 (1898).

⁴ In *Garden and Forest*, iii. 556 (1890).

⁵ *Forest Flora Japan*, 68 (1894).

QUERCUS DENTATA

Quercus dentata, Thunberg, *Fl. Jap.* 177 (1784), and *l.c. Pl. Jap.* dec. 5, t. 6 (1794); Franchet et Savatier, *Enum. Pl. Jap.* i. 445 (1875); Sargent, *Forest Flora Japan*, 67, t. 23 (1894); Skan, in *Journ. Linn. Soc. (Bot.)*, xxvi. 511 (1899); Shirasawa, *Icon. Ess. Forest. Japon*, text 52, t. 27, figs. 1-15 (1900).

Quercus obovata, Bunge, *Enum. Pl. China*, 62 (1835).

Quercus Daimio, Koch, *Dendrologie*, ii. 2, p. 45 (1873).

Quercus yunnanensis, Franchet, in *Journ. de Bot.* 1899, p. 146.

A tree, occasionally attaining 80 ft. in height and 10 ft. in girth. Young branchlets covered with a dense brownish or greyish tomentum, retained in the second year. Buds tomentose, the terminal one surrounded by persistent stipules. Leaves (Plate 337, Fig. 43) deciduous in autumn, 8 to 12 in. long, 3 to 6 in. broad, obovate, acute or rounded at the apex, cuneate or subcordate at the base, with six to nine pairs of small rounded lobes; margin ciliate; upper surface pubescent on the midrib and nerves, elsewhere glabrous or with scattered hairs; lower surface pale, sparsely covered with a minute stellate pubescence; petiole $\frac{1}{4}$ to $\frac{1}{2}$ in. long, tomentose.

Fruit ripening in the first year, clustered, sub-sessile or stalked; acorn sub-globose; cupule covered with long tomentose scales, those in the basal ranks ovate-oblong, obtuse, and spreading, those towards the rim linear, acute, and reflexed.

This species displays a considerable amount of variation in the wild state, and several varieties¹ have been distinguished, none of which are in cultivation. The following remarkable variety is cultivated in Japanese gardens, but does not seem to have been introduced:—

1. Var. *pinnatifida*, Matsumura.

Quercus pinnatifida, Franchet et Savatier, *Enum. Pl. Jap.* i. 445 (1875), and ii. 497 (1879).

Leaves deeply lobed, almost to the midrib.

This species is a native of Japan, Korea, Chinese Manchuria, and China. In Japan, according to Sargent, it is found in central Hondo only on the high mountains, where it is not at all common; but in the extreme northern part of the island it appears in great numbers on gravelly slopes at no great height above the sea-level. In Yezo, where Elwes collected it at Asahigawa, it grows on low ground with *Q. grosseserrata*, and though it attains a height of 80 ft., is not a fine or imposing tree. Mayr mentions as remarkable its occurrence on volcanic sands, and states that its bark is the most valuable tanning material in Japan, and recommends it for planting on sand dunes. The wood, according to Sargent, is coarse-grained, porous, and brittle, and worthless except for firewood.

In China it is common on poor soil on low hills in the northern provinces, and

¹ Var. *M'Cormickii*, Skan, *loc. cit.*; var. *oxylola*, Franchet, in *Journ. de Bot.* xiii. 146 (1899). *Q. yunnanensis*, Franchet, *loc. cit.*, is also a peculiar form, occurring in Yunnan.

it extends on the high western plateaux as far south as Mengtze in Yunnan, nowhere, so far as I have observed, attaining considerable dimensions.

This tree was probably introduced into Europe by Siebold, who sent acorns of several Japanese oaks to Leyden in 1830. According to Loudon,¹ young plants were growing in 1842 in the Tooting and Epsom Nurseries. It has never thriven in this country, usually forming a low bushy tree, liable to injury by both spring and late frosts, and seldom displaying its fine foliage to advantage. At Syon, where a specimen is said to be over thirty years old, it has made but little growth. It appears to thrive better in the United States, where it is hardy as far north as eastern Massachusetts.²

(A. H.)

QUERCUS ALNIFOLIA

Quercus alnifolia, Poech, *Enum. Pl. Cypri*, 12 (1842); Boissier, *Fl. Orient.* iv. 1168 (1879); Schneider, *Laubholzkunde*, i. 183 (1904).
Quercus cypria, Jaubert et Spach, *Illust. Pl. Orient.* i. t. 56 (1843).

A shrub or small tree. Young branchlets densely covered with greyish stellate pubescence, retained in the second year. Leaves (Plate 338, Fig. 60) coriaceous, persistent two years, $1\frac{1}{2}$ to 2 in. long and broad, orbicular or obovate; rounded or acute at the apex; rounded or broadly cuneate at the base; with five to eight pairs of prominent lateral nerves, all but the lower one or two pairs, ending in a minute mucronate tooth; upper surface dark green with deciduous stellate hairs; lower surface covered with a dense orange or yellowish grey tomentum;³ petiole $\frac{1}{2}$ in. long, tomentose.

Fruit ripening in the second year, solitary or two to three on a short tomentose stalk; acorn $\frac{1}{2}$ to $1\frac{1}{2}$ in. long, surrounded at the base by a hemispherical cupule, covered with tomentose scales, the basal ranks ovate and appressed, the median scales lanceolate, and the upper linear scales long and recurved.

This species grows as underwood in the pine forests of the mountains of Cyprus at 1600 to 5000 ft. altitude. It is very rare in cultivation,⁴ the only specimens which we have seen being two small trees, about 7 ft. high, at Kew, which were raised from acorns sent by Sir Robert Biddulph in 1885. One of these is in the temperate house and the other is in the oak collection.

(A. H.)

¹ In *Gard. Mag.* xviii. 17, 41 (1842). Bretschneider, in *Hist. Europ. Disc. China*, 1061 (1898), states that he sent acorns from Peking to the Arnold Arboretum, Mass., from which plants were raised.

² Sargent, *Silva N. Amer.* viii. 10, note 41 (1895).

³ In native specimens the tomentum is orange in colour; but in the shrubs at Kew it is only slightly tinged with yellow.

⁴ Cf. *Gard. Chron.* xiv. 533 (1880), and xvii. 227 (1882); and *The Garden*, xviii. 486 (1880).

QUERCUS COCCIFERA, KERMES OAK

Quercus coccifera, Linnæus, *Sp. Pl.* 1413 (1764); Loudon, *Arb. et Frut. Brit.* iii. 1908 (1838); Mathieu, *Flore Forestière*, 387 (1897).
Quercus pseudococcifera, Desfontaines, *Fl. Atl.* ii. 349 (1799).
Quercus Mesto, Boissier, *Voy. Bot. Esp.* ii. 519, t. 166 (1845).
Quercus anodonta, Borbas, in *Erdesz. Lap.* xxvi. (1887).

A shrub, usually 6 to 12 ft. high, occasionally becoming a small tree, rarely exceeding 20 ft. in height. Young branchlets with scattered brown stellate pubescence. Buds brown, ovoid, minute, glabrescent. Leaves (Plate 338, Fig. 62) persistent two or three years, coriaceous, variable in size and shape, oval or oblong, 1 to $1\frac{1}{2}$ in. long and $\frac{7}{8}$ in. broad, acute or rounded at the apex, sub-cordate or truncate at the base, wrinkled in margin, and with the upper surface concave; with four to eight pairs of minute teeth, each ending in a cartilaginous bristle; glabrous and shining green above and below; petiole $\frac{1}{8}$ to $\frac{1}{4}$ in. long, stellate-pubescent.

Fruit ripening in the second year, solitary or in pairs, sessile or shortly stalked; acorn cylindrical-ovoid, about an inch long, glabrous, shining; cupule hemispheric, $\frac{1}{2}$ to $\frac{3}{4}$ in. wide, covered with tomentose spine-tipped scales, ovate to linear, and very variable in breadth, thickness, and curvature.

The above description applies to the typical form prevalent in the western part of the Mediterranean region, but considerable variation occurs in the size and shape of the leaves (which are occasionally entire) and of the cupules, cupule-scales, and acorns. These differences appear to depend upon the vigour of the plant, and are occasionally present upon the same individual; and the numerous varieties which have been named can scarcely be upheld. The following, however, are noteworthy:—

1. Var. *Auzandri*, De Candolle, *Prod.* xvi. 2, p. 53 (1864).

Quercus Auzandri, Grenier et Godron, *Fl. France*, iii. 119 (1855-6).

Leaves (Plate 339, Fig. 65) more or less stellate-pubescent beneath. Cupules small with scales flattened at the points. This is supposed by Fliche¹ to be a hybrid between *Q. Ilex* and *Q. coccifera*, and has been observed in the south of France and in Algeria.

2. Var. *pseudococcifera*, Boissier, *Flora Orientalis*, iv. 1169 (1879).

Var. *Calliprinos*, Boissier, *loc. cit.*

Quercus pseudococcifera, Labillardière, *It. Pl. Syria*, Dec. v. p. 9, t. 6 (1812), (not Desfontaines),²

J. D. Hooker, in *Trans. Linn. Soc.* xxiii. 381, tt. 36, 37 (1862).

Quercus Calliprinos, Webb, *It. Hisp.* 15 (1838).

The eastern form of the species, often a shrub, occasionally a large tree, Leaves flat, scarcely concave or wrinkled, usually larger than in the type. Fruit variable, but often larger than in the western form.

¹ In Mathieu, *Flore Forestière*, 389 (1897). Albert et Jahandiez, *Plant. Vas. du Var*, 445, pl. xv. (1908), distinguish four hybrids between *Q. Ilex* and *Q. coccifera*, all of which have been seen in the south of France.

² *Q. pseudococcifera*, Desfontaines, described from Algerian specimens, is absolutely identical with *Q. coccifera*.

The Kermes oak is a native of the Mediterranean region, occurring in northern Africa, Spain, and Portugal, the south of France, Italy, Dalmatia, Albania, Greece, Asia Minor, and Syria. It covers dry poor soils with a shrubby vegetation, being often mixed on limestone with *Q. Ilex*. Its bark, especially that of the roots, is much esteemed for tanning, whilst its branches are often covered with an insect (*Chermes Ilicis*) called Kermes in Arabic, which was formerly used like cochineal, as a scarlet dye. (A. H.)

In Asia Minor and Syria this species occasionally becomes a large tree, of which Hooker gives the following account:—"This is by far the most abundant tree throughout Syria, covering the rocky hills of Palestine especially with a dense brushwood of trees 8 to 12 ft. high, branching from the base, thickly covered with small evergreen rigid leaves, and bearing acorns copiously. Owing to the indiscriminate destruction of the forests in Syria this oak rarely attains its full size. We saw but few very good trees, one of which is the famous oak of Mamre called Abraham's oak, of which a portrait is given (Plate xxxvi.), and I saw other good ones at Anturah on the Lebanon. Abraham's oak is supposed to indicate the spot where grew the oak under which the patriarch pitched his tent, and is revered by Jews, Mahometans, and Christians. In general habit it much resembles *Q. Ilex* as grown in this country. The diameter of the foliage is given, no doubt correctly, by Porter as 90 ft., the girth of the trunk as 23 ft. In the winter of 1856-57 when in the streets of Jerusalem the snow fell deep and lay for many days, a great branch of Abraham's oak was broken off, and when cut up was sufficient to load seven camels." A more recent photograph in my possession shows that this tree has now been protected by a stone wall, and though its foliage is more scanty than as shown in Hooker's drawing, the tree is still a very fine one.

According to Loudon the species was cultivated as long ago as 1683, but is now rarely seen, except in botanic gardens. At Kew it is perfectly hardy, young Algerian specimens having survived the severe winter of 1860-61, and it occasionally bears fruit. We have specimens from Kew, Eastnor, the Heatherside Nursery near Bagshot, and Fota. At Bitton¹ it forms a bush about 20 ft. high, which was raised from an acorn gathered near Athens in 1854-55. It produces root-suckers freely.

According to Mouillefert,² it is hardy at Grignon near Paris, where it has borne a temperature of 5° Fahr. without injury, and thrives well on poor calcareous soil.

(H. J. E.)

¹ Canon Ellacombe, in *Gard. Chron.*, 1870, p. 1155, says that it produces acorns very freely, but these are nearly always abortive.

² *Ess. Forest.* 112 (1903).

QUERCUS ILEX, ILEX OR HOLM OAK

- Quercus Ilex*, Linnæus, *Sp. Pl.* 995 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1899 (1838); Willkomm, *Forstliche Flora*, 415 (1887); Mathieu, *Flore Forestière*, 374 (1897).
Quercus Gramuntia, Linnæus, *Sp. Pl.* 995 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1906 (1838).
Quercus sempervirens, Miller, *Gard. Dict.* ed. viii. No. 3 (1768).
Quercus calicina and *expansa*, Poirét, in Lamarck, *Dict. Suppl.* ii. 216 (1811).
Quercus ilicifolia, Salisbury, *Prod.* 392 (1796).
Quercus pseudoilex, Chatin, in *Bull. Soc. Bot. France*, xvi. 22 (1869).

A tree, attaining in favourable conditions 90 ft. in height and 20 ft. in girth; often shrubby or of small size in dry climates and on poor soils. Bark of older stems divided into small scaly plates. Young branchlets covered with grey tomentum, retained in the second year. Leaves (Plate 339, Fig. 69) coriaceous, persistent two or three years, very variable in size, shape, and margin, even upon the same tree; larger leaves, often 3 in. long and 1½ in. broad, occurring on vigorous branches and on trees growing in moist climates and in good soils; smaller leaves, often 1 in. long and ½ in. broad, being characteristic of branches of feeble growth and on shrubby trees growing in dry climates and on hot calcareous soils; larger leaves usually ovate or ovate-lanceolate, acuminate at the apex, and tapering at the base; smaller leaves usually oval, acute at the apex, and rounded at the base, but with many intermediate forms; margin entire or undulate on the upper branches of older trees, or with holly-like spine-tipped teeth on lower branches and on young trees; upper surface dark green, shining, with numerous stellate hairs; lower surface usually covered with a dense fine white or greyish tomentum, occasionally glabrescent and light green on branches of young trees; lateral nerves seven to ten pairs, ending in the teeth of dentate leaves, dividing and looping before reaching the margin of entire leaves; petiole ¼ to ¾ in. long, tomentose.

Fruit ripening in the first year, solitary or in pairs, on a short stout grey tomentose peduncle; acorns, very variable in size and shape, often slightly pubescent towards the apex, which is surmounted by a conical umbo, tomentose except for a glabrescent or glabrous narrow basal zone; cupule hemispheric or rarely turbinate, with closely appressed ovate grey tomentose scales, diminishing in size from the base to the margin of the cupule.

VARIETIES

Spread over a wide area, occurring in different soils and climates, and showing a large amount of variation in the individual tree, influenced by age, vigour of branchlets, etc.,—this species has numerous forms, impossible to define in the present state of our knowledge, and only a few conspicuous varieties¹ can now be alluded to.

¹ Albert et Jahandiez, *Plant. Vasc. du Var*, 439, Pl. xi., xii., xiii., xiv. (1908), enumerate and describe thirty-one varieties.

1. Var. *Ballota*, De Candolle, *Prod.* xvi. 2, p. 39 (1864).

Quercus rotundifolia, Lamarck, *Encyc. Méth.* i. 723 (1783).

Quercus Ballota, Desfontaines, in *Mém. Acad. Sc. Paris*, 1790, p. 394, t. 6, and *Fl. Atlant.* ii. 350 (1800); Webb, *Iter Hisp.* 14 (1838); Loudon, *Arb. et Frut. Brit.* iii. 1905 (1838).

Leaves variable, spiny-dentate or entire, usually rounded at the base and white beneath. Acorns large, sweet, edible.

This variety is the prevalent form in Spain and northern Africa, and occurs also in Portugal, where Coutinho¹ distinguishes another variety, with sweet acorns (var. *avellanæformis*), very small, sub-globose, and almost enclosed in the cupule. Webb says that the leaves in var. *Ballota* always have a round rather than an elliptic shape, and that toothed and entire leaves are mixed on the same branch; the down which clothes them is thicker, the branches stiffer, and the acorns besides being very sweet are much longer and more cylindrical. He also found it more tender² than the common form, and said that a specimen which he grew for twenty years in a warm situation only reached 6 ft. high in that time.

2. Var. *Gramuntia*, Loudon, *Trees and Shrubs*, 882 (1842).

Quercus Gramuntia, Linnæus, *Sp. Pl.* 995 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1906 (1838).

Quercus Cookii, Loudon, *Arb. et Frut. Brit.* iii. 1926 (1838).

Leaves (Plate 339, Fig. 68) broadly oval, obovate, or almost orbicular, often sub-cordate at the base, 1 to 1½ in. long; margin wrinkled, with a few inflexed teeth, ending in long sharp spines.

This variety was described by Linnæus from a specimen growing in the wood of Gramont, near Montpellier, where, however, De Candolle afterwards failed to find it. A tree bearing this name was growing in 1838 at Purser's Cross. It was raised in 1835 in the Chiswick Garden from acorns procured from Gibraltar. It is probably a form in which the seedling characters are preserved, and was both by Loudon and by Cook confused with var. *Ballota*. It is a small tree, occasionally seen in gardens, as at Kew and at Osborne, where there was a tree, 36 ft. by 4 ft., in 1908, bearing the name of *Q. Ballota*.

3. Var. *Fordii*, Loudon, *Gard. Mag.* xix. 36 (1843).

Quercus Fordii, Koch, *Dendrologie*, ii. 2, p. 56 (1873).

Leaves narrow, lanceolate, 1 to 1½ in. long; margin wrinkled, undulate or with a few irregular teeth, without spiny points. This peculiar form originated many years ago in Lucombe and Pince's nursery at Exeter, and was named after Ford, one of the proprietors.

4. Var. *crispa*, Loudon. As seen at Kew, a monstrous form, with very small entire leaves, about ½ in. in length, with the edges rolled inwards and the under surface concave.

5. Var. *Smilax*, Nicholson, in *Kew Handlist, Trees*, 689 (1902).

Quercus Smilax, Linnæus, *Sp. Pl.* 994 (1753).

Leaves entire, narrow, lanceolate, long acuminate at the apex.

¹ In *Boll. Soc. Brot.* vi. 94 (1888).

² The seedlings which Elwes raised at Colesborne were killed by a frost, which left seedlings of the typical form in the same bed unhurt.

6. Var. *Genabii* and var. *latifolia* are forms with very large leaves, up to 5 in. long, and 2½ in. wide, usually dentate towards the apex.

7. In Afghanistan and the western Himalayas, a variety described as a distinct species, *Q. Baloot*, Griffith, *Itin. Notes*, 328 (1848), occurs at altitudes between 3000 and 8500 ft.¹ In western China, several peculiar varieties² have been found on the high mountains of Szechwan, Hupeh, and Yunnan. None of these Asiatic forms have been introduced into cultivation, and need not be here further alluded to.

HYBRIDS

Reputed hybrids between *Q. Ilex* and *Q. Suber* have been reported in France,³ Italy,⁴ Spain,⁵ and Portugal.⁶ This species also hybridizes with *Q. coccifera*. Cf. p. 1279.

Q. Turneri, supposed to be a hybrid between *Q. Ilex* and *Q. pedunculata*, is described on p. 1288. *Q. audleyensis*, possibly a hybrid with *Q. sessiliflora*, is described on p. 1291.

DISTRIBUTION

Q. Ilex is a native of the Mediterranean region, occurring in Spain and Portugal, France, Italy, Southern Tyrol, Istria, Dalmatia, Greece, the coast region of Syria, and in Morocco, Algeria, and Tunis.

In France, *Q. Ilex* occurs in the departments bordering on the Mediterranean, and ascends the valley of the Rhone to a point near Valence, spreading on the east along the valleys of its tributaries through Drôme, Basses-Alpes, and Hautes-Alpes, and being limited on the west by a line passing through the southern parts of Ardèche, Lozère, Aveyron, and Tarn, and including the greater part of Aude and Pyrénées Orientales, where M. Flahaut observed it in the valley of the Tet as high as 5000 ft. elevation. In south-eastern France this species is only met with on limestone, and is rarely seen except as coppice, its bark being a valuable tanning material. At low altitudes and in arid situations it is often mixed with *Pinus halepensis*, and at higher altitudes with *Quercus lanuginosa*. These coppices consist usually of scattered bushes separated by paths frequented by flocks of sheep. The most remarkable forest of this kind is that of Bédoin, on the southern slope of Mt. Ventoux, where *Q. Ilex* ascends from 300 to 2700 ft., occurring pure up to 2300 ft., and mixed with *Q. lanuginosa* between 2300 and 2700 ft. In this coppice is found the most esteemed kind of truffle, that of Périgord.⁷ In the south-west and west of France *Q. Ilex* is found here and there on limestone in small

¹ Cf. Hooker, *Fl. Brit. India*, v. 602 (1888).

² Cf. Skan in *Journ. Linn. Soc. (Bot.)* xxvi. 516 (1899). *Q. Ilex*, var. *phillyræoides*, Franchet, a native of Japan and western China, is very different and is treated by us as a distinct species. See p. 1298.

³ *Quercus Bertrandii*, Albert et Reynier in *Bull. Acad. Intern. Géog. Bot.*, 1902, ex Albert et Jahandiez, *Plant. Vasc. du Var*, 444, pl. xiv. (1908).

⁴ *Quercus Morisii*, Borzi, in *Nuov. Giorn. Bot. Ital.* xiii. 10, fig. 1 (1881). This hybrid is reported by Pereira in *Bull. Soc. Bot. France*, xiv. 69 (1892) to occur near Bastia, in Corsica.

⁵ Mentioned by Laguna, as occurring in Estremadura and Andalusia.

⁶ Coutinho reports this hybrid to be not uncommon in Alentejo.

⁷ Cf. Huffer, *Économie Forestière*, i. 386-390 (1904).

groups, in the Basses-Pyrénées, Gironde, Charente, around Nantes and Poitiers; and is reported as far north as Quimper. In France, though limited in the wild state to the milder regions, it bears a considerable degree of winter cold, having sustained without injury at Grignon a temperature of -23° Cent. in 1871; but in 1879 when the temperature fell to $-26\frac{1}{2}^{\circ}$ Cent. it was killed to the ground, but the root has since produced a vigorous shoot.¹

In Corsica, *Q. Ilex* is a common tree, and forms fine forests in the north-western part of the island. That of Piriò, near Calvi, occupies northern slopes between 600 and 2500 ft. altitude, and contains many large trees, up to 90 ft. in height. (A. H.)

In Italy, *Q. Ilex* is widely spread. Bunbury² says that "in the Cascine, near Pisa, mixed with stone pine and pinaster, it forms extensive woods on light sandy soil. The limestone mountains behind Spoleto are entirely clothed with the Ilex; so are those near Terni, around the famous falls of the Velino, and those bounding the valley of the Nar from Terni to Narni. There are many large trees of it on the banks of the Nar near the Bridge of Augustus. The superb Ilexes in the grounds of the Villa Borghese and Villa Pamfili at Rome are celebrated; but the finest trees of the kind that I remember ever to have seen are on the road between Castel Gondolfo and the Capuchin convent above the town of Albano. They are of vast size." I measured a very fine tree, said to be over 150 years old, in the garden of the Hotel Hassler at Naples, formerly belonging to the King of Naples. In March 1910 it was over 90 ft. high and $12\frac{1}{2}$ ft. in girth, and had borne many large acorns, some of which I brought home.

Q. Ilex is generally known in Spain as *encina*, but sometimes called *carrasca*, or *chapparro*; and in Portugal is named *azinho* or *azinheira*. It is an extremely variable tree found throughout Spain except perhaps in Galicia, most abundant in the south, where it ascends, near Ronda, to 1500, and in the Sierra Nevada to 2000 metres; and is a most characteristic tree of large tracts in Estremadura and Leon. Widdrington considered it distinct from the common *Ilex* grown in England, and says that he instantly recognised it in a bed of seedlings at Kensington, which on inquiry turned out to have been raised from acorns sent from Valencia by Lord Holland. He adds that it is less hardy, and would barely exist in the north of England, where the Italian form grew well.

In passing through the great open plains which lie between the Portuguese frontier and Ciudad Rodrigo this was almost the only tree that I saw scattered over the country for many miles as a sort of open forest, cultivated with wheat or rye between the trees, or grazed. The trees were heavily pruned like olive trees, to make them produce as many acorns as possible; and these acorns, known as *bellotas*, are looked on as good food for man and beast.

In Portugal the tree is not so common generally as *Q. Suber* and *Q. lusitanica* in the south, or as *Q. pedunculata* and *Q. Toza* in the north; and I saw none of great size; though a tree at Villa Nova de Baronia, in Alemtejo, is recorded by Gebhart as 3.35 metres in girth, with a crown 19 metres in diameter when less than 100 years

¹ Cf. Mouillefert, *Essences Forestières*, 104 (1903).

² *Arboretum Notes*, 112 (1889).

old, and was said to produce 1000 litres of acorns in one year. The flowering of the tree is earlier in Portugal than that of the cork oak, and so profuse that in April the trees had quite a golden appearance. The timber is valued for cart wheels and other farm implements, and preferred to that of the cork oak. It is also largely used for firewood and charcoal.

CULTIVATION

The Ilex or holm¹ oak as it was formerly called, was introduced into this country at a very early period, and was known to Clusius in 1581, who spoke of two trees then growing near London, one of which was old enough to bear acorns; and Evelyn² spoke of it as a tree which "thrives manifestly with us; witness his Majesty's privy garden at Whitehall, where once flourish'd a goodly tree of more than four-score years growth, and there was lately a sickly imp of it remaining. And now very many rais'd by me have thriv'd wonderfully, braving the most severe winters, planted either in standards or hedges, which they most beautifully become."

It ripens seed freely in the warmer parts of England, and reproduces itself where conditions are suitable; but pheasants are so fond of the acorns that few get a chance to grow; and they are better sown in a nursery or in pots, as the roots at first have very few fibres, and the tree, as Evelyn long ago remarked, is difficult to transplant. It is better to move them like hollies late in spring, or in August, if the autumn is moist and the climate mild. The Ilex undoubtedly likes sea air, and rarely grows as large inland as near the coast. It grows well on limestone, but also thrives in a good loamy soil, dry and well drained; and is sometimes killed by severe winters on wet and cold situations away from the coast.³

The tree varies extremely both in habit and foliage; and in a plantation at the Barton Farm, Osborne, I.W., where cork oaks and Ilex have been planted together, there are many seedlings which might be hybrids, though the bark of the older trees is always a good mark of distinction. In the Prince of Wales plantation, a little beyond the statue in Windsor park, I saw in 1909, a number of trees of very upright habit, which are said to have been planted in 1880, and are now in some cases over 40 ft. high.

REMARKABLE TREES

Among the largest and finest trees in England are those at Mamhead, of which Bradley⁴ wrote as follows: "That curious gentleman Robert Balle, Esq., F.R.S.,⁵

¹ Murray, *Eng. Dict.* v. 343 (1901), states that *holm* is a phonetic corruption of *holm*, from *holen*, *hollin*, the Old English equivalents of the modern word holly. *Holm* is used by Chaucer in the *Knight's Tale*, meaning holly tree. *Holm* was apparently first used for the evergreen oak by Cooper, *Elyot's Dict.* (1552),—"Ilex, a tree called by some holme." Holland, *Pliny* i. 495 (1601), says: "There is an holme growing in the Vatican, elder than Rome it selfe." *Ilex*, however, is so generally used, that it may now be considered an English word.

² *Silva*, 171 (1706).

³ In East Anglia, young trees twelve to twenty years old were killed in the severe winter of 1859-60; but old trees escaped with merely a browning of their leaves (cf. *Gard. Chron.*, 1869, p. 167). Many trees at Kew, but not all, were quite defoliated in the severe winter of 1908-9, when the temperature fell to 10° Fahr. on 30th December. Cf. *Kew Bull.*, 1909, p. 236.

⁴ Bradley, *Improvements of Planting*, 38 (1739).

⁵ In Polwhele's *History of Devonshire* (1793) it is said: "The woods and plantations of Mamhead were extensive; many of the trees were introduced by Mr. Thomas Ball, the last of that family (he died in 1749), who returning from the continent, brought with him a quantity of cork tree, Ilices, wainscot oaks (*Q. Cerris*), chestnuts, acacias, cedars, and other trees."

has, among other improvements for the good of his country, propagated a large parcel of these trees in England, some of which have in about thirty years grown to a considerable greatness of stature. This gentleman has raised some thousands of them from acorns, and to follow his method we must set the acorns in loam well sifted, in garden pots in February, and turn them out with the earth about their roots when they are two years old." Ellis¹ a year later says that "at Mamhead in a shallow sort of soil of but 9 in. deep, before a red rock appears, these trees had prospered so well that at forty years' end the diameter of their bodies measured above a foot each, and the height of one of them was above 50 ft., with a straight taper stem without a knot." R. Pince² of the Exeter Nursery gave the dimensions of some of the trees at Mamhead in 1835 as follows:—

	Height.	Girth.	
1. <i>Quercus Suber</i>	60 ft.	12½ ft.	
2. " "	50 ft.	11 ft. 3 in.	
3. <i>Q. Ilex</i>	85 ft.	11 ft.	One of a group on the confines of Haldon, about 600 ft. above sea-level.
4. " . . .	70 ft.	14 ft.	Detached in middle of park.
5. " . . .	55 ft.	22 ft.	In a sheltered place about 250 ft.
6. <i>Q. Cerris hybrida</i> , Fulham oak	80 ft.	13½ ft.	About 500 ft. elevation.
7. <i>Q. Cerris</i> , Turkey or wainscot oak	100 ft.	12 ft.	In a sheltered situation about 500 ft. elevation.
8. " . . .	90 ft.	15 ft. 3 in.	About 500 ft. elevation.
9. " . . .	80 ft.	14 ft. 1 in.	" exposed situation.

Of these I cannot now identify Nos. 3 and 6. No. 4 is probably a fine old tree (Plate 326) near the big cork oak, and, in 1908, was 17 ft. 10 in. in girth. No. 5 is probably a very spreading tree with a short bole, near the gardens, which in 1908 measured³ 21 ft. in girth. Besides these there is a group of very tall trees close to the Dawlish Lodge, which Sir R. Newman believes to be some of the earliest planted. The finest of these is at least 90 ft. high by 16½ ft. in girth.

At Tregothnan in Cornwall there are great numbers of this tree, which shade a beautiful drive along the shores of the harbour, but owing to the rocky soil do not attain any great size.

Perhaps the oldest-looking tree which I know of is at Wilton House, close to the mansion, and, though of no great height, its trunk measures no less than 18 ft. in girth, and its branches, which are supported by props, cover an area 90 paces round. Loudon states that in 1810 this tree was 10 ft. in girth.

At Frogmore, there is a large tree, having the leaves much larger than usual, and supposed to have been raised from Algerian acorns, though I can get no exact history of it. It measured about 50 ft. by 17 ft. in 1904; and another close by it with different leaves was 15½ ft. in girth.

¹ Ellis, *The Timber Tree Improved* (1740).

² Loudon, *Gard. Mag.* xi. 127 (1835).

³ The girth, 22 ft., recorded in 1835, may have been taken near the ground.

At Goodwood there are many fine trees in the grounds and in a belt north of the house. Here I measured in 1906 a tree 83 ft. by 7 ft. 7 in.

At Siston Court, Gloucestershire, there is a well-shaped and spreading tree which in 1908 was about 60 ft. by 17 ft. At Epping House, Hertford, Mr. H. Clinton Baker measured a tree 60 ft. by 16½ ft. in 1909.

At Godinton, near Ashford, the seat of G. Ashley Dodd, Esq., there is one of the finest that I have seen in England. This beautiful tree has a short bole 18 ft. 1 in. in girth, dividing into many large spreading branches which reach a height of about 75 ft., and spread over an area no less than 102 paces in circumference. It is a symmetrical tree, in perfect health, and must be considerably over 100 years old.

At Betteshanger, in the same county, Lord Northbourne showed me a tree of the same character, which measures about 50 ft. by 17 ft. at 3 ft. from the ground, and shows the suitability of this tree for a chalky soil, in the south-east of England.

At Cobham Park a beautifully shaped tree measured in 1905, 80 ft. by 15 ft., with a clean bole 20 ft. high. Lord Darnley thought it was surpassed by a tree at Faringford, Lord Tennyson's place in the Isle of Wight; but when I measured this in 1906, I found that, though it covered an area 94 paces round, its trunk, which consists of several stems fastened up by chains, was much inferior to the Cobham tree.

In Somersetshire, Sir C. T. D. Acland showed me a big *Ilex* at Holnicote, a stool with four trunks, about 70 ft. by 17 ft.

In the eastern counties near the coast this tree also thrives at many places, among which Holkham is pre-eminent for numbers and size. The *Ilex* seems to have been a very favourite tree with the late Earl of Leicester and his father, who planted in the park what is now the largest grove of evergreen oaks that I know. In this grove, known as the Obelisk Wood, I measured one in 1903, 75 ft. by 10½ ft., with a clean bole 28 ft. long; and another with a remarkable twisted trunk (Plate 324). A third tree on the outside of this grove, with wide-spreading branches, is shown in Plate 325. At Ken Hill near Snettisham, in Norfolk, the seat of Sir E. Green, there are two fine trees, the largest of which measures about 75 ft. by 19½ ft. at 2 ft. from the ground, dividing at 4 ft. into two main stems.

In Wales the finest I know of is a tree mentioned by Loudon at Stackpole Court, said to be 100 years old in 1838, and then 78 ft. high by 7½ ft. in girth. It is probably the same as one which in 1906 measured 80 ft. by 9 ft. 8 in., and though split to the ground, was kept together by a chain. The best *Ilex* now at Stackpole is a tree on the lawn measuring about 60 ft. by 14 ft. 5 in., whose trunk is curiously gnarled and distorted.

In Scotland the *Ilex* grows well on the south-west coast, especially in the Earl of Stair's grounds at Castle Kennedy, where there is a tree remarkable for its very weeping habit. This tree has five stems forking close to the ground, where it measures 12 ft. 8 in. in girth, and is about 47 ft. high. Another large tree is reported by Mr. Renwick to grow at Mount Stuart, in Bute, the seat of the Marquess of Bute, and to measure 10 ft. 5 in. in girth. At Fullerton House, near Troon, a tree is recorded by Paxton in *Remarkable Trees of Ayrshire*, 11 ft. 9 in. in girth.

As far north as Gordon Castle the *Ilex* is hardy near the coast; and I measured a tree there, which was 45 ft. by 10 ft. 10 in. in 1907.

Possibly the oldest if not the largest tree in Ireland, is one growing at Courtown on the Wexford coast, of which the Earl of Courtown has been good enough to send me a photograph. He believes that it may have been planted by Sir Walsingham Cook, whose mansion and garden were conveyed in 1648 to T. Jones, a sea-captain of Stepney: but in any case is a tree of very great age. In 1884 it was 66 ft. high, dividing into several large trunks close to the ground. At Rossanagh there is a very fine old tree 80 ft. high by 16 ft. 7 in. near the ground, dividing at 3 ft. into two big stems, one of which is 10 ft. 9 in., the other 8 ft. 8 in. in girth.

At Kilruddery Castle, Co. Wicklow, Henry measured two big trees in 1904, one 77 ft. by 14½ ft., the other 77 ft. by 11½ ft., with a bole about 25 ft. high. At Castlemartyr there are many fine old trees, one of which in 1908 measured nearly 100 ft. by 12 ft., with a bole of 30 ft. At Belgrove, near Queenstown, Mr. Gumbleton showed me a very handsome and well-shaped tree about 70 ft. by 14½ ft., the branches over 80 yds. round.

At Doneraile Court, Co. Cork, there is a tree with a short butt, 15 ft. 3 in. in girth, dividing into two main stems about 45 ft. high, with a spread of branches about 80 ft. across. At Cooper Hill, Limerick, Henry saw several very old trees of no great height, but of immense girth, one 21 ft., the other 18 ft., in 1907.

(H. J. E.)

QUERCUS TURNERI, TURNER'S OAK

Quercus Turneri, Willdenow, *Enum. Hort. Berol.* 975 (1809), and *Berlin. Baumz.* 339, t. 3, fig. 2 (1811); Loudon, *Arb. et Frut. Brit.* iii. 1922 (1838).

Quercus hispanica, var. γ , *le chêne Turnère*, Lamarck, *Encyc. Méth.* i. 723 (1783).

Quercus hybrida nana, Loudon, *Arb. et Frut. Brit.* iii. 1924 (1838).

A tree, attaining about 50 ft. in height and 8 ft. in girth, variable in bark and foliage, probably hybrid in origin, the supposed parents¹ being *Q. pedunculata* and *Q. Ilex*. Two distinct forms occur, one with short broad leaves, corresponding to the typical plant described by Willdenow; the other with larger narrower leaves, treated by us as a variety. These two forms are connected by trees intermediate in foliage; and a seedling, about 5 ft. high, raised at Kew in 1894 from an acorn, produced by the narrow-leaved form, has both broad and narrow leaves.

The typical form is characterised as follows:—Young branchlets covered with dense stellate pubescence, glabrescent in the second year. Leaves slightly coriaceous,

¹ The fruit on long peduncles, and the auricles often present at the base of the leaf indicate *Q. pedunculata* parentage. The subevergreen habit, the pubescence on the branchlets and leaves, and the mucronate teeth of the latter, suggest the influence of *Q. Ilex*. The bark usually resembles that of *Q. Ilex* more than the common oak.

falling early in spring, before the new leaves appear, about 3 in. long and 2 in. wide, obovate, rounded or acute at the apex, rounded or slightly auricled at the base, with five to eight pairs of lateral nerves, all but the lowest one or two pairs ending in a sinuate tooth, with a cartilaginous tip, long and bristle-like in young plants, short and blunt in old trees; upper surface dark green, with deciduous scattered stellate hairs; lower surface pale green, with white stellate hairs on the midrib and nerves, elsewhere glabrous or with scattered inconspicuous pubescence; petiole ¼ in. long, densely pubescent.

Fruit ripening in the first year, three to seven, of which only one or two develop, sessile on a slender tomentose peduncle, about 2 in. long; acorn ovoid, about ¾ in. long, with appressed long white hairs towards the apex, which is crowned by the conspicuous tomentose style; cupule about ½ in. in diameter, urceolate, covered with closely appressed grey tomentose ovate scales, reddish at the tips, and diminishing in size from the base to the constricted thin margin of the cupule.

Var. *pseudoturneri*.

Quercus glandulifera, Masters, in *Gard. Chron.* xiv. 714, fig. 134 (1880) (not Blume).

Quercus pseudoturneri, Schneider, *Laubholzkunde*, i. 200, fig. 126 g, h (1904).

Quercus aizoon, Koehne, in *Gartenflora*, liii. 657 (1904).

Usually a smaller tree than the typical form. Leaves (Plate 337, Fig. 45) usually longer and narrower, averaging 4 to 5 in. long and 1½ to 2 in. wide; teeth larger, with mucronate points often obsolete; under surface more pubescent than in the type; base rounded, auricled, or cuneate.

The earliest account of this oak is by Lamarck, who described it in 1783, from a specimen growing in the garden of the Trianon, as *le chêne Turnère*, said to have been found originally as a seedling in England, which was propagated by grafting. Messrs. Loddiges informed Loudon that it was a hybrid, "raised about 1795 or before, by Mr. Spencer Turner, in the Holloway Down Nursery, Essex, which was founded by him about 1787." The latter account is evidently inaccurate as regards dates; but it may be assumed that the oak was raised by Mr. Turner sometime before 1783, when it was well-known to Lamarck. Willdenow¹ founded his description on a plant of the broad-leaved form, growing at Berlin, which had been sent to him by Loddiges. The narrow-leaved variety appears to have been the form more generally propagated, especially by Rivers at the Sawbridgeworth Nursery, where Loudon states that there was a tree forty years old in 1838. It is possible that both forms of foliage occurred on the original tree in Turner's nursery.

In the Bristol Nursery, a tree was found in 1825 in a bed of seedling oaks, which Loudon describes as *Q. hybrida nana*, and this seems to have been a form of *Q. Turneri*, bearing both broad and narrow leaves. It is said by Loudon to have been a bush rather than a tree; but the original plant made fairly rapid

¹ Willdenow's statement that the tree came originally from Tibet is evidently due to a confusion between Spencer Turner, the nurseryman, and Samuel Turner, the famous traveller, who visited Tibet about 1786.

growth, having attained 9 ft. high in twelve years. This was propagated by Messrs. Loddiges, and may be the origin of some of the trees now in cultivation.

(A. H.)

REMARKABLE TREES

Of the typical form, we have identified the following, but it is probable that other trees exist which we have overlooked.

A tree at Ham Manor, Sussex, forking near the ground, and carrying its leaves until after mid-winter. In 1907 it was about 45 ft. high.

A tree at Nuneham Park, with bark like that of the common oak on which it is grafted, measured by Henry in 1907, 48 ft. by 4 ft. 4 in. A tree in the Wilderness at White Knights, grafted on the common oak and not showing much of the *Ilex* character in the bark, measured by me in 1907, when it was 52 ft. by 6 ft. 10 in. above the graft. At Bayfordbury a tree said to have been planted in 1837 with *Ilex*-like bark, 40 ft. by 3 ft. At Henham Hall, Sussex, a tree 50 ft. by 8 ft. At Lyndon, a tree 53 ft. by 6 ft. grafted near the ground on the common oak and showing no trace of the *Ilex* parentage in the bark.

A small tree in the Royal Botanic Garden, Edinburgh, is the only one we have seen in Scotland; but Mr. Bean mentions one 45 ft. high in 1906, which he saw at Kinfauns Castle, Perthshire.

In Ireland there is a tree at Oriel Temple with typical *Ilex*-like bark, which in 1908 was 48 ft. by 4 ft. with a bole about 20 ft. high.

Of the *pseudoturneri* form the best specimen we know of is at Syon, a tree 62 ft. by 4 ft. 4 in., having a clean bole of considerable height injured on one side. At Kew there are several trees of which the largest measures 37 ft. by 5 ft. Their history is unknown and they were unnamed before 1880. In the Sawbridgeworth Nursery there are two trees believed to have been propagated from the original tree by grafting on the common oak. The larger of these measured in 1908 about 50 ft. by 5 ft., and on June 4th had a good many of the previous year's leaves still on it. The other tree, growing in a beech hedge, is much more stunted, and had no old leaves left on it, but was flowering profusely. We have specimens of this form from trees growing at Eastnor Castle; from Alnwick sent by Miss Manders; and from Monreith. I also found a tree at Castlewellan in Ireland.

Judging from all that we know, this hybrid does not seem to have anything to recommend it as an ornamental tree, and is much inferior in size and beauty to the Lucombe oak.

(H. J. E.)

QUERCUS AUDLEYENSIS

Quercus Ilex × *Q. sessiliflora* (?)

At Audley End, Essex, there is a remarkable oak, which we have been unable to identify with any described species, and which is probably a hybrid between the evergreen oak and *Q. sessiliflora*. It is characterised as follows:—

Young branchlets slender, grey tomentose, the tomentum being retained in the second year. Buds $\frac{1}{5}$ to $\frac{1}{4}$ in., ovoid, obtuse, few-scaled, pubescent. Stipules persistent, linear, pilose, $\frac{1}{2}$ in. long, two at the base of each leaf. Leaves (Plate 338, Fig. 59) slightly coriaceous, falling late in the season, up to $3\frac{1}{2}$ in. long and 2 in. broad, very variable in shape on the same branch, narrow elliptical and entire or slightly undulate in margin, or obovate to obovate-oblong with 4 to 5 pairs of sinuate teeth or small lobes in the upper two-thirds, occasionally with one to three teeth near the apex; teeth with or without a minute projecting mucro; nerves five to eight pairs, ending in the teeth or dividing before reaching the margin when it is entire; apex rounded; base unequal, rounded or cuneate; both surfaces stellate pubescent when young, upper surface, when mature, dark green, shining, glabrous; lower surface pale green, retaining the pubescence on the midrib and basal part of the blade; petiole $\frac{1}{2}$ to $\frac{3}{4}$ in. long, with scattered stellate tomentum.

Fruit, imperfect, probably never developing, in pairs at the apex of a short erect tomentose axillary peduncle.

In favour of this oak being a hybrid, may be noticed the instability of form of the leaves on the same branch; some resemble the entire leaves of *Q. Ilex*; others are like the obovate lobed leaves of *Q. sessiliflora*. It agrees with both species in the nervation. The slender tomentose branchlets, minute mucros of the teeth, and the persistent stipules are like *Q. Ilex*, from which it may derive its subevergreen habit.

It resembles superficially some of the forms of *Q. lusitanica* in Portugal, but these have uniform leaves on the same branchlet and are different in venation.

This beautiful oak, the origin of which is unknown,¹ has bark somewhat resembling that of *Q. Ilex*, and measured in 1908, 86 ft. in height and 11 ft. 3 in. in girth (Plate 327). It was reported never to bear fruit; but a few imperfect acorns were formed in 1909.

(A. H.)

¹ Lord Braybrooke informs us that in a catalogue of trees at Audley End, made in 1834, he finds "Lucombe's Oak" mentioned; and as I saw no tree of that species, it is probable that it is the same as the one now described.

QUERCUS SUBER, CORK OAK

- Quercus Suber*, Linnæus, *Sp. Pl.* 995 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1911 (1838); Willkomm, *Forstliche Flora*, 424 (1887); Coutinho, in *Bull. Soc. Brot.* vi. 82 (1888); Mathieu, *Flore Forestière*, 377 (1897).
Quercus suberosa, Salisbury, *Prod.* 392 (1796).
Quercus Bivoniana, Gussone, *Fl. Sicul. Syn.* ii. 604 (1844).

A tree, attaining 60 ft. in height and 20 ft. in girth, usually much smaller. Bark thick and corky, occasionally becoming a foot in thickness on old trunks, which are deeply fissured. Young branchlets covered with a dense greyish tomentum, retained in the second year. Leaves (Plate 339, Fig. 63) coriaceous, persistent two or three years, often convex above and concave beneath, about 2 in. long and $1\frac{1}{4}$ in. wide, variable in shape, ovate or oval, acute or rounded at the apex, unequal at the base; with about six pairs of lateral nerves, all but the lowest one or two pairs, ending in a minute mucronate tooth; upper surface bright green, glabrescent; lower surface covered with a dense grey tomentum; petiole, $\frac{1}{4}$ to $\frac{1}{2}$ in. long, tomentose.

Fruit in the typical form, ripening in the first year, solitary or in pairs on short stout grey tomentose axillary peduncles; acorn $\frac{3}{4}$ to 1 in. long, variable in shape, glabrous, with a tomentose apical umbo; cupule turbinate, $\frac{1}{2}$ to $\frac{3}{4}$ in. in diameter at the rim, covered with grey tomentose scales, reddish at the tips, ovate and short in the basal ranks, long linear and mostly erect in the upper half of the cupule.

Var. *occidentalis*.

- Quercus occidentalis*, Gay, in *Ann. Sc. Nat.* vi. 243 (1856), and in *Bull. Soc. Bot. France*, iv. 449 (1857); Mathieu, *Flore Forestière*, 384 (1897).

Leaves deciduous in June of the following year, when the next season's leaves are already developed. Fruit ripening in the second year; cupules hemispherical, with appressed ovate obtuse grey tomentose scales, red at their tips.

This variety is the only form of the cork oak in the south-west of France, and is also found on the coast of Portugal, where according to Coutinho,¹ the distinction between it and the type disappears, acorns of both kinds being found on the same tree. There the cork oaks flower continuously from January to April. The acorns produced by the first flowers either ripen in September or in October and November, two distinct crops being noticeable. The acorns produced by the last flowers of the season are stopped in their growth by the winter cold, and ripen in the following year, constituting a third crop. The latter, according to Coutinho, have cupules with scales similar to those of *Q. occidentalis* in the Landes.

This variety is, however, considerably hardier than the type, as plantations made in Brittany in 1826 with acorns from the Landes succeeded, while those made with

¹ Daveau, who had much experience in Portugal as well as in Provence, in a pamphlet, *Note sur le Q. occidentalis*, ex *Ann. Soc. Hort. Hérault* (Montpellier, 1899), confirms the opinions of Coutinho.

acorns from Catalonia soon perished. At Nancy, var. *occidentalis* resists the cold of ordinary winters, while the typical form always succumbs in the first winter after planting.

DISTRIBUTION

The cork oak is a native of the Mediterranean region, exclusive of the Levant, and occurs in France, Spain, Portugal, Corsica, Sardinia, Italy, Sicily, Istria, Dalmatia, and Albania; and in northern Africa, in Morocco, Algeria, and Tunis. It is usually found growing wild on granitic or slate soils, and is never seen on limestone formations, where it is replaced by *Q. Ilex*. It usually either forms pure and rather open woods, or is mixed with other oaks; but on sandy soil near the sea-coast is often found scattered in the forests of maritime pine.

In France there are three regions where it flourishes and is of commercial importance: in the Landes and in Lot-et-Garonne; in the Pyrénées Orientales, where it ascends to 1600 ft.; and along the Mediterranean coast from Toulon to Antibes, where it is confined to non-calcareous soils. In Corsica, though large woods are rare, it is widely spread and covers an estimated total area of 18,000 hectares. In Sardinia, nearly all the important woods, which were formerly very fine and of large extent, have been destroyed, except those in the valley of Tempio, where there are fine trees producing an excellent cork. The cork tree is of no great importance on the mainland of Italy, though widely distributed on the western coast; but in Sicily there are extensive forests, often composed of large trees, the most notable between Caltagirone and Terranova having an area of 40,000 hectares.

In Algeria, the principal forests where this species is met with are in the mountainous region close to the sea, from Dellys eastward to the Tunisian frontier, where the annual rainfall exceeds 24 in. Here three species of oak occur, often mixed; but as a rule *Q. Suber* and *Q. Mirbeckii* occupy northern aspects, the former growing on the slopes and crests of the mountains, and the latter in the better soil in the ravines; while *Q. castaneaefolia* is restricted to southern slopes. In Oran and the western part of the province of Algiers, the oak woods are small in extent, and are mainly composed of *Q. Suber*, *Q. Ilex*, and *Q. coccifera*. The total area covered by the cork oak in Algeria is estimated at 426,000 hectares; and the annual production of cork, steadily increasing, amounted in 1899 to about 16,000 tons.

In Tunis, the forests of this species occur in the north-east in the Khroumir mountains, and cover about 82,000 hectares, with an annual production of cork of 1200 to 1500 tons. In Morocco, there are large forests in the Riff mountains between Tetuan and Melilla; and scattered smaller woods are reported in the interior, as far south as Morocco and Agadir; but up to the present these have not been utilised, except in a trifling way.

In Spain, where the woods of *Q. Suber* are estimated to cover an area of 300,000 hectares, the most important are in Catalonia, in the hills close to the sea-coast, where this species is associated with *Pinus Pinea* and *Pinus Pinaster*. There are also extensive forests in Estremadura, and many scattered woods throughout Andalusia.

The Catalonian forests furnish the best quality of cork, that used for champagne bottles; and it was here that about 150 years ago, at San Lorenzo de la Muga, the trees were first artificially treated, so as to produce a better quality of cork than the natural bark affords. Throughout Spain, the forests are poorly treated; natural regeneration is rendered nearly impossible by grazing animals, and artificial plantations are unknown.

(A. H.)

In Portugal, where, according to Lefebvre, the largest amount of cork is produced, the forests are well cared for, and many new plantations are made. In central and southern Portugal the cork oak is one of the commonest and most widely cultivated trees, principally on account of the value of its bark, but also for its acorns. It is usually planted on the drier lands which are ploughed for wheat at intervals of two or three years, and are grazed by sheep and pigs at other times.

In the better cultivated districts it is barked at intervals of eight to ten years, and from about twenty-five to thirty years up to a hundred and fifty or more, when the quality of the cork begins to decline. The bark is taken off the trunk and lower branches down to about 6 in. in diameter, and the trees so treated have a very different appearance to wild or unbarked trees, being comparatively smooth and reddish brown in colour. In the woods near Cintra, on Sir Frederick Cook's property, there are many large and very picturesque trees, which are never barked, and have wide-spreading branches, but they do not here attain anything like the size that they do farther inland, where the soil is stronger and the climate drier.

On the property of Senhor Suares Mendes, near Abrantes, where the lower parts of the valleys running back into the plateau were full of splendid cork oaks, I measured a magnificent tree nearly 60 ft. high, with a trunk about 12 ft. in girth, dividing at about 12 ft. into twenty large branches, which covered an area 25 paces in diameter. Another, which some years previously had been severely lopped, was about 25 ft. in girth, and though of great age seemed to be perfectly sound. In this valley, which reminded me somewhat of the foothills in San Bernardino county, California, the cork trees were scattered at irregular intervals, as though self-sown, and gave the effect of old oaks in an English park. Their produce is very valuable, and I was told by Mr. Percy Ellis of Lisbon, who has a large cork factory, that there was much difference in the quality in different parts of the country, but that the cork of Alemtejo was perhaps equal, if not superior to any in the world. Specimens of the different qualities showing the injuries produced by various causes, which he was good enough to give me, are now in the Cambridge Forestry Museum.

I heard of still larger trees than those which I have mentioned; one between Niza and Povia de Meadas, in Alemtejo, supposed to be 300 years old and growing on granite soil, which seems to suit this tree best, was 18 metres high by 7.20 metres in girth, the diameter of the crown 28 metres; another at St. Anna de Malto in the commune of Concho, 5 metres in girth, produced in 1879, 1465 kilos, and in 1889, 1755 kilos (nearly two tons) of cork. A third, near the Chapel of San Gonçalo, on the road to Palonella, 10 miles south of Lisbon, of which a photograph is given in *Bull. Soc. Tosc. d'Hort.* ser. ii. vol. ii. p. 19 (1887), was 18 m. high by 9 m. in

girth, with bark 20 cm. thick, and supposed to be 400 years old. This tree has produced as much as 800 litres of acorns in one year. The cork tree is known in Portugal as *sobreiro*, and in Spain as *alcornoque* or *suro* in Catalonia, and *sobreiro* in Galicia.

I did not see or hear of any cork trees either in the south-west of France, or on the Riviera, which approached the dimensions above given. In the Esterel mountains between Cannes and Frejus, where it is abundant, the trees rarely exceed about 50 ft. in height and 10 ft. in girth. There is a large cork tree in the Botanic Garden at Florence, believed to have been planted in 1805. When I saw it in February 1910, it measured 80 ft. by 10½ ft., with a clean trunk about 20 ft. high, and a well-shaped spreading crown.

CULTIVATION

I am informed by M. Marc Bazille of Montpellier that all the attempts which have been made in the south of France to graft the cork oak upon the Ilex, with the object of extending its cultivation to the calcareous soils of Provence, have failed, and this is confirmed by Prof. Flahault.

The cork oak is said¹ to have been introduced in 1699 by the Duchess of Beaufort; but the present Duchess, who has been good enough to search the archives at Badminton, was not able to find anything relating to the introduction. Judging from the age of many existing trees it must have become fairly common early in the eighteenth century. It seems to have been usually grown from acorns, which are commonly produced in the warmer parts of the south of England and usually ripen in the second season.² Though it has in one place reproduced itself naturally, it is best to sow the acorns in pots or in a frame, as the seedlings require protection for two or three years at least.

In England the largest³ is the splendid tree at Mamhead Park near Exeter, the seat of Sir R. Newman, Bart., which is now about 60 ft. by 15 ft. 2 in. in girth (Plate 328). This noble specimen grows on red loam at an elevation of at least 400 ft., and is exposed on all sides. A second tree about 50 ft. by 11½ ft. grows near it. At Haldon House, near Exeter, there is a tree only second in size to the one at Mamhead, and even more perfect in shape. In 1908 it was 60 ft. by 9 ft. 4 in., and looked very healthy. At Sidmouth Miss Woolward has photographed a tree over 60 ft. high and 9 ft. 4 in. in girth; and at Powderham, Killerton, and other places in south Devonshire, there are trees nearly as large. At Tregothnan, Mr. A. B. Jackson measured a tree 58 ft. by 9 ft. in 1908.

At Sherborne Castle, Dorset, there is a tree in the walk, east of the old castle, which has been rather drawn up by other trees, and in 1909 was 59 ft. by 8 ft. 2 in. At Claremont there is another which is fast decaying, and of no great height, whose trunk measured in 1903 no less than 16 ft. in girth.

At Pains Hill, in Surrey, there is a fair-sized tree which has reproduced itself naturally from seed, and healthy seedlings were growing in the grass near it in 1903.

¹ Aiton, *Hort. Kew.* v. 289 (1813).² Judging from the few specimens, which we have seen, with ripe fruit.³ Cf. p. 1286.

But in the midland and northern counties the tree seems to suffer so much from exceptionally severe frosts and lack of summer heat, that we know of no good trees.

In the east of England the cork tree is also quite hardy, and at Linton Park, Kent, there is a fine tree, planted by Sir Horace Mann in 1778, which is 50 ft. by 9 ft. At Orwell Park, Suffolk, on the lawn, exposed to the east wind from the North Sea, there is a tree about 40 ft. by 8 ft. whose leaves were only just appearing on 23rd June 1905 when most of the old leaves had fallen. At Henham Hall, Suffolk, the seat of the Earl of Stradbroke, there is a healthy cork tree close to the house, which in 1909 measured about 40 ft. by 11 ft., and sometimes produces ripe acorns.

At Stout Hall, in Glamorganshire, Mrs. Nicholl tells me of a tree which is considered to be the largest in Wales, and which is 50 ft. high by 13 ft. near the ground, where it forks into five or six main stems.

In Scotland the only tree we have on record is one at Mount Stuart, Bute, which, when measured in 1903 by Mr. A. Renwick, was about 20 ft. by 3 ft. 10 in., with a bole 10 ft. high.

In Ireland the only tree we know of large size is one at St. Joseph's Cemetery, near Cork, which Henry measured in 1903, when it was about 50 ft. high, with a short trunk dividing into four stems which measured from $4\frac{1}{2}$ to 6 ft. in girth. The tree at Summerstown, near Cork, figured by Loudon, and said to be 30 ft. by 8 ft. 10 in. below the fork in 1828, has been dead for some years, although, when recently seen by Mr. R. A. Phillips, 6 ft. of the trunk, with the bark quite sound but the timber rotten, was still lying on the ground.

TIMBER. CORK

The timber of the cork tree seems to be little used except for firewood, and to some extent by wheelwrights in Portugal, probably because it is rarely cut until the tree is worn out and partly decayed, and I could not learn that it is ever exported. According to Mathieu, the wood is similar to that of *Q. Ilex*, but is not so homogeneous or fine in the grain, but is equally heavy and hard. A board which was sent me from a tree which died at Blaize Castle, showed very handsome grain when quartered, but the heartwood was discoloured.

The cork naturally produced, what is called in French natural, male, or virgin cork, is of little value on account of its hardness and brittleness, but is taken off the trees when young, which then begin to produce the cork of commerce called female or reproduced cork. This increases in thickness fastest between the second and sixth year, and is usually taken off after eight to ten years, the quality improving with the age of the tree, which may continue to produce marketable cork for 150 to 200 years or even more. When taken off, the slabs are scorched over a fire and pressed to flatten them.

Many details with regard to the commercial production and preparation of cork¹ are given at length by Loudon and other authors, but as the subject has no economic importance to British arboriculturists, we omit them. (H. J. E.)

¹ The best and latest account of the cork tree, with complete statistics of the production, export, and imports of cork throughout the world, is given by Lefebvre, *Forêts de l'Algérie*, pp. 135-326 (1900). Another monograph on the cork oak in its commercial aspect by E. A. Müller, published in *Abh. k.k. Geogr. Ges. Vienna*, 1900, may also be consulted.

QUERCUS SEMECARPIFOLIA

Quercus semecarpifolia, Smith, in Rees, *Cyclop.* xxix. No. 20 (1819); Hooker, *Fl. Brit. India*, v. 601 (1888); Skan, in *Journ. Linn. Soc. (Bot.)* xxvi. 520 (1899); Gamble, *Man. Indian Timbers*, 671 (1902); Brandis, *Indian Trees*, 625 (1906).
Quercus obtusifolia, Don, *Prod. Fl. Nepal*. 56 (1825).
Quercus Cassura, Don, *Prod. Fl. Nepal*. 57 (1825).

A tree, occasionally attaining in the Himalayas 100 ft. in height and 18 ft. in girth, usually considerably smaller. Young branchlets with scattered stellate pubescence. Leaves (Plate 338, Fig. 53) coriaceous, subevergreen, falling a month or two before the new leaves appear, very variable in size and margin; averaging 3 in. long and 2 in. broad; usually elliptical; rounded or rarely acute at the apex; cordate or rarely rounded at the base; margin on old trees undulate-entire, on young trees with spine-tipped serrations or teeth; lateral nerves six to ten pairs, forking before reaching the margin; upper surface dark green, with scattered stellate pubescence, retained on the midrib, soon deciduous elsewhere; lower surface pale, with scattered fine stellate pubescence; petiole $\frac{1}{16}$ to $\frac{1}{2}$ in., stellate-pubescent.

Fruit ripening in the second year, solitary or in pairs, on a short stout pubescent peduncle; acorns globose or ovoid, enclosed at the base in a hemispherical cupule, about $\frac{1}{2}$ in. in diameter, and covered with closely appressed tomentose scales.

This species, which has holly-like leaves, is readily distinguished from *Q. Ilex* by the subevergreen leaves, which have lateral veins always forked before reaching the margin.

It is a native of the Himalayas from Kumaon to Bhutan and Munnipore, occurring at altitudes of 6000 to 12,000 ft.; and also occurs in the mountains of China, in the provinces of Szechwan and Yunnan. Though mentioned by Loudon¹ as one of the Himalayan oaks worthy of a trial in this country, it appears not to have been introduced till lately. Mr. Gamble has raised two plants from acorns received in 1900 from Chakrata in the north-west Himalaya at 9000 ft. These have thriven in his garden at East Liss, Hants, and seem perfectly hardy, their present height being 10 ft. and 15 ft. (A. H.)

¹ *Arb. et Frut. Brit.* iii. 1935 (1838).

QUERCUS INCANA

Quercus incana, Roxburgh, *Hort. Bengal*, 104 (1813), and *Fl. India*, iii. 642 (1832); Hooker, *Fl. Br. India*, v. 603 (1888); Gamble, *Man. Indian Timbers*, 675 (1902); Brandis, *Indian Trees*, 626 (1906).

Quercus dealbata, Wallich, *List*, 2769 (1828-49).

Quercus lanata, Don, var. *incana*, Wenzig, in *Jahrb. bot. Gart. Berl.* iv. pt. i. 222 (1886).

A tree, attaining 80 ft. in height and 12 ft. in girth. Young branchlets white tomentose. Leaves (Plate 335, Fig. 18) coriaceous, persistent two years, 3 to 6 in. long, 1 to 2 in. wide, elliptic-lanceolate, acuminate at the apex, rounded or tapering at the base; with ten to fifteen pairs of lateral nerves, all but the lowest one to three pairs ending in a mucronate triangular serration; upper surface glabrous; lower surface densely covered with white tomentum; petiole $\frac{1}{4}$ to $\frac{1}{2}$ in. long, white tomentose.

Fruit ripening in the second year, solitary or clustered on very short tomentose stalks; acorn ovoid-conic, about an inch long, tomentose with a short cylindrical umbo, enclosed for half its length in a hemispherical cupule, $\frac{1}{2}$ in. in diameter, covered with closely appressed tomentose triangular scales.

This species is a native of the north-western Himalayas at altitudes between 4000 and 8000 ft.

The only specimen we have seen in cultivation is growing in the temperate house at Kew. Mr. Gamble has young plants at East Liss, Hants, which are kept alive with difficulty out-of-doors in winter. This oak has not, however, been tried in the south-west of England or in Ireland, where it would probably be hardy and worth cultivating on account of its handsome foliage. (A. H.)

QUERCUS PHILLYRÆOIDES

Quercus phillyræoides, A. Gray, in *Mem. Amer. Acad.* vi. 406 (1859); Masters, in *Gard. Chron.* i. 632 (1874); Franchet et Savatier, *Enum. Pl. Jap.* i. 446 (1875); Shirasawa, *Icon. Ess. Forest. Japon*, text 58, t. 31, figs. 1-12 (1900).

Quercus Ilex, Linnæus, var. *phillyræoides*, Franchet, in *Journ. de Bot.*, 1899, p. 152; Skan, in *Journ. Linn. Soc. (Bot.)* xxvi. 516 (1899).

A small tree, 20 to 30 ft. high, or a large shrub. Young branchlets densely covered with minute stellate pubescence, retained in part in the second year. Leaves (Plate 339, Fig. 66) coriaceous, persistent two years, $1\frac{1}{2}$ to 2 in. long, $\frac{3}{4}$ to 1 in. broad, oval or obovate-oblong, rounded or acute at the apex, rounded or sub-cordate at the base; lateral nerves inconspicuous, about eight pairs, dividing and looping before reaching the margin; occasionally entire, but usually with four

or five pairs of serrations in the apical half of the blade; upper surface dark green, stellate-pubescent on the midrib, elsewhere glabrescent; lower surface light green, glabrous except for dense pubescence on the base of the midrib, continuous with that on the very short stout petiole.

Fruit ripening in the second year, sub-sessile; cupule hemispherical, about $\frac{3}{8}$ in. in diameter, tomentose within, and covered externally with whitish tomentose closely appressed scales, dark red at the tips; acorn, $\frac{1}{2}$ to $\frac{3}{4}$ in. long, tomentose towards the apex.

This species is a native of Japan, where it was discovered near Simoda; and in recent years has been found in the high mountains of western China in the provinces of Szechwan and Yunnan.

In Kew Gardens, the only place where we have seen this species, it forms an elegant shrub, with dense bright green foliage, and is perfectly hardy. The oldest specimen, which has not yet produced acorns, is about 15 ft. high, and was introduced by Oldham, who made collections in Japan in 1861 and 1862. Smaller specimens, 2 to 6 ft. high, have been obtained since from Japan. (A. H.)

QUERCUS CHRYSOLEPIS

Quercus chrysolepis, Liebmann, in *Overs. Dansk. Vidensk. Selsk. Forhandl.* 173 (1854); Sargent, *Silva N. Amer.* viii. 105, tt. 398, 399 (1895), and *Trees N. Amer.* 257 (1905).

Quercus fulvescens, Kellogg, in *Proc. Calif. Acad.* i. 67 (1855).

Quercus crassipocula, Torrey, in *Pacific R. R. Rep.* iv. 1, p. 137 (1856).

A tree, occasionally attaining 50 ft. in height and 15 ft. in girth, with wide-spreading branches; often shrubby. Bark covered with small appressed scales. Young branchlets with scattered stellate pubescence. Leaves (Plate 338, Fig. 61) coriaceous, persistent three years, very variable in size and shape, often entire on old trees; on young trees, oblong ovate, about 2 in. long and $1\frac{1}{4}$ in. wide, acute and spine-tipped at the apex, broad and usually cordate at the base; margin with twelve to twenty spiny triangular small teeth; upper surface dark green with minute stellate pubescence; lower surface more or less covered with yellow appressed hairs and dotted with minute shining glands; petiole, $\frac{1}{8}$ in. long, pubescent, glandular.

Fruit ripening in the second year, solitary, sessile or sub-sessile; acorn ovoid, variable in length, slightly pubescent at the apex, enclosed at the base in a thick turbinate cupule, covered with triangular scales, hoary at their short free tips, or hidden in a dense yellow tomentum.

This species is extraordinarily variable both in foliage and fruit; and is most readily recognised by the glands on the lower surface of the leaf.

In var. *vacciniifolia*, Engelm., in *Trans. St. Louis Acad.* iii. 393 (1878), a low prostrate shrub, growing on sub-alpine slopes, the leaves are usually oval and entire, and scarcely exceed an inch in length.

This species is more widely distributed than *Q. agrifolia* and *Q. Wislizeni*, the

other Californian evergreen oaks with spiny leaves; as it extends northwards into southern Oregon, southwards to Mt. San Pedro Martir in Lower California, and eastward to the high mountains of southern Arizona, New Mexico, and the province of Sonora in Mexico. It yields valuable wood, which is used in the manufacture of waggon and agricultural implements.

The only specimens which we have seen in cultivation are plants at Kew, 2 to 3 ft. high, raised from acorns obtained from Meehan in 1904. There are also small plants at Coombe Wood.

(A. H.)

QUERCUS GLABRESCENS

Quercus glabrescens, Bentham, *Pl. Hartw.* 56, 348 (excl. syn. *Q. splendens*, Née) (1839); De Candolle, *Prod.* xvi. 2, p. 34 (1864); Liebmann, *Chênes Am. Trop.* t. 39 (1868); Hemsley, *Biol. Centrali-Amer. Bot.* iii. 172 (1882).

A small tree. Bark peeling off in thin quadrangular scales. Young branchlets slender, with scattered stellate pubescence. Buds minute, globose, surrounded by persistent linear pubescent stipules. Leaves (Plate 339, Fig. 67) coriaceous, persistent two years, 2 to 2½ in. long, ¾ to 1 in. broad, obovate-oblong, rounded or sub-cordate at the base, acute at the apex; margin thickened, revolute, with three to six pairs of gland-tipped small teeth above the middle; lateral nerves seven or eight pairs ending in the margin; upper surface dark green, shining, pubescent on the midrib, elsewhere glabrescent; lower surface yellowish, with scattered stellate pubescence; petiole stout, ¼ in. long, stellate-pubescent.

Fruit ripening in the first year, two or three on a pubescent peduncle; acorn ovoid, surrounded in its lower half by a hemispherical cupule, covered with appressed ovate pubescent scales.

This species is a native of the mountains of southern Mexico, and was first described by Bentham, from specimens collected by Hartweg, the locality being unknown, but supposed to be near Real del Monte. Liebmann afterwards, in 1841 and 1842, found it growing on the peak of Orizaba at 8000 to 9000 ft. altitude, and also at Chinantla, Cuesta de Lachopa, and Cerra Leon. It appears to be a small evergreen tree, but its dimensions are not stated. Amongst Liebmann's specimens at Copenhagen, there is an entire-leaved variety of this species, which I have not seen.

This appears to have been one of the trees introduced by Hartweg, who sent all his specimens of oaks, with acorns of some of the species, to the Horticultural Society; but Gordon,¹ in his account of the new plants introduced into the Chiswick Garden in 1840, states that the acorns of this species were presented by Mr. Strangways.

The only tree which survives, so far as we know, is growing in the Botanic

¹ In Loudon, *Gard. Mag.* xvi. 636 (1840). Cf. Loudon, *Trees and Shrubs*, 904 (1842).

Garden of Trinity College, Dublin, and is now about 25 ft. high, with a bole 9½ ft. in height and 2 ft. 5 in. in girth. Mr. S. G. Wild reports that it is healthy and vigorous, and not affected by the winter's cold. It produced acorns in 1905, which apparently did not ripen.

(A. H.)

QUERCUS ALBA, WHITE OAK

Quercus alba, Linnæus, *Sp. Pl.* 996 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1864 (1838); Sargent, *Silva N. Amer.* viii. 16, tt. 356, 357, 358 (1895), and *Trees N. Amer.* 259 (1905).

A tree, attaining in America 150 ft. in height and 18 ft. in girth. Bark grey, on young trees broken into long thin loose irregular scales; on old trunks about 2 in. thick, and divided into broad flat scaly ridges. Young branchlets glabrous, shining. Buds ovoid, obtuse, reddish brown, ⅓ in. long. Leaves (Plate 336, Fig. 33) deciduous in winter, turning reddish before they fall, occasionally withering and persistent during winter, about 7 in. long and 4 in. broad, obovate, cuneate at the base, obtuse at the apex, with seven to nine lobes; terminal lobe truncate, sinuate, or with three lobules, of which the two lateral are unequal in size; lateral lobes oblong, usually entire, variable in width and depth; lateral nerves ending in some of the sinuses as well as in the lobes; upper surface dark green, glabrous; lower surface pale, covered with a very minute pubescence, only discernible with a strong lens, no conspicuous hairs being present on the midrib or nerves; petiole ½ in. long, glabrous.

Fruit ripening in the first year, sessile or on a slender stalk, both forms sometimes occurring on the same branch, single or in pairs; acorn edible, ovoid, rounded at the apex, shining, ¾ in. long, enclosed for one-quarter of its length in a hemispherical cupule, which is covered with tomentose scales thickened and tuberculate in the lower ranks, thin and membranous towards the rim. Individual trees, believed to be hybrids¹ of *Q. alba* with other oaks, have been observed in different parts of North America, the most noteworthy being that with *Q. macrocarpa*. See p. 1304.

The White Oak has a wide distribution, extending northward to lat. 46° in southern New Brunswick, south-western Quebec, and southern Ontario; westward through southern Michigan and Wisconsin to southern Minnesota, south-eastern Nebraska, and eastern Kansas; and southward to northern Florida and the Gulf States as far as the Brazos river in Texas. It is one of the most common oaks of the Mississippi basin and of the Atlantic states, growing both on fertile uplands and on alluvial soil, which is not too moist. It is abundant and of large size in Ontario and the northern borders of the United States, furnishing the "Canadian oak" exported to England, which is now supplemented by large supplies from Ohio and Indiana, and even from Kentucky and west Virginia, by way of the Great Lakes. The tree is most abundant and of its largest size in the alluvial lands of the lower Ohio basin,

¹ These are described and figured by Sargent, *Silva N. Amer.* viii. 18, tt. 359, 360, 361 (1895).

in the Carolinas, and on the western slopes of the Alleghanies in Tennessee, rarely ascending above 2000 ft. in the extreme south.

Prof. Mohr states that in the forests where the white oak originally formed one-fourth to one-half of the timber growth, it is associated with black and Spanish oaks, hickories, beech, black walnut, and tulip tree; towards the north and at high levels in the south, its companions are red oak, scarlet oak, and chestnut; and in the extreme south it is mixed with the Carolina hickory, *Q. Phellos*, *Q. Schneekii*, and *Magnolia acuminata*. The undergrowth is mostly *Cornus*, *Ostrya*, *Carpinus*, *Amelanchier*, and *Cercis*. Where the original forest has been cut down, white oak is scarcely seen in the second growth, the more aggressive species of the red oak group occupying almost exclusively its place. Owing to the difficulty and scarcity of its natural regeneration, together with the fact that forest land suitable for its growth is occupied by the farmer, Prof. Mohr considers that so far as economic interests are concerned, the final extinction of the white oak will take place at no distant date. Even the immense forests of Kentucky and Tennessee are becoming exhausted. Future supplies of white oak must come from the forests south of the confluence of the Ohio and Mississippi rivers, and the sawmills are being moved southwards. Nashville, until a few years ago, was the most important market. At present Memphis, Mobile, and New Orleans are becoming the main centres, where white oak is sawn and marketed.

(A. H.)

Ridgway gives many details of the size of white oak in the bottoms of southern Indiana and Illinois, the largest measured by Dr. J. Schneck in Wabash Co. being 150 ft. by 6 ft. in diameter with a clean bole 60 ft. long. The average of ten trees here was about 125 ft. in height by 4 ft. in diameter, whilst on the uplands in the same district the average height was only 100 ft. by 2'40 ft. in diameter.

In an article¹ on this tree by Sargent, good illustrations are given of the white oak in summer and winter from a tree growing in the grounds of Mr. Fearing, near Jobstown, New Jersey, which shows the form the tree assumes when grown in the open, like the park oaks of Great Britain; but though he says that the white oak in girth of stem and stoutness of branches is not second to its Old-World relative, the dimensions given by various writers do not show that any trees now exist which can rival our big English oaks. The tree in question is of no great height, and has a very short bole, 18 ft. in girth at 3 ft. from the ground. It is remarkable for its very wide-spreading and well-shaped crown, which covers a space 120 ft. in diameter.

Sargent also gives² a picture of a very beautiful and well-shaped tree at Shandy Hall, Maryland, which is 36 ft. in girth at the ground and 22 ft. just below the first limb at about 10 ft. The spread of the branches covers a circle 122½ ft. in diameter. In size, shape, and appearance, this tree is very similar to the Bourton Oak (Vol. II. Plate 93). In *Gard. Chron.* xxxiv. 51, figs. 19 and 20 (1903), some very large and old white oaks growing in the State reservation at Waverley, near Belmont, Massachusetts, are described and figured. The largest is about 80 ft. by 25 ft. in girth at 5 ft., and its age is estimated at 800 years, though there is no

¹ *Garden and Forest*, iv. 1, figs. 1, 2 (1891).

² *Ibid.* v. 254, fig. 50 (1892).

evidence that this species attains so great an age. It is said that during 100 years no seedling white oaks have come up in the reservation.

Prof. Sargent took me to see a fine white oak at Ponkapoug pond, near Boston, which was also very like an English park oak in habit, and measured about 60 ft. by 15 ft., with a spread of 40 paces. What was to my mind even more striking was the inhabited house of a settler dating from 1704, the white oak timbers and part of the weather-boarding of which was still quite sound, though unpainted for 200 years.

This oak has been repeatedly tried¹ in this country since its introduction in 1724, but has never thriven in our climate, the only specimens, except nursery plants at Kew, which we have seen² being a stunted tree at Tortworth, scarcely 20 ft. high, which was planted many years ago; and some plants at Aldenham, with sickly yellow foliage, planted eight years ago and reputed to be twenty years old from seed.

It seems to do rather better in France, where there are three trees at Les Barres in the old nursery, and some smaller ones which are not thriving. The best of them measure from 40 to 45 ft. high, and some produce acorns. At Verrières le Buisson, near Paris, in M. Philippe de Vilmorin's garden, there is a fairly healthy and well-grown tree, which, when I saw it last in 1905, measured 58 ft. by 4 ft. 2 in.

(H. J. E.)

QUERCUS LYRATA, OVERCUP OAK

Quercus lyrata, Walter, *Fl. Car.* 235 (1788); Loudon, *Arb. et Frut. Brit.* iii. 1871 (1838); Sargent, *Silva N. Amer.* viii. 47, t. 374 (1895), and *Trees N. Amer.* 268 (1905).

A tree, attaining in America 100 ft. in height and 9 ft. in girth, but usually smaller. Bark broken into scaly plates. Young branchlets glabrous. Leaves (Plate 336, Fig. 31) deciduous and turning scarlet in autumn, 6 to 8 in. long, 2 to 3 in. wide, obovate, cuneate at the base, obtuse or acute at the apex, with five to nine lobes, the upper two lateral lobes broad, emarginate, and much larger than the middle and basal triangular lobes; upper surface dull green, with quickly deciduous minute scattered pubescence; lower surface pale, covered throughout with a minute pubescence; petiole ¼ to ⅝ in. long, glabrous or with a few hairs.

Fruit ripening in the first year, sessile or on slender pubescent stalks; acorn pubescent in its upper half, almost or entirely enclosed in a nearly spherical thin cupule, pubescent within and covered with ovate tomentose scales, thick and twisted in the basal ranks, thinner and forming a ragged edge at the margin of the cupule.

This species is a native of river swamps and wet alluvial land, from Maryland

¹ Loudon, in *Gard. Mag.* xix. 124 (1843), states that hundreds, even thousands of pounds, had been spent fruitlessly in the importation of acorns from America. In 1843, 30,000 plants which had been sent from New York, packed with moss in barrels, were said to have been thriving in a favourable soil in Surrey, but doubtless these soon perished.

² Loudon's account in *Arb. et Frut. Brit.* iii. 1868 (1838), of white oaks of large size in England is erroneous. In *Gard. Mag.* xviii. 656 (1842), he admits that there was only one tree known to him in England, growing in Loddiges' nursery. This was probably a young specimen. A supposed *Q. alba* at Muswell Hill was cut down in 1839, and a tree bearing that name at York House, Twickenham, was ascertained to be *Q. Prinus* by Loudon. Henry visited York House in 1904, and found no trace of this American oak.

south to Florida, and westward through the Gulf States to Trinity river, Texas, ascending the Mississippi basin to southern Indiana and Illinois, most common and attaining its largest size in Louisiana.

The overcup oak was introduced¹ by Fraser in 1786, but Loudon only mentions in 1838 a small plant in Loddiges' nursery. Probably neglected by nurserymen, and unsuited for our climate, it is now nearly unknown in cultivation, the only specimens which we have seen being two trees in Kew Gardens, about 10 ft. high, which were obtained from the Arnold Arboretum in 1897. (A. H.)

QUERCUS MACROCARPA, BURR OAK

Quercus macrocarpa, Michaux, *Hist. Chênes Am.* No. 2, tt. 2, 3 (1801); Loudon, *Arb. et Frut. Brit.* iii. 1869 (1838); Sargent, *Silva N. Amer.* viii. 43, tt. 371, 372, 373 (1895), and *Trees N. Amer.* 267 (1905).

Quercus olivæformis,² Michaux f., *Hist. Arb. Am.* ii. 32, t. 2 (1812); Loudon, *Arb. et Frut. Brit.* iii. 1869 (1838).

A tree occasionally attaining in America 170 ft. in height and 20 ft. in girth. Bark, 1 to 2 in. thick, deeply furrowed, and broken on the surface into irregular flattened scales. Young branchlets stout, with a minute pubescence, gradually disappearing in summer. Buds ovoid, $\frac{1}{8}$ to $\frac{1}{4}$ in. long, greyish tomentose; the terminal bud surrounded by persistent stipules. Leaves (Plate 336, Fig. 29) deciduous in autumn, turning dull brown before they fall, 6 to 12 in. long, 3 to 6 in. wide, obovate, rounded or acute at the apex; variable in outline, usually with five to seven lobes, the terminal lobe large, ovate, and crenately toothed, the lower lobes smaller, oblong, and separated by deep sinuses; occasionally, more regularly divided into more numerous shallower lobes; upper surface yellowish green, with quickly deciduous scattered hairs; lower surface pale, covered with a minute appressed pubescence, disappearing in greater part before the end of summer; petiole stout, pubescent, $\frac{1}{2}$ to 1 in. long.

Fruit ripening in the first year, solitary or in pairs, sessile or long-stalked, variable in size and shape; acorn usually broad, ovoid, rounded or depressed at the apex, from $\frac{1}{2}$ in. long in the north to 2 in. long in the south; cupule usually hemispheric, thick, pubescent within, covered externally with grey tomentose scales, tuberculate below, prolonged into awn-like tips above, forming a fringed border to the cupule.

Q. macrocarpa is remarkable for the corky wings³ on the branchlets, sometimes an inch or more in width, when these are three or four years old.

A supposed hybrid⁴ between this species and *Q. alba* was first discovered by M. S. Bebb at Fountaindale, Illinois, and has since been found in other localities.

¹ Aiton, *Hort. Kew.* v. 295 (1813).

² This name was applied by Michaux to trees with deeply lobed leaves and small fruit; but the foliage is so variable on this species, even on the same individual, that it is doubtful if it can be maintained even as a varietal name.

³ Cf. Miss Gregory, in *Bot. Gaz.* xiii. 254, pl. xxii. (1888).

⁴ *Quercus Bebbiana*, Schneider, *Laubholzkunde*, i. 201 (1904).

A tree¹ of this kind is growing in the Arnold Arboretum, from the acorns of which Elwes has raised seedlings, which are not, however, growing vigorously at Colborne, where the summers are too short and cold for it. (A. H.)

This is one of the most widely distributed oaks in North America, and extends farther to the northward and westward than any other of the eastern species. Its natural range is from Manitoba, the eastern foothills of the Rockies in Montana, the Dakotas, Nebraska, central Kansas, Indian Territory, and eastern Texas, eastward to the Atlantic coast. In the north-western states and about the Great Lakes, it sometimes grows in pure stands, forming the characteristic "oak openings," which are an intermediate region between the prairie and the forest. It resisted well the fires which constantly swept over this country before it was settled. An excellent picture of the type of tree found here is given in *Garden and Forest*, iii. 407 (1890), representing an oak near Whitewater, Wisconsin. In Manitoba, according to Macoun,² it forms thickets and open forests in many parts, sometimes becoming a fine tree, but dies out west of the Assiniboine. In Nova Scotia, New Brunswick, and westward through the valley of the St. Lawrence to Ontario, it is not so common and does not attain as large a size as *Q. alba*. It is most abundant and most important in the low ground of the Mississippi basin, where it is associated with white oak, lime, white ash, poplar, black walnut, and hickories. The largest dimensions given by Ridgway are of trees in Wabash county, Illinois, measured by Dr. J. Schneck—165 ft. by 22 ft., with a trunk 72 ft. long; and 162 ft. by 20 ft. East of the Alleghanies it is rare and local; and in the northern and north-western limits of its distribution, where the climate is cold and very dry, it dwindles to a mere shrub.

This species was introduced into England in 1811, but was rare in Loudon's time. Like most of the white oaks from eastern North America, it cannot be said to thrive in this country. From acorns which I gathered from a tree of no great size near Ottawa, I raised seedlings which, at first, were more vigorous than any of the American oaks that I raised at the same time, except the hybrid between this species and *Q. alba*, but are now, like the latter, apparently suffering from the soil and climate.

The best specimen we have seen is a tree at Eastnor Castle, which was 40 ft. high by 3 ft. in girth in 1905. Smaller trees are growing at Hildenley, Yorkshire, in Kew Gardens, at Tortworth, Orton, Fota, and Castlewellan. It does not appear to ripen fruit in this country, but I collected specimens with ripe acorns in September 1907 from a tree in M. Allard's arboretum at Angers, France. At Les Barres it seems to endure calcareous soil better than other American oaks, and has attained 13 metres in height; but Pardé does not think it likely to have any value as a forest tree in France.

According to Pinchot,³ the burr oak is one of the most valuable hardwood trees in North America. The wood is heavy, hard, very strong, and durable; and in the market is not distinguished from white oak, and is used for the same purposes.

(H. J. E.)

¹ This tree is one of several raised in the Arnold Arboretum from acorns taken from a hybrid oak growing near Charle-ville, Vermont. They reproduce the foliage of the parent, and grow more rapidly than trees of *Q. alba* and *Q. macrocarpa* in the same plantation. Cf. Sargent, *Silva N. Amer.* viii. 18, note 3, t. 350 (1895).

² In *Proc. Roy. Soc. Canada*, xii. pt. 4, p. 12.

³ U.S. Forest Service Circular No. 56 (1907).

QUERCUS LOBATA, CALIFORNIAN VALLEY OAK

Quercus lobata, Née, *Ann. Cienc. Nat.* iii. 277 (1801); Sargent, *Silva N. Amer.* viii. 23, t. 362 (1895), and *Trees N. Amer.* 261 (1905).

Quercus Hindsii, Bentham, *Bot. Voy. Sulphur*, 55 (1844).

Quercus longiglанда, Frémont, *Geograph. Mem. Upper California*, 15, 17 (1848).

A tree, attaining in California 100 to 130 ft. in height, with a trunk often 12 ft. and occasionally 20 to 30 ft. in girth. Bark about an inch thick, with small loosely appressed scales. Young branchlets slender, minutely pubescent. Buds ovoid, acute, $\frac{1}{8}$ in. long, pubescent. Leaves (Plate 336, Fig. 30) deciduous in autumn, 2 to 3 in. long, 1 to $1\frac{1}{2}$ in. broad, obovate or oblong, cuneate or rounded at the base, obtuse at the apex, with seven to eleven lobes, separated by sinuses of varying depth, the lateral lobes truncate or bidentate at their broad apex or triangular-ovate; upper surface dark green, with scattered minute stellate pubescence; lower surface paler, with denser similar pubescence; margin ciliate; petiole $\frac{1}{8}$ to $\frac{1}{2}$ in. long, pubescent.

Fruit ripening in the first year, sub-sessile, solitary or in pairs; acorns conical, elongated, 1 to 2 in. in length; cupule hemispheric, tomentose, the scales towards the base thickened and tuberculate, the others with long acute ciliate tips, the uppermost forming a fringe-like margin to the cupule.

This splendid tree is found in the valleys of western California, between the Sierra Nevada and the ocean, from the upper Sacramento to Tejon Pass. Alone or mixed with *Q. Wislizeni* and *Q. Douglasii*, it forms large open park-like groves. The Ukiah valley a few years ago was a vast forest of oaks, many of which still survive and are of a large size, Carl Purdy¹ having measured here in 1897 one tree 132 ft. high and 23 ft. 9 in. in girth, and another 120 ft. by 19 $\frac{1}{2}$ ft. A heavy rainfall, rich soil, and sheltered situation have produced these surprising dimensions, unequalled by any other oaks on the Pacific Slope. Mr. Shinn² describes and figures a grove near Visalia, about 150 acres in extent, with trees 55 to 94 ft. in height and 11 to 15 ft. in girth. These grow on a heavy alluvial soil, rich in alkaline salts. Hilyard³ also notices the growth of this tree on slightly alkaline soil, as in the delta lands of the Kaweah valley, where it forms a dense forest.

Mr. F. R. S. Balfour tells us that these oaks are the most conspicuous landmarks in the great central valleys of Sacramento and San Joaquin. They now stand solitary and stately in the vast expanse of wheat and barley in the grain tracts of Fresno, Merced, and other counties, which are now under cultivation. These trees were left to give shade in former times, when these districts were devoted to cattle-raising. The wood is remarkably brittle, and can only be used for firewood.

The date of introduction into Europe is uncertain; but Koch⁴ had seen

¹ In *Garden and Forest*, x. 52, fig. 8 (1897).

³ *Soils*, 480 (1906).

² *Ibid.* x. 202, figs. 25, 26 (1897).

⁴ *Dendrologie*, ii. 2, p. 54 (1873).

specimens in 1873 from Simon-Louis's nursery at Metz. It is rare in cultivation,¹ the only specimens which we have seen being a tree at Tortworth, about 20 ft. high, and another at Kew, about 30 ft. The latter is a narrow pyramidal fast-growing tree, the date of planting of which is unknown. (A. H.)

QUERCUS BICOLOR, SWAMP WHITE OAK

Quercus bicolor, Willdenow, in *Neue Schrift. Gesell. Natfr. Berlin*, iii. 396 (1801); Sargent, in *Bot. Gaz.* xlv. 226 (1907).

Quercus platanoides, Sudworth, *Rep. Agric. U.S.*, 1892, p. 327 (1893); Sargent, *Silva N. Amer.* viii. 63, tt. 380, 381 (1895), and *Trees N. Amer.* 269 (1905).

Quercus Prinus, β *platanoides*, Lamarck, *Dict.* i. 720 (1783).

Quercus alba palustris, Marshall, *Arbust. Am.* 120 (1785).

Quercus Prinus, β *tomentosa*, Michaux, *Hist. Chênes Am.* t. 9 (1801); Loudon, *Arb. et Frut. Brit.* iii. 1876 (1838).

Quercus Prinus discolor, Michaux f., *Hist. Arb. Am.* ii. 46, t. 6 (1812).

Quercus Prinus, β *bicolor*, Spach, *Hist. Vég.* xi. 158 (1842).

A tree, attaining in America occasionally 100 ft. in height and 25 ft. in girth, usually much smaller. Bark of young trees separating into large membranous persistent scales, curling back and exposing the inner bark; on old trunks fissured into broad flat scaly ridges. Young branchlets glabrous. Buds ovoid, obtuse, pubescent, $\frac{1}{8}$ in. long. Leaves (Plate 336, Fig. 37) deciduous in autumn, 5 to 6 in. long, 2 to 4 in. broad, obovate, rounded or acute at the narrowed apex, cuneate at the base, with six to eight pairs of rounded or acute small lobes; nerves more numerous than the lobes; upper surface shining green, with quickly deciduous scattered hairs; lower surface pale, often silvery white, covered with a dense tomentum, velvety to the touch; petiole about $\frac{1}{2}$ in. long, slightly pubescent.

Fruit ripening in the first year, usually in pairs, on pubescent stalks; acorn edible, ovoid, about an inch long, pubescent at the apex, enclosed for one-third its length in a thick hemispherical cupule, covered with tomentose scales, those near the base thickened with twisted tips, those near the margin thinner and often forming a fringe-like rim.

A hybrid² between this species and *Q. alba* was discovered in 1894 by J. G. Jack at Chateaugay in Canada.

Q. bicolor is a native of Canada and of the northern and central parts of the United States, extending from the southern peninsula of Michigan, Ontario, southwestern Quebec and southern Maine, southwards to the District of Columbia and northern Kentucky; extending along the Alleghany mountains to northern Georgia; and westwards to Iowa, Missouri, and Arkansas. It usually grows in small groves on the borders of streams and swamps, in moist fertile soil, but is nowhere abundant, and attains its largest size in western New York and northern Ohio. (A. H.)

¹ Sargent, in *Silva N. Amer.* viii. 25, states that *Q. lobata*, like the other Californian oaks, does not succeed beyond the borders of its native state, and that attempts to establish it in eastern America and in Europe have not been successful.

² *Q. Jackiana*, Schneider, *Laubholzkunde*, i. 202 (1904).

An excellent account of this oak in *Garden and Forest*, iv. 241 (1891) says that in its young state, and until it has reached 20 to 30 ft. high, this species develops short stout branches which are very persistent and generally pendulous, as shown in the plate which accompanies the article. The bark separates into long thin papery scales, which remain long on the young trees, and give them a ragged appearance. I have noticed these peculiarities, in a minor degree, on some English-grown trees. The foliage of this oak when newly unfolded in spring is extremely beautiful, the upper surface being bronzed or green, and the lower side covered with white down. In autumn, however, they have no red or orange tints. Sargent says that the largest tree of this kind on record formerly grew at Wadsworth, on the Genesee river, New York, and measured 24 ft. in girth at the narrowest part of its trunk. As the timber is even more valuable than that of the white oak, and the trees bear transplanting better than that species, Sargent recommends planting it in deep moist soils.

In England, however, though introduced probably about 1800, the tree is very rare, and none of the specimens which we have seen look very thriving. Perhaps if it were planted on deeper and moister soils, free from lime, in the south of England, it might do better, but the seedlings raised from acorns collected in 1904 at Boston soon died at Colesborne. Loudon mentions no trees except small ones in the gardens of the Horticultural Society and of Loddiges.

The largest we know of is a tree at Syon, 59 ft. by 5½ ft., which seems healthy. Another at Arley Castle, planted about 1820, No. 36 of *Hortus Arleyensis*, was 50 ft. by 3 ft. 3 in. in 1904. A third at Corsham Court, growing in damp soil, measured 47 ft. by 3 ft. in 1905, and looked fairly healthy, though the twigs seemed to have been repeatedly cut back by frost. A small tree at Kew, with the bark scaling like that of a hickory, is healthy, but grows slowly. There is a well-grown tree in a rather cold and exposed situation at Lyndon Hall (Plate 329), 52 ft. by 4 ft. 3 in. This, when I saw it in 1909, had a large wound at 7 ft., nearly covered over by new wood, and though many young twigs were dead, there was still plenty of healthy foliage on 12th October.

In France the finest tree that I have seen is one at Verrières, 65 ft. by 6 ft. 1 in. in 1909. There is a tree about 35 ft. high in the collection at Les Barres, catalogued by Pardé as *Q. bicolor*, which was formerly named *Q. alba*. Prof. Sargent and Mr. Proctor, who saw it, considered it to be *Q. bicolor*, but Mr. Rehder, who saw it still later, thought that it was a hybrid between *alba* and *bicolor*.¹

(H. J. E.)

¹ Pardé, *Arb. Nat. des Barres*, 289, note 1 (1906).

QUERCUS PRINUS, CHESTNUT OAK

Quercus Prinus, Linnæus, *Sp. Pl.* 995 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1872 (1838); Sargent, *Silva N. America*, viii. 51, tt. 375, 376 (1895), and *Trees N. America*, 272 (1905).
Quercus montana, Willdenow, *Sp. Pl.* iv. 440 (1805).
Quercus Castanea, Emerson, *Trees Mass.* 137, t. 5 (1846).

A tree, occasionally attaining in America 100 ft. in height and 20 ft. in girth, but usually much smaller. Bark on young trees smooth, thin, shining, purplish brown; on old trunks about an inch thick, dark in colour, and divided into broad rounded scaly ridges. Young branchlets stout, glabrous. Buds ovoid, pointed, about ¼ in. long, pubescent at the tip, with reddish brown glabrous ciliate scales. Leaves (Plate 336, Fig. 36) deciduous in autumn, turning a dull orange or rusty brown before they fall, averaging about 6 in. long and 3 in. broad, obovate or elliptical; usually unequal and cuneate, rarely rounded at the base; apex acute or shortly acuminate; lateral nerves 10 to 13, each ending in a rounded or acute oblique crenate tooth; upper surface dark green, shining, glabrous; lower surface pale, covered with a fine pubescence, disappearing in summer; petiole glabrous, ½ to 1 in. long.

Fruit ripening in the first year, on stout stalks about ¾ in. long, single or in pairs; acorn ovoid-oblong, about an inch long, shining, glabrous, enclosed nearly half its length in a thin hemispherical cup, pubescent within, and roughened or tuberculated externally, especially near the base, by the small appressed greyish pubescent scales, which are thickened in the centre and free at their tips.

This species closely resembles in foliage *Q. Mirbeckii*; but the leaves of the latter species are readily distinguished by the brown fluffy pubescence along the midrib on the lower surface.

The allied species, *Q. Michauxii*, Nuttall, formerly considered to be a variety of *Q. Prinus*, is not in cultivation, but is distinguished in the key, and figured on Plate 336, Fig. 34.

The chestnut oak ranges from southern Maine, the valley of the Genesee in New York, and the Bay of Quinte in Ontario, southwards to north-eastern Maryland, and along the Alleghany Mountains through the western portions of the Carolinas to northern Georgia and Alabama, becoming, however, in these two states small in size and confined to high altitudes, 2000 to 4500 ft. In the north, in Ontario and New England, it is rare and local and of no commercial importance. It is most abundant in the Alleghany Mountains from southern Pennsylvania, through Virginia, West Virginia, and Kentucky to central and eastern Tennessee. The tree is now found mostly on poor land, or on exposed hill-sides and high rocky ridges, where it often forms a quarter or a third of the hardwood forest in such situations, while on lower slopes and on alluvial land it seldom forms more than 5 per cent. It is mainly associated with *Q. velutina*, *Q. alba*, and hickories, and is slow in growth and intolerant of shade; and on this account tends to be excluded from the better soils and low altitudes, where hemlock, maple, and beech predominate.

A good illustration of the trunk and peculiar bark of this tree, taken from the Washington oak at Fishkill on the Hudson river, is given by Sargent,¹ who says that it may be eight or ten centuries old, and was 7 ft. in diameter in 1888.

This was one of the first American oaks introduced. Mentioned by Ray² in 1688, it was first figured and described by Plukenet³ three years later, and is included⁴ amongst the trees for sale in the Catalogue of the Society of Gardeners, published in 1730.

In Loudon's time it was a rare tree, as he only notices plants in Loddiges' nursery and in the Chiswick Garden. It apparently has not been successful in our climate, as the only specimens⁵ which we have seen are small trees at Kew and at Westonbirt.

According to Foster and Ashe,⁶ this species is becoming more valuable as a timber tree than formerly, as the wood is now used as a substitute for white oak. The best qualities are mixed with white oak and sold under that name. The wood is heavy, strong, tough, close-grained, and durable in contact with the soil, but is inclined to check in drying. It is dark brown in colour, with paler sapwood. Slightly softer than white oak, it does not take so high a polish. The medullary rays are not so broad as in the white oak, and when quarter-sawn the silver grain is not so pleasing. In western Virginia half the railway sleepers are now made of chestnut oak, where white oak was once the only wood accepted. In the northern factories it is now being put to uses for which only a few years ago white oak was considered essential, as for furniture, farm implements, tool handles, oil barrels, interior finish, and wagons. The inferior kinds are often marked with black specks, due to the burrowing of a minute larva.

Until about 1900 the great bulk of the chestnut oak was cut for the bark alone, the timber being abandoned in the forest. The bark is richer in tannin than any other of the eastern American oaks, and is still much used in local tanneries, and is also made into tannic acid for export.

(A. H.)

QUERCUS MUEHLENBERGII, YELLOW OAK

Quercus Muehlenbergii, Engelmann, in *Trans. St. Louis Acad.* iii. 391 (1878); Sargent, in *Bot. Gaz.* xlv. 226 (1907).

Quercus Prinus acuminata, Michaux, *Hist. Chênes Am.* No. 5, t. 8 (1801); Loudon, *Arb. et Frut. Brit.* iii. 1875 (1838).

Quercus acuminata, Sargent, in *Garden and Forest*, viii. 93 (1895), *Silva N. Amer.* viii. 55, t. 377, (1895), and *Trees N. Amer.* 273 (1905).

Quercus Castanea, Willdenow, *Neue Schrift. Gesell. Natfr. Berlin*, iii. 396 (1801) (not Née).

A tree, occasionally attaining in America 160 ft. in height and 12 ft. in girth above the broad and often buttressed base. It is mainly distinguished from

¹ In *Garden and Forest*, i. 511, fig. 81 (1888).

² *Historia Plantarum*, ii. 1801 (1688).

³ *Phytographia*, t. 54, f. 3 (1691).

⁴ Cf. Loudon, *Arb. et Frut. Brit.* i. 68 (1838).

⁵ The tree figured under this name in *Gard. Chron.* xiv. 617, fig. 101 (1893), is *Q. Mirbeckii*.

⁶ U.S. Forest Service Circular No. 135 (1908).

Q. Prinus by the narrower leaves (Plate 336, Fig. 35), 4 to 7 in. long and 2 to 3 in. wide, with long narrow or short broad apices; with eight to ten pairs of inflexed teeth, glandular at their tips; upper surface yellowish green, glabrescent; lower surface pale with scattered minute pubescence; petiole $\frac{1}{2}$ to 1 in. long, glabrescent.

Fruit smaller than in *Q. Prinus*; acorn broadly ovoid, $\frac{1}{2}$ to $\frac{3}{4}$ in. long; cupule hemispherical, pubescent within, covered with appressed ovate tomentose scales, the lower ranks thickened, those above with free tips forming a fringe-like margin to the cupule.

This is the most important of the chestnut oaks, being more widely distributed than *Q. Prinus*, extending farther westward to Nebraska, Kansas, Indian Territory, and the Guadalupe mountains, Texas. It is rare and local in the Atlantic States, where it is usually found growing on limestone soils, from the district of Columbia and the valley of the Potomac northwards to Lake Champlain and southern Ontario. It is very abundant west of the Alleghany mountains, attaining an enormous size in the luxuriant forest of the Wabash valley in Indiana and Illinois.

Ridgway says of this tree¹ that it may be recognised at a distance by its thin-scaled very light-coloured bark and tall slender growth, being probably the tallest in proportion to its diameter of any of the white barked species. The tallest, however, that he measured was 130 ft. high by 13 ft. in girth; another 122 ft. high and 84 ft. to the first fork, was only $3\frac{1}{2}$ ft. diameter on the top of the stump. He describes the acorns as very small and sweet, much resembling the nuts of *Castanea pumila* in appearance and taste. The wood is said to be tougher than that of *Q. alba*, and much used by wagon-builders.

This species, though said by Loudon to have been introduced in 1822, is one of the rarest oaks in cultivation in Europe. The only specimens which we know of are two trees, about 8 ft. high, at Aldenham, which were procured, under the name *Q. Esculus*, about eight years ago from a German nursery. The yellow-green leaves, turning scarlet or orange in autumn, are handsome and peculiar, owing to their wrinkled uneven margin, caused by the teeth being turned inwards and upwards.

(A. H.)

QUERCUS PRINOIDES

Quercus prinoides, Willdenow, in *Neue Schrift. Gesell. Natfr. Berlin*, iii. 397 (1801); Sargent, *Silva N. Amer.* viii. 59, t. 378 (1895).

Quercus Prinus humilis, Marshall, *Arbust. Am.* 125 (1785).

Quercus Prinus pumila, Michaux, *Hist. Chênes Am.* No. 5, t. 9, f. 1 (1801); Loudon, *Arb. et Frut. Brit.* iii. 1875 (1838).

Quercus Prinus Chincapin, Michaux f., *Hist. Arb. Am.* ii. 64, t. 10 (1812).

Quercus Chincapin, Pursh, *Fl. Am. Sept.* ii. 634 (1814).

Quercus Muehlenbergii, var. *humilis*, Britton, in *Bull. Torrey Bot. Club*, xiii. 41 (1886).

A shrub, 12 to 15 ft. high. Young branchlets glabrous. Buds ovoid, obtuse, glabrous, $\frac{1}{8}$ in. long. Leaves (Plate 336, Fig. 38) deciduous in autumn, turning

¹ *Proc. U.S. Nat. Mus.*, 1882, p. 82 (in separata).

orange and scarlet before falling, about 4 in. long and 2 in. broad, obovate or ovate, acute at the apex, cuneate at the base; with four to seven pairs of acute or rounded teeth; lateral nerves five to eight pairs; upper surface dark green, with scattered glandular hairs; lower surface pale, with scattered minute pubescence; petiole glabrous, $\frac{1}{4}$ to $\frac{1}{2}$ in. long.

Fruit ripening in the first year, clustered, sessile; acorn edible, ovoid, $\frac{1}{2}$ to $\frac{3}{4}$ in. long, white pubescent and rounded at the apex, enclosed for half its length in a hemispherical cupule, pubescent within, and covered with grey tomentose scales, large and thickened in the lower ranks, thin and forming a fringe-like rim at the upper margin of the cupule.

This is usually a low shrub, spreading by root suckers, and growing on rocky slopes and hill-sides. It is distributed from Massachusetts to North Carolina, extending westward to Nebraska, Kansas, Indian Territory, and eastern Texas, where it is often seen on the low undulating prairies.

It was introduced in 1823, but is very rare in cultivation, the only specimens which we have seen being at Kew and Tortworth, where it does not appear to bear fruit.

(A. H.)

QUERCUS OBTUSATA

Quercus obtusata, Humboldt and Bonpland, *Pl. Æquin.* ii. 26, t. 76 (1813); Loudon, *Arb. et Frut. Brit.* iii. 1942 (1838); De Candolle, *Prod.* xvi. 2, p. 27 (1864); Hemsley, *Biol. Centrali-Amer. Bot.* iii. 175 (1882).

Quercus pandurata, Humboldt and Bonpland, *Pl. Æquin.* ii. 28, t. 77 (1813); Loudon, *Arb. et Frut. Brit.* iii. 1942 (1838).

Quercus ambigua, Humboldt and Bonpland, *Pl. Æquin.* ii. 51, t. 93 (1813) (not Michaux).

Quercus Hartwegi, Benth., *Pl. Hartweg*, 56 (1839).

Quercus affinis, Martens et Galeotti, in *Bull. Acad. Brux.* x. 222 (1843).

Quercus nudinervis, Liebm., in Seemann, *Bot. Herald*, 334 (1852-57), and in *Overs. K. Dansk. Vidensk. Selsb. Forhand.*, 1854, p. 182.

A large tree in Mexico. Young branchlets with quickly deciduous scattered minute hairs. Buds ovoid, $\frac{1}{8}$ in. long, obtuse, with reddish brown glabrous ciliate scales. Leaves (Plate 333, Fig. 4), deciduous late in the season (January to March), coriaceous, averaging 4 in. long and 2 in. broad, obovate or obovate-oblong; narrowed and auricled at the base; usually rounded, rarely acute, at the apex; margin with irregular callous-tipped crenate inflexed teeth, variable in size and number, and often obsolete; lateral nerves, ten to twelve, mostly ending in the margin; upper surface dark green, glabrous; lower surface pale or greyish green, glabrous; petiole $\frac{1}{4}$ to $\frac{1}{2}$ in., stout, glabrous.

Staminate catkins, slender, filiform, $1\frac{1}{2}$ to 2 in. long, covered with white hairs; calyx pilose; anthers six, glabrous. Pistillate flowers two or three, on a slender densely pubescent stalk about $\frac{3}{4}$ in. long.

Fruit, ripening in the first year, solitary or two to three on a slender glabrescent stalk averaging $1\frac{1}{2}$ in. in length; acorn ovoid, $\frac{3}{4}$ in. long, glabrescent, with a pubescent umbo, enclosed for one-third its length in a hemispherical cupule, $\frac{1}{2}$ in. in diameter,

tomentose within, and covered with closely appressed tomentose scales, reddish at their apices, those at the margin of the cupule minute, gradually increasing in size and thickened towards the base.

The above description is taken from specimens in cultivation, which show considerable variation in the shape of the leaves. Herbarium specimens from Mexico show greater variation, and have been grouped by De Candolle into three forms, the type and two varieties, *pandurata* and *Hartwegi*.

This species appears to be widely spread in the mountains of southern Mexico, where it was discovered by Humboldt near Ario, at an elevation of 6000 ft. He describes it as a lofty tree, 3 to 4 ft. in diameter, with very thick deeply cracked bark, and very compact strong wood, susceptible of taking a fine polish. Galeotti found this oak in the woods and savannas of Mirador and Zacuapan at 2500 to 3000 ft. altitude. It was collected by Hartweg at Tuxpan near Anganguio, by Bourgeau near Santa Fé, and by Berlandier between Tula and Tampico. Seemann found it also on the Cerro de Pinal in northern Mexico.

Specimens of this oak, described by Benth. as *Q. Hartwegi*, were sent by Hartweg to the Horticultural Society in 1839; and seedlings probably were raised in the Chiswick Garden, though there is no definite record of its cultivation.

(A. H.)

The finest specimen which we have seen is a tree in the Cambridge Botanic Garden, which is grafted on the common oak. It retains its leaves till March or April, and does not appear to suffer from severe winters. In 1908, a favourable season, it bore well-formed acorns; but in 1909 none of the fruit ripened.

A small tree, about 12 ft. high, at Kew, was obtained from Smith of Worcester in 1873. It has long borne the label *Q. genuensis*; but this appears to be an abbreviation of *Q. rugosa*¹ *genuensis*, the name applied to a tree at Glasnevin, about 16 ft. high, which was obtained from the same firm in 1885.

At Kilmacurragh, Co. Wicklow, there is a good specimen, reported by Capt. Acton to be 36 ft. high and 2 ft. 8 in. in girth. Its history is unknown.

This species is also in cultivation at Westonbirt; where a number of uncommon oaks were planted in Silkwood by the late Mr. Holford, on soil too dry and thin to enable them to develop themselves.

(H. J. E.)

QUERCUS TOZA, PYRENEAN OAK

Quercus Toza, Bosc, in *Journ. Hist. Nat.* ii. 155 (1792); Mathieu, *Flore Forestière*, 359 (1897).

Quercus pyrenaica, Willdenow, *Sp. Pl.* iv. 451 (1805); Loudon, *Arb. et Frut. Brit.* iii. 1842 (1838).

Quercus Tauzin, Persoon, *Syn. Pl.* ii. 571 (1807).

Quercus stolonifera, Lapeyrouse, *Pl. Pyren.* 582 (1813).

A tree, attaining about 70 ft. in height and 10 ft. in girth, but usually smaller; producing root-suckers freely. Bark dark brown, fissured longitudinally. Young branchlets covered with a dense grey tomentum, persistent in part in the second and

¹ *Q. rugosa*, Née, *Ann. Cienc. Nat.* iii. 275 (1801), is a different Mexican species, identified by De Candolle with *Q. crassifolia*, Humboldt and Bonpland.

third year. Buds $\frac{1}{5}$ in. long, pale brown, ovoid, obtuse, pubescent. Leaves (Plate 335, Fig. 28) deciduous in autumn, 4 to 8 in. long, 3 to 4 in. wide, oval or obovate, variable in shape, acute or obtuse at the apex, cuneate or sub-cordate at the base; usually pinnatifid, with five or six pairs of deep, entire or sinuately-toothed lobes, either oblong, rounded at the apex, and with narrow sinuses, or triangular and acute with wide sinuses; upper surface dark green, stellate-pubescent; lower surface grey or whitish, covered with a dense soft tomentum; lateral nerves more numerous than the lobes; margin ciliate; petiole about $\frac{1}{2}$ in. long, tomentose.

Fruit ripening in the first year, two to four on a tomentose, usually erect, rarely pendulous stalk, $\frac{1}{2}$ to 2 in. long; acorn variable in size and shape, cylindrical, ovoid or globose, pubescent at the apex, elsewhere glabrous; cupule hemispheric, $\frac{1}{2}$ to $\frac{3}{4}$ in. in diameter, with tomentose scales, closely appressed, except near the margin of the cup, where they are occasionally slightly spreading at their tips.

Q. Toza varies extremely in the size and shape of the foliage, and in Portugal hybridises occasionally both with *Q. lusitanica*¹ near Coimbra, and with *Q. pedunculata* near Castello Novo, where Padre Tavares showed Elwes trees which he considered to be intermediate between them.

At Angers, where *Q. Toza* is found growing in the hedges with both *Q. pedunculata* and *Q. sessiliflora*, it forms occasional hybrids with these species, which have been described by Abbé Hy.²

A small tree at Tortworth appears to be a hybrid between this species and *Q. pedunculata*. Its leaves are variable in size and shape, usually more deeply lobed than *Q. pedunculata*, of which it has the auricles at the base; less deeply lobed than *Q. Toza*, and greyish tomentose beneath, as in the latter species. It bears fruit freely, intermediate in character between the two species, from which seedlings have been reared at Colesborne, which resemble the parent tree in foliage.

DISTRIBUTION

This oak is a native of south-western France, and of Spain and Portugal. In France it is more or less common in the departments of the Basses-Pyrénées, Gers, Landes, Lot-et-Garonne, Gironde, Dordogne, Charente, and Charente Inférieure; and scattered trees are met with as far north as Angers and Le Mans. Its distribution is thus confined to near the coast and to low altitudes; as it succumbs to the cold winters, which occasionally occur in the interior, a temperature of -4° Fahr. being fatal to it. In the Landes,³ a tenth of these oaks were killed in 1829-30, when the thermometer fell to 5° Fahr. A plantation⁴ of this species at Les Barres, made in 1829-34, was almost entirely destroyed by the severe winter of 1871-72. In France, it is usually a low tree, with a short and crooked stem, doubtless due to the bad soil where it is mainly found, as in favourable situations moderately tall trees with straight stems are met with. It commonly grows unmixed with

¹ Coutinho, in *Bull. Soc. Brotero*, vi. 57 (1886).

² *Q. Trabuti* and *Q. Guerangeri*, Hy, in *Bull. Soc. Bot. France*, xvii. 556, 557 (1895), are names given to supposed crosses with *Q. sessiliflora*. *Q. Rechini*, and *Q. andegavensis*, Hy, *op. cit.* 557, 558, are names applied to the hybrids with *Q. pedunculata*.

³ Dufour, quoted by Mathieu, *op. cit.* 360.

⁴ Pardé, *Arb. Nat. des Barres*, 288 (1906).

other trees on almost pure sand or on sandy clays; but is occasionally seen in mixture with *Q. pedunculata*. It is usually treated as coppice, as it regenerates freely from cut stools and from the roots; but is of little value except for its bark and for firewood. It produces fruit abundantly every year; and the woods in which this species occurs near Bayonne are celebrated for fattening pigs. (A. H.)

This is one of the common trees of the north of Spain and Portugal, extending from the Pyrenees through the Cantabrian mountains to Portugal; and according to Laguna¹ is found more or less in every province of Spain, occurring in the Sierra de Gredos up to 5000 ft., and in the Sierra Nevada to 6000 ft. In Galicia, according to Gadow,² it is abundant from about 1000 to nearly 3000 ft. Barros Gomes³ says that it is with the chestnut, the dominant tree in Beira Trasmontana, on the upper Lezera, the Côa, and the Serra de Montemuro, at an elevation of 200 to 1500 metres. I found it mixed with *Q. pedunculata* in the Serra do Gerez in north Portugal, at about 3000 ft., and abundantly near Castello Novo in Beira Baixa, where it varies very much in the shape and size of its foliage, and was in full leaf by the end of April.

It is known in Galicia as *cerquinho*, and in the Serra do Gerez as *carvalho cerquinho*, meaning little oak. In Portugal it is sometimes called *negral* or *carvalho negro*; near Santander, *roble negro* or *tocio*; and in the mountains of Cuenca, *melejo*. It is rarely allowed to become a large tree, the branches being lopped as fodder for goats and cattle, and it never seems to attain the size of the common and cork oaks, the largest that I saw or heard of, near Castello Novo, which, however, were not old trees, were about 70 ft. by $7\frac{1}{2}$ ft.⁴

It usually bears numbers of large galls, produced by *Cynips Tozae*, Bosc, which are also characteristic of *Q. lusitanica*, and are described and figured, with many other galls, in a valuable paper by Padre Joaquim da Silva Tavares.⁵

CULTIVATION

This species is said by Loudon to have been introduced in 1822, but the tree at Clonmannon is probably older than this date. It never seems to have been popular with nurserymen, and possibly is short-lived.

In England, the best tree appears to be one at Strete Raleigh, which Miss F. Woolward reports to be about 40 ft. high, but with the branches much broken by wind. There is a good specimen at Tortworth, and others at Kew, Syon, Melbury, and Westonbirt.

At Smeaton Hepburn, East Lothian, Sir Archibald Buchan-Hepburn, Bart., reports a tree which, although it has lost 12 ft. of its leader, is 35 ft. high and $4\frac{1}{2}$ ft. in girth. The branches are distinctly pendulous, but have been repeatedly broken by north-westerly gales.

The finest tree that we know of is at Clonmannon, Co. Wicklow, which, when seen by Henry in 1904, measured 66 ft. in height and 9 ft. in girth; but was beginning to be attacked by a fungus, a portion of the butt being unsound (Plate 330). There is no authentic information to be obtained concerning the date of planting

¹ *Flora Forestal Española*, 232 (1883). ² *Northern Spain*, 389 (1897). ³ *Journ. Sc., Acad. Sci., Lisbon*, v. 235 (1876).

⁴ A large tree in the forest of Bussaco is figured in *Bull. Soc. Dend. France*, 1905, p. 5.

⁵ *Broterid*, vi. t. vi. fig. 6 (Lisbon, 1905).

of this remarkable tree. A tree, 40 ft. by 2½ ft., in the same year, is thriving at Kilmacurragh in the same county. (H. J. E.)

QUERCUS CONFERTA, HUNGARIAN OAK

Quercus conferta, Kitaibel, in Schultes, *Östr. Fl.* i. 619 (1814); Masters, in *Gard. Chron.* v. 85, fig. 18 (1876).

Quercus farnetto, Tenore, *Cat. Pl. Hort. Neap.* 65 (1819).

Quercus apennina, Loiseleur, in *Nouv. Duham.* vii. 177 (1819) (not Lamarck).

Quercus hungarica, Hubeny, in *Gemein. Blätt. Ofn. u. Pesth. Zeitschr.* xx. 2, p. 754 (1830); Willkomm, *Forstliche Flora*, 412 (1887); Hempel u. Wilhelm, *Bäume und Sträucher*, ii. 71, t. 24 (1889); Beck, *Vegetationsverhält. illyrisch. Länd.* 210 (1901).

Quercus pannonica, Booth, *ex Gordon*, in Loudon, *Gard. Mag.* xvi. 637 (1840).

A tree, attaining 100 ft. in height and 12 ft. in girth. Bark less deeply fissured than that of *Q. sessiliflora*, broken on the surface into small square scaly plates. Young branchlets with scattered hairs. Buds (Plate 78, Fig. 5) ovoid, obtuse, ½ in. long, with pubescent ciliate scales. Leaves (Plate 335, Fig. 26) deciduous¹ in autumn, about 6 in. long and 4 in. broad, obovate, rounded at the apex, usually subcordate at the base, with six to eight pairs of oblong, entire or sinuately-toothed lobes, with sinuses extending about half way to the midrib; margin ciliate; upper surface dull green, with a quickly deciduous scattered minute pubescence; lower surface greyish or pale green, covered with a thin stellate tomentum; petiole ¼ to ½ in. long, pubescent.

Fruit ripening in the first year, three or four clustered on a short stout pubescent peduncle; acorn ½ to ¾ in. long, rounded at the apex; cupule hemispherical, ½ to ¾ in. broad, with tomentose loosely appressed scales.

This species is closely allied to *Q. Toza*; but has thinner, not so densely tomentose leaves, and almost glabrous branchlets. It is reported² to hybridize with *Q. sessiliflora*, *Q. pedunculata*, and *Q. lanuginosa*.

DISTRIBUTION

This oak is a native of south-eastern Europe, attaining its northern limit in the southern provinces of the Hungarian kingdom, where it is widely spread through Slavonia, Banat, and the adjoining districts to Transylvania. It extends southwards through the Balkan States, Bulgaria, and northern Greece; and is also found in southern Italy.

In Italy, according to Borzi,³ *Q. conferta* is not found north of lat. 42°, but is common, either pure in small woods, or mixed with *Q. sessiliflora* and *Q. Cerris*, in the hills of southern Latium, in the Terra di Lavoro, and in the southern part of the Abruzzi as far as the slopes of Mt. Gargano. Farther south it gradually becomes rare and sporadic, and is not seen in the extreme south of Calabria. Its occurrence in Sicily is doubtful, as it has not been found recently by Lojacano in the locality near Taormina, where specimens were gathered by Di Leo and sent to Borzi in 1884.

¹ M'Nab exhibited a branch of a tree, growing at Edinburgh, which retained its leaves fresh and green in January. This was probably a young tree. Cf. *Gard. Chron.* v. 113 (1876).

² Schneider, *Laubholzkunde*, i. 194 (1904).

³ *Fl. Forestal Ital.* 167 (1880), and in *Boll. R. Orto. Bot. Palermo*, iv. 48 (1905).

In southern Hungary and Servia, it is one of the constituents of the oak forests, found on the hilly land and the lower slopes of the mountains, its companions being *Q. sessiliflora* and *Q. Cerris*; and is not met with in the great oak forests of the alluvial plains, where *Q. pedunculata* is the sole species. It usually grows on dry slopes with a sunny aspect, for which it is well adapted by its pubescent leaves. These check evaporation of water; and on hot days in summer in the Drina valley, I observed the leaves on the upper part of the tree, exposed to the sun, turning their greyish under surfaces to the east in the morning and to the west in the afternoon. It occupies drier situations than *Q. sessiliflora*; but does not ascend on the hot exposed ridges, with shallower soil, to as great an altitude as *Q. Cerris*, which often forms pure forests at 3000 ft. elevation.

Q. conferta becomes less common west of the Drina valley, and is only met with in Bosnia in the mountains south of the Save, east of Brčka, and in the valleys of the Drina and Lim rivers.

In Herzegovina, *Q. conferta* occurs in a few localities in the Narenta valley, the most important being the large forest of Dobrava, south of Mostar and west of Stolac, which is composed of a mixture of this species with *Q. Cerris* and *Q. macedonica*. Similar woods are met with in Montenegro and in Albania.

In Roumania, according to Huffel,¹ it occasionally forms pure woods; but is more commonly mixed with *Q. Cerris*; and in rare cases grows on moist clay soil with *Q. pedunculata*.

The largest tree,² which I measured in an oak forest in the Drina valley at about 1000 ft. elevation, was 85 ft. high and 12 ft. in girth; and here it seemed to be outgrown by the Turkey oaks standing beside it, which attained about 100 ft. by 10 ft.; but I was informed that in many places it grew to a larger size, equalling *Q. sessiliflora* in height and girth.

Q. sessiliflora and *Q. conferta*, growing in the hills in Servia, produce timber which is practically indistinguishable and is exported under the same name. In Slavonia, this hill oak timber is sold, for similar sizes, at about two-thirds the price of the wood of *Q. pedunculata*. The latter, grown in the forests of the alluvial plain of the Save, in moist ground, exposed to floods, is claimed locally to be the best oak in the world; and sells in the forest, close to the railway, when of the best quality and over 3½ ft. in diameter, at about a shilling per cubic foot.

Huffel, speaking of the wood of *Q. conferta* in Roumania, says that it has the peculiar property of breaking transversely, when force is applied, as neatly as if cut with a saw; and that, on this account, it is unsuitable for building purposes; but he adds that it rends well, is beautifully figured, and not liable to crack or warp in drying. (A. H.)

CULTIVATION

Q. conferta was introduced into England shortly before 1838, as Loudon³ mentions, as a possible variety of *Q. Toza*, an oak, in the Horticultural Society's

¹ *Les Forêts de la Roumanie*, 4 (1900).

² A tree cut down in this forest, ninety-five years old, showed on a radius of 14 in., 11 in. of heartwood with 85 annual rings, and 3 in. of sapwood with 10 rings.

³ *Arb. et Frut. Brit.* iii. 1844 (1838).

Garden at Chiswick, which had been received from Pesth, under the name *Q. conferta*; and Gordon,¹ in a list of the plants cultivated at Chiswick in 1839, enumerates *Q. pannonica*, which had been obtained from Booth of Hamburg. Grafted plants² were sold soon afterwards in considerable quantity by Lawson of Edinburgh. The species is, however, quite rare in England, though it seems to grow well where it has been planted in the southern and midland counties.

The largest we know is at Orton Hall, which in 1905 measured 68 ft. by 8½ ft., and is apparently grafted on the common oak (Plate 331). At Beauport there is a fine tree 67 ft. by 7 ft. 3 in. in 1909. At Westonbirt a well-grown tree in the arboretum measured 53 ft. by 5 ft. in 1909. At Kew³ a fine young tree is about 45 ft. by 6 ft. At Tortworth a well-shaped and thriving specimen was 41 ft. by 3 ft. in 1904. At Osterley Park, there are two healthy young trees about 35 ft. high. Smaller ones are growing at Bicton, Grayswood near Haslemere, Liphook, Sawbridgeworth, and Aldenham.

In the Edinburgh Botanic Garden, a tree,⁴ planted in its present position by Sir W. Gibson Craig in 1866, measured in 1905, 39 ft. by 5 ft.; and another, planted by Dr. Masters in 1875, measured in 1905, 30 ft. by 3½ ft. (H. J. E.)

QUERCUS MIRBECKII, ALGERIAN OAK

Quercus Mirbeckii, Durieu, in Duchartre, *Rev. Bot.* ii. 426 (1847); Mathieu, *Flore Forestière*, 362 (1897).

Quercus lusitanica, Webb, sub-species *baltica*, De Candolle, *Prod.* xvi. 2, p. 19 (1864).

Quercus Prinus, Masters, in *Gard. Chron.* xiv. 617, fig. 101 (1893) (not Linnaeus).

A tree, attaining in Algeria 120 ft. in height and 20 ft. in girth. Bark thick, hard, dark coloured, and deeply fissured into narrow scaly plates. Young branchlets glabrous, or with a few scattered hairs. Buds (Plate 78, Fig. 6) ovoid, angled, pointed, about ¼ in. long; scales pubescent, ciliate. Leaves (Plate 337, Fig. 44) deciduous in January, February, and March, variable in size and shape, the wider obovate leaves averaging 4 in. long and 3 in. broad, the narrower oval leaves nearly as long, and about 2 in. wide; acute at the apex; truncate, rounded, or auricled at the base; with nine to fourteen pairs of lateral nerves, each, except the lowest one or two pairs, ending in a rounded or acute tooth or short lobe; upper surface dark green, glabrous, except for slight pubescence at the base of the midrib; lower surface paler or slightly glaucous, glabrous, except for a brown flocculent tomentum along the midrib, especially at its base; petiole, ½ to ¾ in. long, brown tomentose in part.

Fruit ripening in the first year, clustered, sessile; cupule nearly hemispheric, ¾ in. wide, with appressed tomentose scales, those at the base oval, thickened, and

¹ In Loudon, *Gard. Mag.* xvi. 637 (1840).

² Cf. Masters, in *Gard. Chron.* v. 85 (1876).

³ This tree is mentioned under the name *Q. sessiliflora pannonica*, by Hemsley, in *Gard. Chron.* iv. 455 (1875).

⁴ This tree was 20 ft. high in 1876, and was one of Lawson's original plants, which had been for some time in the garden in an unsuitable site. Cf. *Gard. Chron.* v. 86 (1876).

larger than the narrow triangular scales towards the thin margin; acorn ovoid, about an inch long, glabrous.

This species in Algeria varies¹ considerably in the size and shape of the leaves, the largest and most obovate forms occurring in the rainy districts near the coast; while small and narrow leaves are characteristic of the trees growing in the dry mountains of the interior, as in the cedar forest of Teniet-el-Hâad, where the specimens which I collected are scarcely half the size of those of the coast forest of Akfadou. In the driest regions of the western part of Algeria, where the soil is limestone, the leaves are not only small, but are covered beneath with a thin tomentum, constituting var. *tlemcensis*, Warion.²

Q. Mirbeckii also occasionally forms hybrids with *Q. Suber*, a tree of this kind with corky bark found in the forest of Tlemcen being *Q. Pseudosuber*, Desfontaines, *Fl. Atlant.* ii. 348 (1800) (not Santi). A similar tree has lately been found in the same forest by M. Trabut.

DISTRIBUTION

This species is a native of southern Portugal (where it seems to be rare,³ and confined to the province of Algarve), Morocco, Algeria, and Tunis. Little is known of its distribution in Morocco, where it was collected in the mountains near Tangier by Ball in 1862; while in Tunis it appears to be limited to and not abundant in the Khroumir mountains. In western Algeria and throughout the Atlas range, owing probably to the insufficient rainfall, *Q. Mirbeckii* grows only in a few localities, on the northern slopes of the mountains, as in the forest of Hafir, near Tlemcen, at Nesmoth, around Ténès, at Teniet-el-Hâad, Matmata, and Blida. At Teniet-el-Hâad it grows in company with the cedar, from 4700 ft. to the summit at 5900 ft., and forms wide-spreading branching trees often 12 ft. in girth. This oak is much more abundant and of considerable commercial importance in the extensive broad-leaved forests, which are situated in the mountains near the coast, in eastern Kabylia and in the province of Constantine, where the rainfall is heavy. The forest of Akfadou, near Bongie, which I visited in January 1907, is mainly composed of oaks, with a slight admixture of maples, willows, cherry, and holly. In the lower zone, between 1500 and 3000 ft., *Q. Suber* predominates, with a few scattered small trees of *Q. Mirbeckii*; above 3000 ft. the latter becomes the main species, and increases in size, the cork oak ceasing at about 3700 ft., and being replaced by *Q. castaneaefolia*. Above this level to the summit, about 5000 ft., the forest is an equal mixture of the latter species and *Q. Mirbeckii* (Plate 323). In this forest the largest *Q. Mirbeckii* is reported to be 17 ft. in girth; but I saw none exceeding 13 ft., and the tallest tree which I measured was 90 ft. by 8 ft. 4 in. M. Trabut informed me that the finest forest of this species, nearly pure, is at Ain-ma-beurd, near Djidjelli, where the trees rival in height and in density upon the ground those of *Q. sessiliflora* in the famous forest⁴ of Bercé, in France. The total annual yield of

¹ Cf. Trabut, in *Rev. Gén. de Bot.* iv. 1-6, figs. 1-3 (1892).

² Ex Battandier et Trabut, *Fl. Algér.* 821 (1890).

³ The only specimen which I have seen from Portugal, is one collected by Welwitsch, on the Serra da Picota in Algarve. This specimen is in the Kew herbarium.

⁴ Cf. vol. ii. p. 331.

timber of *Q. Mirbeckii* in the forests of eastern Algeria is said to be about 3,500,000 cubic feet.

The wood is very dense and heavy, sinking in water when green, and in the dry state having a specific gravity of 0.924. It is easy to rend, but is very liable to warp and split when drying. In structure it differs from the wood of the common oak in having smaller and fewer large pores in the zone formed in spring, these being represented by one, or at most two, rows, the greater part of the annual ring, that formed in autumn, being composed of fibrous tissue. The timber is valuable for building purposes, and for other uses similar to those of the common oak, but up to the present it has been mainly used in Algeria for railway sleepers.

(A. H.)

CULTIVATION

This species was introduced¹ about 1844 or 1845, when King Louis Philippe sent acorns, which had been procured in Algeria, to Queen Victoria, who distributed them amongst the ladies of the court. *Q. Mirbeckii* has handsome foliage, which is subevergreen, and thrives well in the warmer parts of England; and, though we have found no trees in Wales, Scotland, or Ireland, no doubt it would succeed there in many localities.

The largest tree we know of is at Bicton, where in 1902 I measured one 75 ft. high and 12 ft. 9 in. in girth, with a spreading crown 30 paces in diameter. At Tregothnan Mr. A. B. Jackson measured a tree about 60 ft. high and 6½ ft. in girth in 1908.

At Ham Manor, near Worthing, there are two fine trees, the largest of which in 1907 was 70 ft. by 8 ft. 3 in.; the other, close to it, was about 60 ft. by 7 ft.

On a lawn at Hursley Park, Winchester, there is a well-shaped specimen which in 1906 measured 62 ft. by 7½ ft. (Plate 332). I am informed by Colonel Heathcote that it is known as "The Speaker's Oak," because the late Lord Eversley, who was Speaker of the House of Commons from 1837 to 1857, and an intimate friend of the late Sir William Heathcote, then of Hursley, jumped over the tree when it was planted.

At Syon there is a tree 53 ft. by 5 ft. 3 in. in 1904, when it ripened a large number of acorns. Some of these which were sown at Colesborne have grown well, and carry their leaves until spring. An older tree, purchased under the name of *Q. afghanistanica*, has proved quite hardy at the same place, though planted in a situation very subject to spring frost, on a cold clay soil.

At Albury there is a small tree 24 ft. high, forking near the ground into two stems, each 2½ ft. in girth, which was figured in the *Gardeners' Chronicle*, xiv. 617 (1893) as *Q. Prinus*. At Melbury there is a tree about 40 ft. by 4 ft. in 1909. In the Victoria Park, Bath, another is about 50 ft. At Blenheim, Westonbirt, Tortworth, Howick in Northumberland, and in the Cambridge Botanic Garden there are trees of smaller size.

At Tockington Manor, Gloucestershire, Capt. H. Pomeroy Salmon has two trees

¹ See correspondence at Kew with Mr. J. W. Ford, of Enfield Old Park, Winchmore Hill, who gives an account of the origin of an old tree of this species which was cut down near Enfield in 1900.

24 ft. and 17 ft. high, which he raised from acorns collected in the Atlas mountains, where the Kabyles grind the acorns and mix the flour with barley meal to make cakes. He adds that the native name is *Abelude n'zān*, which has been corrupted by French authors into *zēn*. (H. J. E.)

QUERCUS PONTICA

Quercus pontica, Koch, in *Linnaea*, xxii. 319 (1849); De Candolle, *Prod.* xvi. 2, p. 49 (1864); Dieck, in *Gartenflora*, xl. 509, fig. 95 (1891); Albow, *Prod. Fl. Colch.* 219 (1895); Schneider, *Laubholzkunde*, i. 192, fig. 102 (1904).

A shrub, attaining 10 to 13 ft. in height. Young branchlets stout, glabrous. Leaves (Plate 339, Fig. 70) deciduous, elliptic, about 6 in. long and 3 in. broad, often larger on young plants, coriaceous, cuspidate or shortly acuminate at the apex, rounded at the base; with 15 to 20 pairs of parallel lateral nerves, prominent beneath, each ending in a large triangular incurved cartilaginous-tipped serration; upper surface dark shining green, glabrous; lower surface glaucous, glabrous except for a few scattered long hairs on the midrib and lateral nerves; petiole stout, swollen at the base, ¼ to ½ in. long, glabrescent.

Fruit not seen. Its affinities are probably with *Q. Mirbeckii*.

This species is readily distinguished by its remarkable buds, which are stout, ovoid, pointed, about ½ in. long; scales glabrous, green, with a brown ciliated margin.

This species was discovered by Koch in north-eastern Asia Minor, in the mountains of Lazistan, near the source of the river Asperos, where, in company with alder and beech, it forms a shrubby vegetation above the conifer region, from 5000 to 7000 ft. elevation.

It is also widely spread in the mountains of Caucasia, which border on the eastern shore of the Black Sea, where it has been found in numerous stations, in Abkhasia, Mingrelia, Imeritia, Adshuria, and Guria. It grows mainly in the subalpine zone of the forests, between 4000 and 7000 ft., often forming with hazel and birch the timber line. Alboff¹ describes it as a shrub 10 to 13 ft. in height, with very variable foliage as regards size and shape,—large broad leaves, 5 to 13 in. long and 2½ to 5 in. wide being characteristic of warm humid districts near the sea; while smaller narrow leaves are the prevalent form in the mountains near the central chain of the Caucasus.

It was seen by Dieck in 1890, who was unable to procure acorns, but brought back cuttings. It was first introduced into England by Lord Kesteven, who collected acorns in September 1905 in the mountains inland from Sukhum-Kaleh, a port on the Black Sea about 100 miles north of Batum. He raised three seedlings, which retained their foliage in March 1910, when they were about 12 to 18 in. high and very thriving. Schneider states that he has only found it in cultivation in the forest garden at Münden in Hanover; but Elwes has recently obtained living plants from the nursery of O. Poscharsky at Laubegast, near Dresden. (A. H.)

¹ In *Bull. Herb. Boissier*, i. 259 (1893). Cf. also Radde, *Pflanzenverb. Kaukasus*, 182, 188 (1899).

QUERCUS MACRANTHERA

Quercus macranthera, Fischer et Meyer, in *Bull. Soc. Nat. Mosc.* x. 260 (1838); De Candolle, *Prod.* xvi. 2, p. 13 (1864); Boissier, *Flora Orientalis*, iv. 1165 (1879); Schneider, *Laubholzkunde*, i. 192 (1904).

A tree, about 60 ft. in height. Young branchlets stout, covered with dense brown pubescence, retained in the second year. Buds pubescent, with persistent pubescent filiform stipules. Leaves (Plate 337, Fig. 42) deciduous in autumn, 4 to 5 in. long, 2 to 3 in. broad, obovate, acute at the apex, unequal and rounded or cuneate at the base, margin ciliate; with seven to eleven pairs of lateral nerves, each ending in a rounded, short, usually entire, rarely toothed lobe; upper surface dark green, with minute scattered brown hairs; lower surface pale, covered with dense tomentum; petiole $\frac{1}{4}$ to $\frac{1}{2}$ in., densely pubescent.

Fruits ripening in the first year, sessile or sub-sessile, crowded at the apex of the branchlet; acorns cylindrical-ovoid, nearly an inch long, glabrous, surrounded at the base by a hemispherical cupule, about $\frac{1}{2}$ in. in diameter, covered with loosely appressed pubescent scales, ovate in the basal ranks, and lanceolate towards the margin of the cupule.

This species, which is closely allied to *Q. Toza* and *Q. conferta*, is a native of the mountains of northern Persia and of the Caucasus, between 4000 and 7500 ft. altitude, where it often grows in subalpine meadows near the timber line. It has also been collected in Karabagh and in Armenia. According to Radde,¹ who gives a photograph of a large tree growing amidst tall grass, it attains a great age and considerable size, one tree being recorded as 425 years old, 2 $\frac{1}{2}$ ft. in diameter, and with 180 cubic ft. in the stem, exclusive of branches.

Q. macranthera, which is a very ornamental species, was introduced some time before 1873, as Koch² in that year mentions small trees in north-eastern Germany, which were perfectly hardy. Mayr³ says that it grows fast at Grafrath, near Munich. A tree in Kew Gardens, obtained from Späth in 1895, is about 20 ft. high, and has borne acorns during the last three years. There are also specimens at Westonbirt and Aldenham.

(A. H.)

QUERCUS LUSITANICA, PORTUGUESE OAK

Quercus lusitanica, Lamarck, *Encyc.* i. 719 (1783); Webb, *It. Hisp.* 11 (1838); Boissier, *Voy. Bot. Espagne*, ii. 575 (1839-45); Hooker, *It. Plant.* vi. t. 562 (1843); Coutinho, in *Bull. Soc. Brot.* vi. 66 (1888).

Quercus australis, Link, ex Loudon, *Arb. et Frut. Brit.* iii. 1925 (1838).

A tree, attaining 60 ft. in height and 10 ft. in girth. Bark thick, divided into small quadrangular scaly plates. Young branchlets tomentose. Buds ovoid, acute,

¹ *Pflanzenverb. Kaukas.* 204, 226 (1899).² *Dendrologie*, ii. 2, p. 44 (1873).³ *Fremdländ. Wald- u. Parkbäume*, 502 (1906).

$\frac{1}{6}$ to $\frac{1}{4}$ in. long, with ciliate scales. Leaves falling late in the season, coriaceous, variable in shape often on the same branch, averaging 3 in. long, 1 $\frac{1}{4}$ in. broad, obovate-oblong, usually rounded at the apex, unequal and cuneate or rounded at the base; lateral nerves seven to nine pairs; margin wrinkled, revolute, with irregular, mucronate, inflexed teeth; upper surface dark green, shining, glabrescent, except on the midrib, which remains pubescent; lower surface covered with a dense greyish tomentum; petiole tomentose, $\frac{3}{8}$ in. long.

Fruit ripening in the first year, two or three together on a tomentose peduncle; acorn ellipsoid, $\frac{3}{4}$ in. long, glabrous, enclosed to a variable height in a hemispherical or urceolate cup, narrowed at the orifice, and covered with appressed tomentose scales.

No species of oak is so variable as *Q. lusitanica*; and after examination of the abundant Spanish and Portuguese material in herbaria, and of the specimens collected by Elwes at Cintra in Portugal, and a fine series of variations obtained by him from Padre Tavares, I am unable to group the numerous forms into distinct varieties. Coutinho, in his valuable paper on the oaks of Portugal, states that the different forms of leaves graduate into each other, and are sometimes found on the same tree, and even on the same branch. The variations are mainly in the size, shape, and texture of the leaves, which have regular or irregular teeth, with or without a mucro at their apex. The dense grey tomentum on the under surface of the leaf and on the branchlets are constant characters, and serve to distinguish this species from the closely allied *Q. lanuginosa*, which has always deep and rounded lobes, not present in *Q. lusitanica*. The variation in some instances is due to the influence of soil, climate, and altitude; but in other cases is perhaps dependent on hybridisation with the other species of oak in the same region.

The principal forms are as follows:—

1. Var. *Broteri*, Coutinho. This is perhaps the typical form, and is described above, from specimens gathered from large trees near Cintra by Elwes. This usually is a large tree, making summer shoots, and characterised by large leaves, with rather irregular teeth.

2. Var. *faginea*, Boissier, *Voy. Bot. Espagne*, ii. 575 (1839-45).

Quercus faginea, Lamarck, *Encyc.* i. 725 (1783).

Quercus valentina, Cavanilles, *It. Fl. Hisp.* ii. 25, t. 129 (1793).

Usually a shrub. Leaves thin in texture, obovate or oblong, 1 $\frac{1}{2}$ to 2 in. long, $\frac{3}{4}$ to 1 $\frac{1}{4}$ in. wide, regularly toothed, with sharp mucros.

A common form, often a tree, is intermediate between var. *faginea* and var. *Broteri*, the leaves (Plate 335, Fig. 25) being small like the former, coriaceous like the latter; and the teeth, though regular, are without mucros.

3. Var. *alpestris*, Coutinho.

Quercus alpestris, Boissier, *Elenchus*, 83 (1838), and *Voy. Bot. Espagne*, ii. 576, pl. 164 (1839-45).

Leaves coriaceous, oblong, 2 to 3 in. long, nearly entire, the mucronate teeth being few, irregular, and inconspicuous. This occurs at high altitudes, and is oftener a shrub than a tree.

4. Var. *humilis*.

Quercus humilis, Lamarck, *Encyc.* i. 719 (1783) (not Miller); Webb, *It. Hisp.* 11 (1838); Masters, in *Gard. Chron.*, 1874, p. 112, f. 31.
Quercus fruticosa, Brotero, *Fl. Lusit.* ii. 31 (1804).

A low shrub, found in poor sandy soil. Leaves late in falling, 1 to 1½ in. long, obovate-elliptic, irregularly and acutely mucronate-toothed; petiole very short, about ⅛ in. long. According to Webb, this covers arid tracts in central and southern Portugal, and finds its most easterly station near Gibraltar.

5. At Tortworth there is a grafted tree, about 40 ft. high, which was procured from the Elvaston Nursery about forty-five years ago, under the name *Q. serratifolia*.¹ This has narrow leaves, with triangular mucronate teeth, a cuneate base and a long petiole, and is one of the forms assignable to var. *Broteri*. It bears fruit freely, from which seedlings have been frequently raised, said to resemble the parent in foliage. One of these seedlings, planted at Kew, has large obovate-oblong leaves, green and glabrous beneath, auricled at the base, and with a short petiole; and is intermediate between *Q. lusitanica* and *Q. pedunculata*. Its parent was probably pollinated by an adjoining common oak. (A. H.)

DISTRIBUTION

Q. lusitanica is a native of Spain and Portugal, being replaced in the Levant by the closely-allied species, *Q. infectoria*. The range of this species in Spain is very wide. According to Laguna and Avila it is found in all the provinces except Galicia, Asturias, and Biscay, but is commonest in Estremadura and Andalusia.

Captain Widdrington seems to have been the first to call special attention to it,² and says that it was a leading feature in the ancient forests of Spain. He found it from the southern part of Andalusia to the centre of Leon, almost to the watershed of Asturias, and from the western Sierra Morena to near Guadalaxara. He notices its extreme variability, and calls it a very beautiful deciduous tree, with shining green leaves varying from 1 to 4 in. in length, and proposed for it the name of *Q. Quexigo*. Laguna and Avila spell this—the common Spanish name—Quejigo.

In Spain it is usually so much cut for firewood that it is rarely seen as a large tree, but in Portugal it attains a great size; and in a paper by Gebhart, in the *Revue des Eaux et Forêts*, I find one recorded in the forest of Casal do Prado, which was 5.40 metres in girth, and with a crown 26 metres in diameter, which produced 840 litres of acorns in one year.

I saw this oak growing abundantly in central Portugal, especially in the Serra of Cintra. It is a medium-sized or large tree, usually attaining 50 to 60 ft. in height, and 8 to 10 ft. in girth; and in this mild and comparatively damp climate seems to be subevergreen, a few leaves remaining on most of the trees in the beginning of April. Its habit is spreading and branchy, very similar to that of the cork oak. The bark is more like that of *Q. Ilex* than that of *Q. pedunculata*, and never becomes corky.

¹ According to Koch, *Dendrologie*, ii. 2, p. 78 (1873), an oak with this name was introduced from Spain by Booth of Flottbeck, near Hamburg.

² *Spain and the Spaniards*, i. 385 (1844).

Coutinho describes and figures the leaves of supposed hybrids between this species and *Q. pedunculata* and *Q. Toza*, found near Coimbra and in other localities in Portugal.

CULTIVATION

This tree, which is very rare in cultivation, was introduced in 1835, when plants were raised in the Horticultural Society's garden at Chiswick, from acorns gathered in the neighbourhood of Gibraltar. These seedlings were named *Q. australis*, Link, and in their juvenile stage, according to Loudon's figure, closely resembled specimens gathered at Cintra in their foliage. A tree on the lawn near the gate of the Director's Office, Kew, grafted at about 3 ft., which measures about 35 ft. in height and 5 ft. 9 in. in girth, and ripened acorns in 1909, bears smaller leaves, somewhat intermediate between var. *Broteri* and var. *faginea*. At Lyndon Hall, Rutland, a low tree, about 6 ft. in girth, which recently died, bore similar foliage. Another tree at Kew, in the oak collection, near the bank of the Thames, about 30 ft. in height, and wide-branching from near the base, has much larger leaves, almost glabrescent in autumn, and is probably one of the forms of var. *Broteri*. (H. J. E.)

QUERCUS INFECTORIA

Quercus infectoria, Olivier, *Voy. Emp. Othm.* i. 252, tt. 14, 15 (1801); Loudon, *Arb. et Frut. Brit.* iii. 1928 (1838); J. D. Hooker, in *Trans. Linn. Soc.* xxiii. 383 (1861).
Quercus lusitanica, sub-species *orientalis*, De Candolle, *Prod.* xvi. 2, p. 18 (1864).
Quercus lusitanica, Boissier, *Fl. Orient.* iv. 1166 (1879) (not Lamarck).

This species, which is the representative of *Q. lusitanica* in the Levant, includes a great number of forms, presenting the same range of variation in the foliage as the Peninsular species; and differs¹ mainly from it in being less pubescent on the branchlets and leaves. The typical form is a shrub or small tree, with very scaly bark. Young branchlets tomentose or glabrescent. Leaves coriaceous, deciduous late in the season, ovate, oblong, or obovate-oblong, about 2 in. long and 1 in. broad; rounded or occasionally acute at the apex; unequal at the base; margin wrinkled, with about six pairs of sinuate teeth, with or without mucros; upper surface light green, shining, glabrous; lower surface pale green, with scattered stellate hairs, glabrescent towards the end of the season; petiole ½ in. long, glabrescent. Fruit similar to that of *Q. lusitanica*.

1. Var. *Boissieri*, De Candolle, *loc. cit.*

Quercus Boissieri, Reuter, in Boissier, *Diag. Ser.* i. 12, p. 119 (1842).

Leaves oblong, or obovate-oblong, larger than in the type, up to 3 or 4 in. long, with more numerous acute mucronate teeth.

2. Var. *petiolaris*, De Candolle, *loc. cit.* Leaves oblong, almost entire, or with

¹ Some specimens from Asia Minor have leaves tomentose beneath, and are indistinguishable from *Q. lusitanica*.

a few inconspicuous irregular teeth. This includes some remarkable forms, which are possibly distinct species.¹

Q. infectoria is widely spread throughout Syria, Asia Minor, Armenia, and Kurdistan; and occurs also in Turkey near Constantinople, and in Cyprus; but appears to be unknown in Greece.²

Sir Joseph Hooker saw it in great abundance on the east slopes of Lebanon, on the rocky hills of Galilee south of Safed, and on the summit of Carmel. It occurred as a small tree 15 to 20 ft. high, or more often, as a bush sparingly branched, with a rather slender rugged trunk, and grey deciduous foliage, white on the under surface, and was rendered very conspicuous by the abundance of spherical galls of a deep red brown colour and shining viscid surface.³ He also speaks of another gall, of smaller size, paler colour, and softer texture with several angular protuberances, found sparingly in Syria and, as he believed, also on this species. Neither of these galls is collected in Syria. The larger and commoner is probably not different from the Aleppo gall, though it may be inferior in quality. Hooker adds that the acorns are of a singularly elegant form and of a bright amber colour.

The galls of this species, known as Aleppo galls, of which a full account is given by Flückiger and Hanbury,⁴ are exported from Smyrna and Trebizond; and are used in medicine, for dyeing and tanning, for making tannic and gallic acids, and in the preparation of ink.

We are indebted to Consul H. Shipley of Erzeroum for some drawings of oak leaves and specimens of galls from Kurdistan, which in the absence of acorns cannot be certainly identified, but which, in Dr. Stapf's opinion, belong in part to *Q. pedunculata*. The galls, however, are extremely similar to those commonly found on *Q. lusitanica* in Portugal.

Loudon says that although, according to the catalogues, this tree was introduced into England in 1822, he had never seen a specimen. Apparently⁵ it was first cultivated in the Chiswick Garden in 1850, when seedlings were raised from acorns sent by Sir A. H. Layard from Kurdistan, where he had found the tree abundant, especially near Bitlis, which was the emporium for galls. Sir J. Hooker⁶ also brought home from Syria, in 1860, acorns in damp earth, from which plants were raised at Kew.

The only specimens that we have seen are at Kew, where a tree of the typical form, about 23 ft. by 2 ft. 3 in. in 1909, is probably one of Hooker's seedlings. Trees of similar size, belonging to var. *Boissieri*, were obtained in 1870 and 1873 from Booth of Hamburg. (A. H.)

¹ Cf. Schneider, *Laubholzkunde*, i. 191, fig. 120 (1904), who describes and figures, as *Q. veneris*, Kerner, an oak in the Botanic Garden at Vienna, which was raised from an acorn sent by Kotschy from Cyprus. This is identical with *Q. Pfaeffingeri*, var. *cypria*, Kotschy, in Unger and Kotschy, *Die Insel Cypern*, 492 (1865), who state that it once formed extensive woods of fine trees, of which only a few scattered individuals now remain.

² It is not mentioned as one of the oaks of Greece, by Halacsy, *Comp. Fl. Græcæ*, iii. 125 (1904).

³ Figured by Lambert, in *Trans. Linn. Soc.* xvii, t. 22 (1837).

⁴ *Journ. Hort. Soc. Lond.* viii. 132 (1853).

⁵ *Pharmacographia*, 595 (1879).

⁶ *Trans. Linn. Soc.* xxiii. 383 (1861).

QUERCUS GLANDULIFERA

Quercus glandulifera, Blume, in *Mus. Bot. Lugd. Bat.* i. 295 (1850); Skan, in *Journ. Linn. Soc. (Bot.)*, xxvi. 514 (1899); Shirasawa, *Icon. Ess. Forest. Japon*, text 50, t. 26, figs. 13-24 (1900).

A small tree, rarely attaining 50 ft. in height. Young branchlets slender, covered with quickly deciduous appressed pubescence. Buds ovoid, $\frac{1}{8}$ in. long, with ciliate glabrous scales. Leaves (Plate 335, Fig. 27) deciduous in autumn, 3 to 5 in. long, 1 to 2 in. broad, membranous, obovate or elliptical, acuminate at the apex, usually cuneate at the base; with eight to eleven pairs of lateral nerves, all but the lowest pair ending in a serration, tipped with a short glandular cartilaginous mucro; upper surface dark green, shining, with deciduous appressed silky pubescence; lower surface pale green, with similar but persistent pubescence; petiole $\frac{1}{4}$ to $\frac{1}{2}$ in. long, appressed, pubescent.

Fruit, ripening in the first year, solitary or clustered, on a glabrescent short peduncle; acorn $\frac{1}{2}$ in. long, surrounded at the base by a shallow cupule, $\frac{1}{2}$ in. broad, covered with lanceolate pubescent scales.

This species is widely spread throughout China, Korea, and Japan. There are four small trees at Kew, about 10 ft. high, which were obtained from the Arnold Arboretum in 1893; and a small specimen is also growing at Aldenham.

(A. H.)

QUERCUS GROSSESERRATA

Quercus grosseserrata, Blume, in *Mus. Lugd. Bot.* i. 306 (1850); Sargent, *Forest Flora of Japan*, 67 (1894); Shirasawa, *Icon. Ess. Forest. Japon*, text 53, t. 27, figs. 16-28 (1900).

Quercus crispula,¹ Blume, var. *grosseserrata*, Miquel, in *Ann. Mus. Bot. Lugd.* i. 104 (1863).

A tree, attaining 100 ft. in height and 12 ft. in girth. Branchlets and buds glabrous. Leaves (Plate 337, Fig. 49) deciduous in autumn, sub-sessile, membranous, 4 to 6 in. long, 3 to $3\frac{1}{2}$ in. broad, obovate, acuminate at the apex, tapering to a narrow auricled truncate base, with twelve to fifteen pairs of regular triangular non-mucronate teeth; upper surface dull, dark green, glabrous except for long hairs on the midrib; lower surface paler, glabrous, with long hairs on the midrib and lateral nerves, each of which except the lower one or two pairs ends in the apex of a tooth; petiole $\frac{1}{8}$ in., glabrous.

Fruit ripening in the first year, clustered at the ends of the branchlets, solitary or two to three on short peduncles; cupule hemispheric, about $\frac{1}{2}$ in. in diameter, with appressed grey tomentose ovate scales, enclosing about one-third of the ovoid acorn, which falls out of the cupule when ripe. (A. H.)

¹ *Quercus crispula*, Blume, in *Mus. Lugd. Bot.* i. 298 (1850), according to Sargent, is indistinguishable in foliage: but is said by Miyabe to have different fruit, the cupule being deeper and enclosing half the cylindrical acorn, cupule and acorn falling together when ripe. Shirasawa only mentions and describes one species, *Q. grosseserrata*.

*Q. grosseserrata*¹ is a native of Japan and the Kurile Isles, and is said to have a more northerly distribution than *Q. crispula*, though both, according to Sargent, grow together on the hills of central Yezo, forming large trees and producing timber of excellent quality. I collected this oak at Asahigawa, in this region, at 500 ft. elevation, where it was growing in open forests mixed with *Q. dentata*. Sargent reports *Q. crispula* to be common on the low ground and near the banks of streams in Yezo; and states that he saw fine forests of it on the Nikko mountains. It is known as *onara* in Japan, where the timber is largely used for sleepers. I believe that this tree produces the greater part of the oak timber which has lately been exported in quantity to Europe and to California, and is very favourably spoken of by Messrs. Marsh, Jones, and Cribb of Leeds, who have used it for furniture. When quarter sawn it shows a good figure, and is not easy to distinguish from Austrian oak.

Sargent collected acorns of this oak in Japan in 1892, from which plants were raised in the Arnold Arboretum. These are said by Rehder to be perfectly hardy and to bear handsome foliage. Some of these plants, sent to Kew in 1893, are about 10 ft. high, but do not look very thriving. Acorns sent to me by Prof. Miyabé from Sapporo in 1905 germinated, but grew badly on my soil, and are now dead.

(H. J. E.)

QUERCUS GLAUCA

Quercus glauca, Thunberg, *Fl. Jap.* 175 (1784); Franchet et Savatier, *Enum. Pl. Jap.* i. 448 (1875), and ii. 501 (1879); Hooker, *Fl. Brit. India*, v. 604 (1888); Skan, in *Journ. Linn. Soc. (Bot.)* xxvi. 515 (1899); Shirasawa, *Icon. Ess. Forest. Japon*, text 56, t. 30, figs. 13-24 (1900); Gamble, *Indian Timbers*, 677 (1902).

Quercus annulata, Smith, in Rees, *Cyclop.* xxix. No. 22 (1819); Loudon, *Arb. et Frut. Brit.* iii. 1921 (1838).

Quercus phullata, Buchanan-Hamilton, in D. Don, *Prod. Nep.* 57 (1825).

A large tree. Young branchlets pubescent at first, soon becoming glabrous. Leaves (Plate 338, Fig. 52) coriaceous, persistent two or three years, about 3 in. long and 1 in. broad, lanceolate, acuminate at the apex, rounded or cuneate at the base, margin mucronate-serrate in its upper half; lateral nerves about ten pairs, prominent beneath; upper surface green, glabrous; lower surface greyish or white, with scattered appressed silky hairs; petiole $\frac{1}{2}$ in. long, glabrous or with scattered hairs.

Fruit (section *Cyclobalanopsis*) ripening in the first year, one to three, sessile on a short stalk; acorn ovoid, acute, much exserted, similar to that of *Q. Vibrayeana*; cupule hemispheric, about $\frac{1}{2}$ in. wide, with grey tomentose scales, connate into four to eight concentric zones, the lower with crenate, the upper with entire margins.

¹ *Q. grosseserrata* is closely allied to *Q. mongolica*, Fischer, ex Turczaninow, in *Bull. Soc. Nat. Mosc.*, 1838, p. 101. The latter species is widely spread in Dahuria, Amurland, Manchuria, Mongolia, and northern China. The leaf, bud, and branchlet of *Q. mongolica* are figured in Plate 337, Fig. 48; and a small tree in Kew Gardens, sent by Sargent in 1893, under the name of *Q. crispula*, is possibly this species. As a rule, the plants usually found in cultivation under the name *Q. mongolica* are *Q. lanuginosa*.—(A. H.)

The above description applies to the Japanese form. The species is very variable in the wild state in foliage, and several varieties have been described. In Himalayan specimens the serrations of the leaves have long mucronate points.

The following peculiar variety probably originated in Japanese gardens:—

Var. *lacera*, Matsumura, *Shokubutsu Mei-I*, 243 (1895).

Quercus lacera, Blume, in *Mus. Lugd. Bat.* i. 306 (1850).

Leaves obovate, ovate, or lanceolate, with the apex prolonged into a long slender caudate acumen; margin deeply lobed, each lobe ending in a long cartilaginous point.

There is a small plant of this variety in Kew Gardens, introduced in 1907 from Yokohama.

Quercus glauca is widely spread in eastern Asia, occurring in the Himalayas from Kashmir to Bhutan at 3000 to 6000 ft., throughout the mountains of China, and in Japan and Formosa. Sargent¹ states that the acorns are eaten by the Japanese, and are of considerable commercial importance.

The Himalayan form was introduced in Loudon's time, as there were plants about 10 ft. high at Kew, Chiswick, and Loddiges' nursery; but none of these appear to have survived. The only specimen which we have seen is a small tree at Tortworth, probably of Japanese origin, which appears to be perfectly hardy, but has never borne fruit.

(A. H.)

QUERCUS VIBRAYEANA

Quercus Vibrayeana, Franchet et Savatier, *Enum. Pl. Jap.* i. 449 (1875), and ii. 498 (1879); Skan, in *Journ. Linn. Soc. (Bot.)* xxvi. 522 (1899); Shirasawa, *Icon. Ess. Forest. Japon*, text 55, t. 29, figs. 16-31 (1900).

Quercus bambusifolia, Fortune, in *Gard. Chron.*, 1860, p. 170; Masters,² in *Gard. Chron.* i. 632 (1874). (Not Hance.)

Quercus acuta, Thunberg, var. *bambusifolia*, Masters, in *Kew Handlist, Trees*, 181 (1896).

A tree, attaining about 50 ft. in height. Young branchlets slender, glabrous. Buds ovoid, minute, glabrous. Leaves (Plate 338, Fig. 55) coriaceous, persistent two years, 3 to 4 in. long, 1 to $1\frac{1}{4}$ in. broad, often larger on young plants, lanceolate, cuneate at the base, long acuminate at the apex, which is often tipped with a mucro; lateral nerves, nine to twelve pairs, slender, inconspicuous; margin minutely serrate in the upper half of the blade; upper surface dark green, shining, glabrous; lower surface pale green, glaucescent, glabrous; petiole $\frac{1}{4}$ to $\frac{1}{2}$ in. long, glabrous.

Fruit (section *Cyclobalanopsis*) ripening in the first year, two to four, sub-sessile on a slender peduncle, about 2 in. long, the upper part of which has fallen, bearing with it the unripened pistillate flowers; acorn ovoid, pubescent towards the tip, which is marked with a lamellate umbo, crowned by the persistent style; cupule

¹ *Silva N. Amer.* viii. 11, note 48 (1895).

² The plant here described by Masters is incorrectly excluded from *Q. Vibrayeana* in *Journ. Linn. Soc. (Bot.)* xxvi. 522 (1899).

hemispheric, about $\frac{2}{3}$ in. in diameter, with grey tomentose scales, connate into seven or eight concentric zones.

This is a rare tree, occurring in Japan, where it was found near Nikko by Savatier, and in the mountains of Chekiang, in China, whence it was introduced¹ into cultivation, under the name *Q. bambusifolia*, by Fortune in 1854. Fortune² saw trees 30 to 50 ft. in height; but, as far as we have seen, it has remained shrubby in this country. There are specimens at Kew, Eastnor, and Syon. (A. H.)

QUERCUS ACUTA

Quercus acuta, Thunberg, *Fl. Jap.* 175 (1784); Shirasawa, *Icon. Ess. Forest. Japon*, text 60, t. 32, figs. 1-13 (1900).

Quercus Buergerii, Blume, in *Mus. Lugd. Bat.* i. 299 (1850).

Quercus marginata, Blume, in *Mus. Lugd. Bat.* i. 304 (1850).

A small tree; young branchlets covered with a dense brownish tomentum, speedily deciduous, though traces of it persist near the tip of the branchlet and above the insertions of the leaves. Buds spindle-shaped, $\frac{1}{3}$ in. long, with reddish glabrous scales. Leaves (Plate 338, Fig. 56) coriaceous, persistent for two years, 4 to 5 in. long, $1\frac{1}{2}$ to 2 in. wide, elliptical; gradually tapering at the base, and prolonged as a narrow wing on each side of the petiole; abruptly contracted into an acuminate apex; entire in margin or with undulate slight crenations towards the apex; lateral nerves about nine pairs, dividing and looping before reaching the margin; glabrous on both surfaces, dull or yellowish green below; petiole $\frac{1}{2}$ to 1 in., glabrous.

Fruit (section *Cyclobalanopsis*) ripening in the second year, clustered on a tomentose peduncle; acorn ovoid, with a laminate pubescent umbo; cupule hemispheric, with tomentose scales connate into about six concentric zones.

This species, which is a native of Japan, was introduced into England by Maries in 1877. It forms a large bush in this country, where it is perfectly hardy, the finest specimen probably being one at Coombe Wood,³ growing on a cold clay soil in an exposed position, and about 20 ft. in height. Seedling plants vary much in habit.

A specimen at Kew, from Holker Hall, bears immature fruit. (A. H.)

¹ Cf. F. B. Forbes, in *Journ. Bot.* xxii. 85 (1884).

² *Gard. Chron.*, 1860, p. 160. In the Cambridge Herbarium there is a specimen dated 1860, from a plant in Glendinning's nursery, raised from acorns sent by Fortune, and labelled *Q. bambusifolia*. The leaves of this specimen, like most of the plants in cultivation, have smaller serrations than those which occur on native adult trees.

³ *Hortus Veitchii*, 405 (1906). Cf. also *Woods and Forests*, 1884, p. 85, and *The Garden*, xix. 285, fig. (1881).

QUERCUS DENSIFLORA

Quercus densiflora, Hooker and Arnott, *Bot. Voy. Beechey*, 391 (1849); Hooker, *Icon. Plant.* t. 380 (1841); Sargent, *Silva N. Amer.* viii. 183, t. 438 (1895).

Quercus echinacea, Torrey, *Pacific R. R. Rep.* iv. 1, p. 137, t. 14 (1856).

Pasania densiflora, Oersted, in *Kjoeb. Vidensk. Medd.*, 1866, p. 83; Schneider, *Laubholzkunde*, i. 161 (1904); Sargent, *Trees N. Amer.* 225 (1905).

A tree, attaining in California 80 or 90 ft. in height, and 18 ft. in girth. Bark divided by narrow fissures into broad rounded scaly ridges. Young branchlets with a dense stellate tomentum, partly retained in the second year. Leaves (Plate 338, Fig. 54) coriaceous, persistent two or three years, 3 to 4 in. long, 1 to 2 in. broad, oblong or ovate-oblong, acute or rounded at the apex, rounded at the base; with about twelve pairs of prominent lateral nerves, all but the lower one or two pairs ending in a cartilaginous-tipped serration; margin revolute; upper surface shining green, glabrous; lower surface rusty pubescent at first, ultimately becoming glabrous and whitish or greyish, some pubescence being often retained on the midrib near the base; petiole $\frac{1}{2}$ to $\frac{3}{4}$ in. long, tomentose.

Fruit (section *Pasania*) ripening in the second year, solitary or in pairs on a stout tomentose peduncle; acorn about 1 in. long, enclosed at the base in a shallow cupule, $\frac{3}{8}$ in. in diameter, with scattered long hairs within; and covered externally with spreading or recurved, long linear rigid stellate-pubescent scales, usually tipped with a reddish gland.

Var. *echinoides*, Sargent,¹ is a shrubby form, with small entire leaves, growing at high elevations in the Siskiyou mountains and the northern part of the Sierra Nevada.

Q. densiflora is distributed from the valley of the Umpqua river in Oregon, southwards through the coast ranges to the Santa Inez mountains in California, and along the western slope of the Sierra Nevada, below 4000 ft. elevation, to Mariposa County. It is abundant in the coast region north of San Francisco bay, and attains its largest size in Napa and Mendocino Counties. Sargent² gives a good illustration of a fine tree near San Francisco. This species has been much cut down on account of its bark, which contains a large amount of tannin; but owing to the vigorous way in which the stumps produce coppice shoots, there is little danger of its extinction.

This tree is apparently unknown in cultivation in Europe, except at Kew, where there are two healthy trees, which scarcely suffered³ from the severe winters of 1879-80, and 1880-81. One in the oak collection measures 21 ft. high by $14\frac{1}{2}$ in., the other, near the flagstaff, is 18 ft. by 1 ft. These were raised from acorns sent to Kew by Prof. Sargent in November 1874. (A. H.)

¹ *Silva N. Amer.* viii. 183, note.

² *Garden and Forest*, v. 517, fig. 89 (1892).

³ Cf. *Gard. Chron.* xvii. 228 (1882).

QUERCUS GLABRA

Quercus glabra, Thunberg, *Fl. Jap.* 175 (1784); Franchet et Savatier, *Enum. Fl. Jap.* i. 447 (1875); Masters, in *Gard. Chron.* xiv. 784, fig. 153 (1880).

Pasania glabra, Oersted, in *Kjoeb. Vidensk. Medd.*, 1866, p. 81; Shirasawa, *Icon. Ess. Forest. Japon.*, text 61, t. 32, figs. 14-24 (1900); Schneider, *Laubholzkunde*, i. 160, fig. 95 (1904).

A small tree with smooth bark. Young branches glabrous. Leaves (Plate 338, Fig. 50) coriaceous, persistent for two or three years, 4 to 5 in. long, 1 to 1½ in. broad, lanceolate or elliptical, tapering at the base and prolonged as a narrow wing on each side of the petiole; apex acute or contracted into a short acumen, rounded at the tip; margin entire, revolute; upper surface shining, glabrescent; lower surface pale, glabrous, with numerous shining minute dots; lateral nerves about ten pairs, dividing and looping before reaching the margin; petiole glabrous, ¼ to ¾ in. long.

Fruit (section *Pasania*) ripening in the second year, grouped in threes and numerous, but only a few developing, on an erect spike about 4 in. long; acorn ovoid, about an inch long, pointed, glabrous, surrounded at the base by a shallow cupule, ½ in. in diameter, covered with appressed grey tomentose ovate acuminate scales.

Q. glabra is a native of Japan, and was introduced¹ into cultivation in England in 1842, when plants were raised in the Tooting and Epsom Nurseries. We have not been able to separate as distinct var. *latifolia*² introduced by Maries in 1877. This species does not appear to be quite so hardy as *Q. acuta*, and remains a large bush, often seen in gardens in the south and west of England, and in Ireland, where it ripens fruit.³ There are specimens in the oak collection at Kew. (A. H.)

QUERCUS CUSPIDATA

Quercus cuspidata, Thunberg, *Fl. Jap.* 176 (1784); Franchet et Savatier, *Enum. Pl. Jap.* i. 449 (1875); Masters, in *Gard. Chron.* xii. 232, f. 38 (1879); Skan, in *Journ. Linn. Soc. (Bot.)* xxvi. 510 (1899).

Pasania cuspidata, Oersted, in *Kjoeb. Vidensk. Medd.*, 1866, p. 81; Shirasawa, *Icon. Ess. Forest. Japon.*, text 62, t. 34, figs. 1-13 (1900); Schneider, *Laubholzkunde*, i. 160 (1904).

A large tree. Bark smooth on young stems, deeply fissured on old trunks. Young branchlets glabrescent. Leaves (Plate 338, Fig. 51) coriaceous, persistent two or three years, 2 to 3 in. long, ¾ to 1 in. broad, elliptical; base tapering

¹ Loudon, *Gard. Mag.* xviii. 17, 41 (1842). Gay, in *Bull. Soc. Bot. France*, v. 32 (1858), mentions a small plant at Verrières in 1858; but this is not referred to in *Hortus Vilmorinianus*, published in 1906.

² Veitch, *Cat. Trees and Shrubs*, 1881-82, p. 22, and *Hortus Veitchii*, 405 (1906).

³ It ripened fruit in 1852 at Bishopstoke, Hants, according to *Gardeners' Chronicle*, 1852, p. 695.

and prolonged as a narrow wing on each side of the petiole; apex long acuminate, rounded at the tip; margin entire, revolute; lateral nerves about eight pairs, inconspicuous, dividing and looping before reaching the margin; upper surface shining, dark green, glabrous; lower surface pale, with deciduous minute appressed pubescence, and showing under the lens shining dots; petiole ¼ in., with scattered minute pubescence.

Fruit (section *Pasania*) ripening in the second year, six to ten alternate and sessile on an erect peduncle; cupule ovoid, acute, ¾ in. long, composed of several rows of coalesced tomentose scales, completely enclosing the acorn, which is set free by the irregular splitting of the cupule into two to four valves.

This species is a native of Japan, Formosa, Korea, and central and southern China. According to Sargent,¹ it is the most widely distributed evergreen oak of Japan, often forming extensive forests in southern Hondo. Its acorns are edible when cooked and are sold in the Japanese markets. The most valuable mushroom of Japan is artificially cultivated upon pieces of the bark of this tree.²

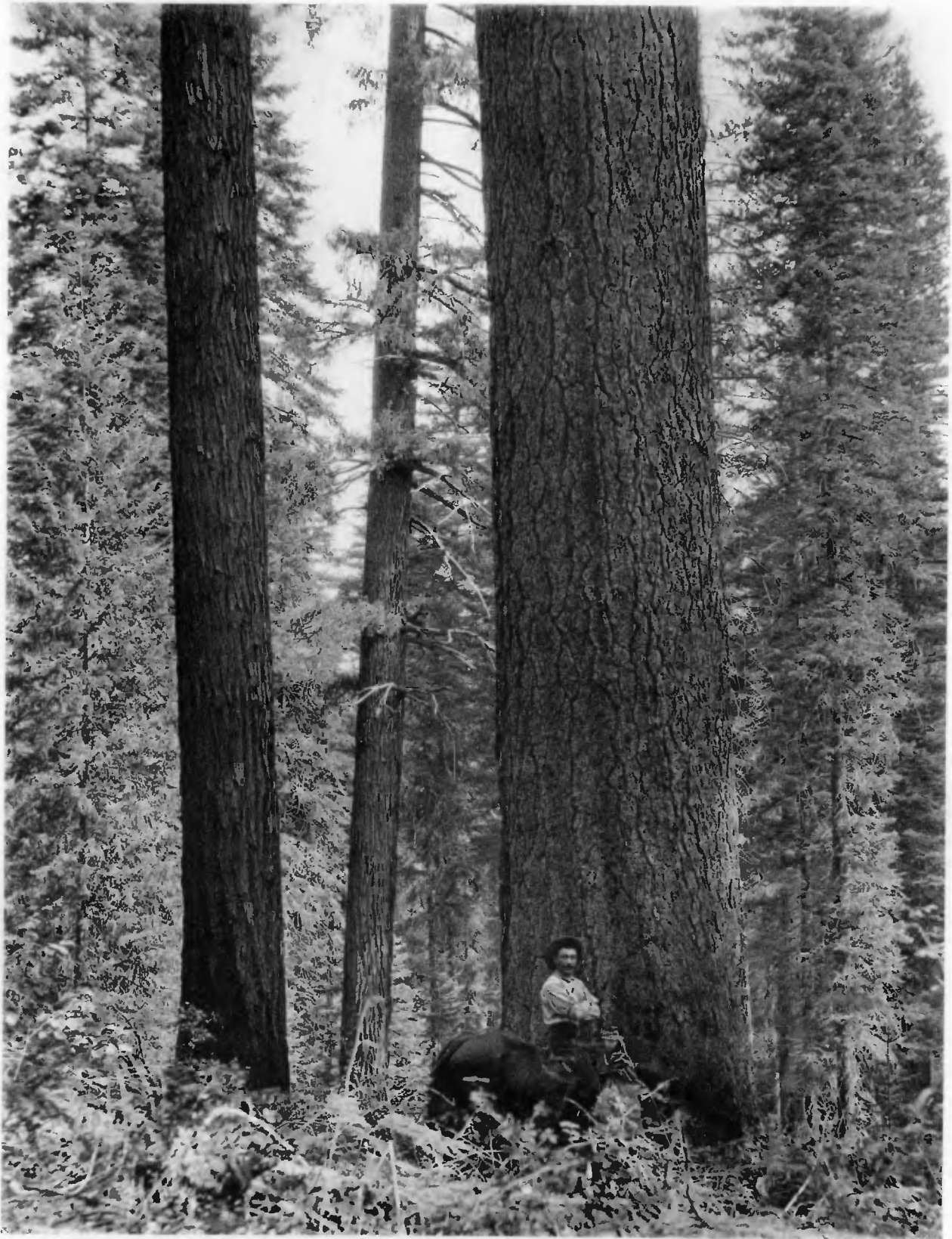
Siebold³ sent acorns of this and other Japanese oaks to Leyden in 1830; but it appears to have been first introduced into England in 1879 by Maries.⁴ The only specimens which we have seen, those at Coombe Wood and at Kew, are shrubby in habit. Maries also sent home from Japan a variegated form (var. *variegata*),⁴ which does not seem to be now in cultivation. (A. H.)

¹ *Silva N. Amer.* viii. 11, note 51 (1895).

² Robertson, *Commercial Reports by H.M. Consuls in Japan*, 1875, p. 52.

³ Siebold et Zuccarini, *Fl. Jap.* i. 11 (1835).

⁴ Cf. *Gard. Chron.* xii. 232, fig. 38 (1879), where a figure is given of var. *variegata*.



SUGAR PINE IN CALIFORNIA



SUGAR PINE AT EASTNOR CASTLE

PLATE 272.

69-12137

NOTICE TO SUBSCRIBERS

ON publishing the Fifth Volume of this work, we desire to explain the unavoidable delay which has taken place in its publication, by saying that we could not foresee the amount of time and work which its preparation required. In the five volumes now issued, we have given subscribers 340 pages and 40 plates more than was promised; yet the vast amount of new material which has come to light since the original prospectus was issued in 1906 compels us to add a Sixth Volume, the materials for which are now ready. As this will be a thick volume, we think that a complete Index to the work will be more convenient to use if printed and bound separately. A few plates of remarkable trees, of kinds described in previous volumes, but not then known to us, will be added; and these may, if desired, be interpolated when the volumes are bound. Another notice will be issued as soon as an estimate can be made of the cost of the Sixth Volume.

We wish to thank most cordially the large number of correspondents and friends who have so greatly assisted us in various ways since we commenced our work; and though we have spared neither time, trouble, nor expense on the Illustrations, we trust that subscribers will forgive any imperfections due to the great difficulty of obtaining successful photographs of trees scattered in remote places throughout the whole of Great Britain and Ireland.

As it is our desire that this work shall be available for reference in public libraries, we would call the attention of librarians to the fact that only a small number of copies remain unsubscribed for.

H. J. ELWES.

A. HENRY.



WESTERN WHITE PINE AT MURTHLY CASTLE

PLATE 273.



JAPANESE WHITE PINE IN JAPAN

PLATE 274.



ALPINE PINE IN THE ENGADINE

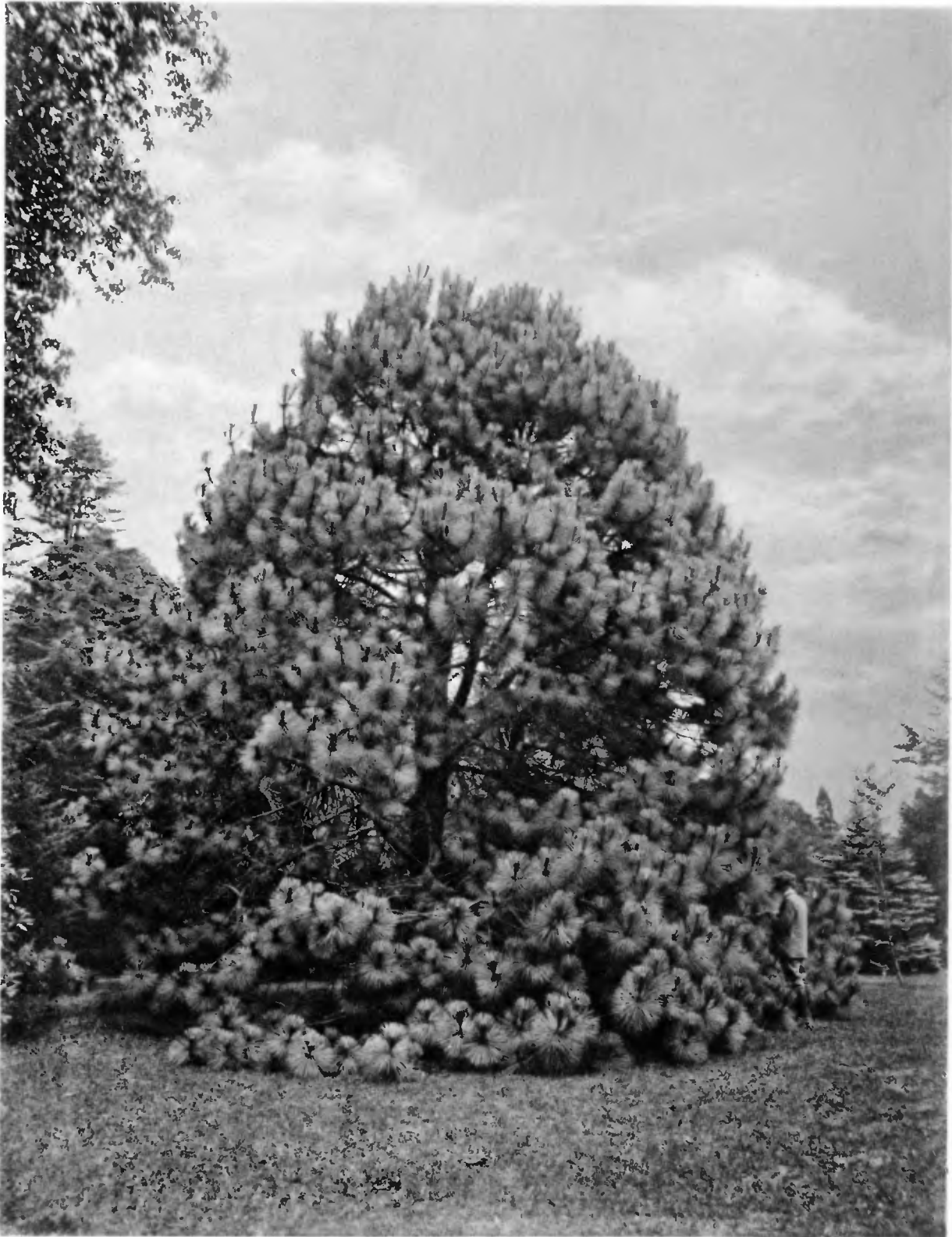
PLATE 275.



WHITE BARK PINE IN MONTANA



FOXTAIL PINE IN CALIFORNIA



MONTEZUMA PINE AT FOTA

PLATE 278.



COULTER'S PINE AT HODDESDON

PLATE 279.

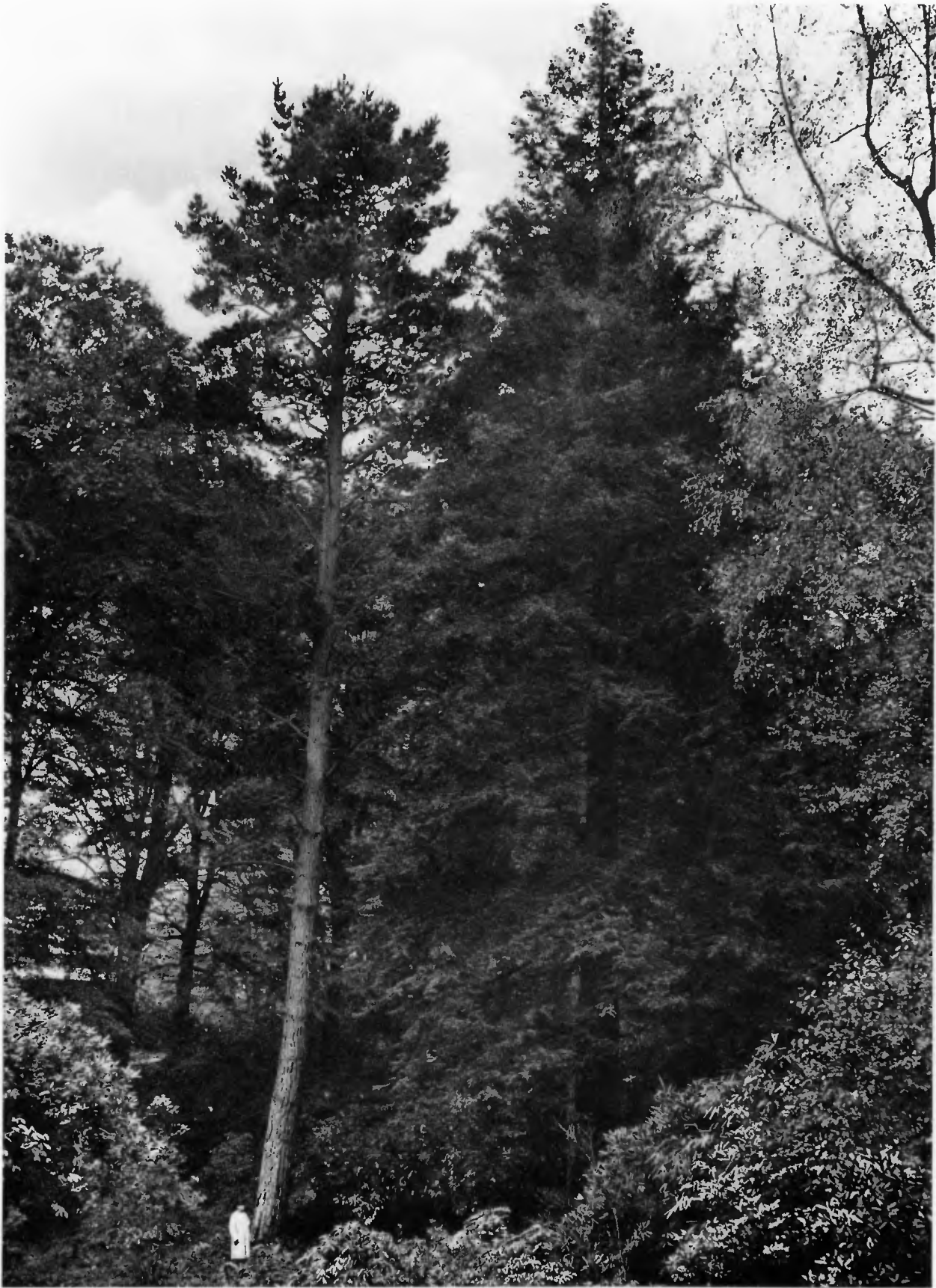


DIGGER PINE AT LEDBURY



YELLOW PINE IN MONTANA

PLATE 281.



MONTEREY PINE AT CUFFNELLS



MONTEREY PINE AT GOODWOOD

PLATE 283.



PLATE 284.

MONTEREY PINE AT MUCKROSS



MEXICAN PINE AT CARCLEW

PLATE 285.



NORTHERN PITCH PINE AT ARLEY CASTLE

PLATE 286.



ALEPPO PINE IN SYRIA

PLATE 287.



ALEPPO PINE AT MARGAM PARK

PLATE 288.



JACK PINE IN MINNESOTA



MARITIME PINE AT FOXLEY



STONE PINE IN PORTUGAL

PLATE 291.



LODGE-POLE PINE AT MERTON HALL

PLATE 292.



MEDITERRANEAN CYPRESS AT HERON COURT



MEDITERRANEAN CYPRESS NEAR MONTPELLIER

PLATE 293 a.



HIMALAYAN CYPRESS AT CUFFNELLS

PLATE 294.



MONTEREY CYPRESS IN CALIFORNIA

PLATE 295.



MONTEREY CYPRESS AT BEAUPORT

PLATE 296.



MONTEREY CYPRESS AT TYKILLEN

PLATE 297.



MONTEREY CYPRESS AT OSBORNE

PLATE 298.



GOWEN'S CYPRESS AT DROPMORE

PLATE 299.



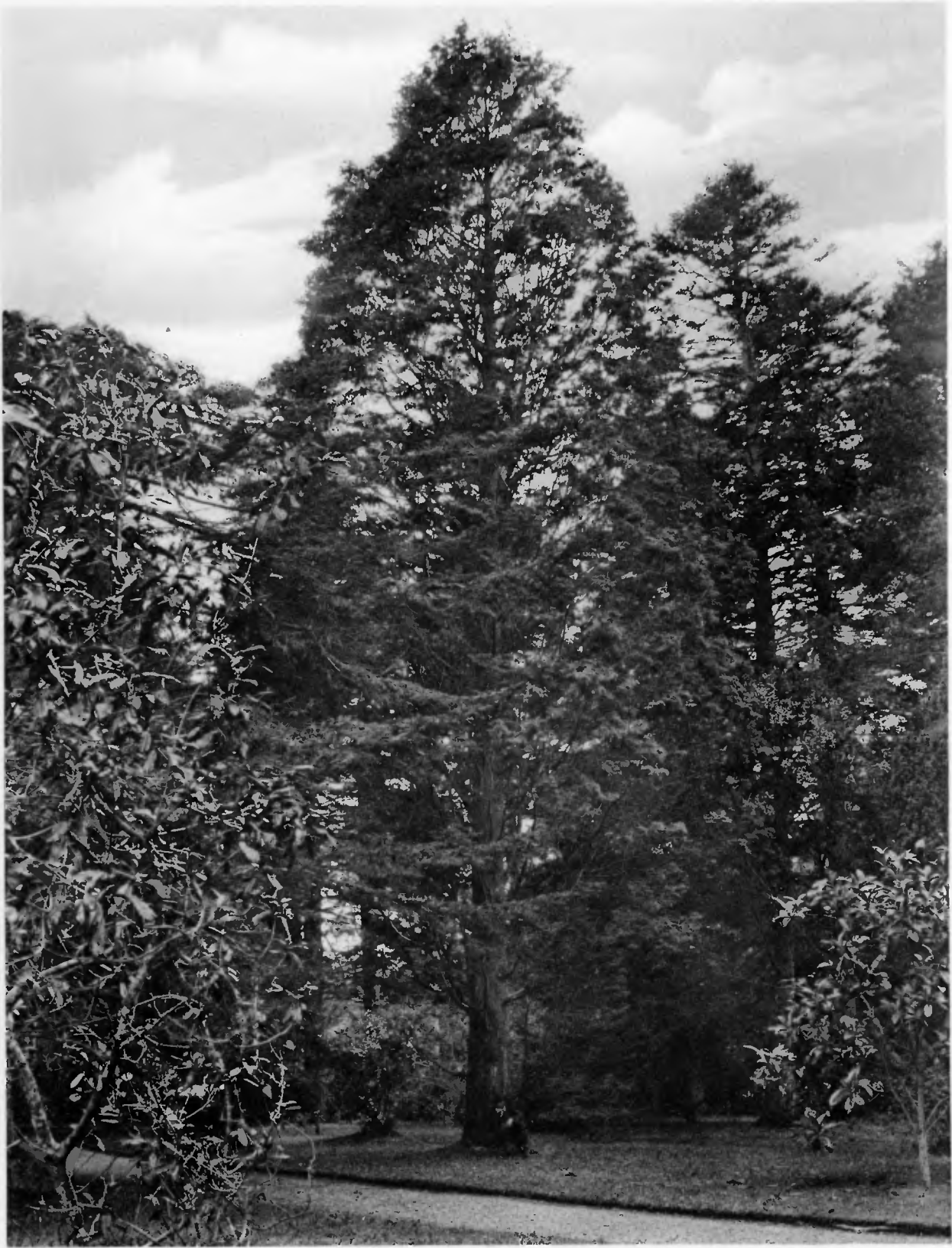
MEXICAN CYPRESS AT HEMSTED

PLATE 300.



PORTUGUESE CYPRESS AT ORIEL TEMPLE

PLATE 301.

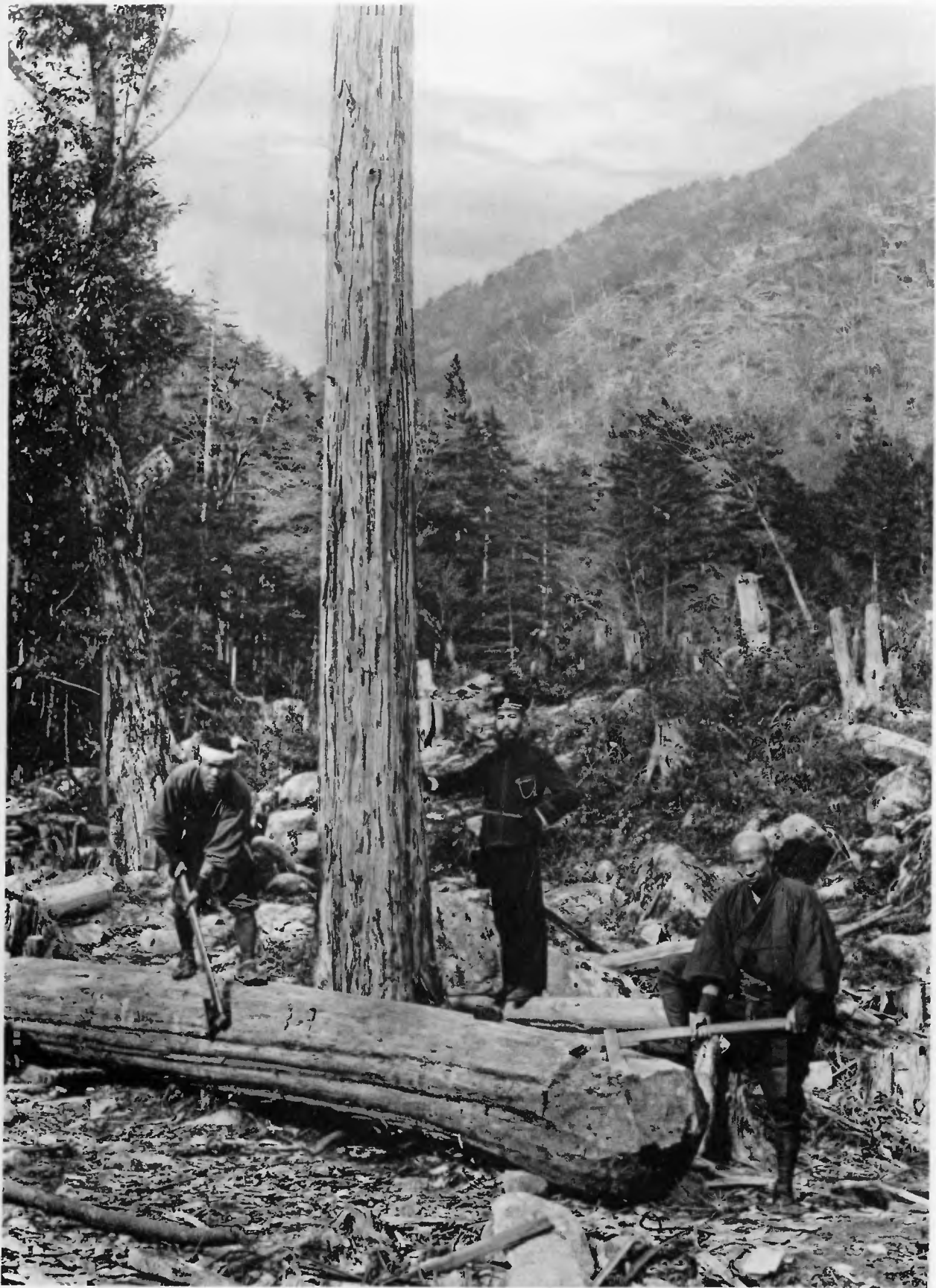


BENTHAM'S CYPRESS AT FOTA



HINOKI CYPRESS NEAR IMAICHI, JAPAN

PLATE 303.



HINOKI CYPRESS IN JAPAN



SAWARA CYPRESS AT BICTON

PLATE 305.



SITKA CYPRESS ON MOUNT RAINIER

PLATE 306.



SITKA CYPRESS IN SNOHOMISH COUNTY, WASHINGTON



SITKA CYPRESS IN NISQUALLY VALLEY, WASHINGTON

PLATE 307.



SITKA CYPRESS AT TORTWORTH

PLATE 308.



PLATE 309.

LAWSON CYPRESS AT KILLERTON



LAWSON CYPRESS AT CASTLEWELLAN

PLATE 310.



WHITE CEDAR IN NORTH CAROLINA



WATER OAK AT LYNDON HALL

PLATE 312.



BLACK OAK AT BAYFORDBURY

PLATE 313.



RED OAK AT KEDLESTON HALL.



PIN OAK IN WINDSOR PARK

PLATE 315.



TURKEY OAK AT BELTON

PLATE 316.



TURKEY OAK AT MAMHEAD

PLATE 317.



TURKEY OAK AT MAMHEAD

PLATE 318.



FULHAM OAK AT KEW

PLATE 319.



LUCOMBE OAK AT CASTLE HILL

PLATE 320.



LUCOMBE OAK AT KILLERTON

PLATE 321.



VALONIA OAK AT LYNDON HALL

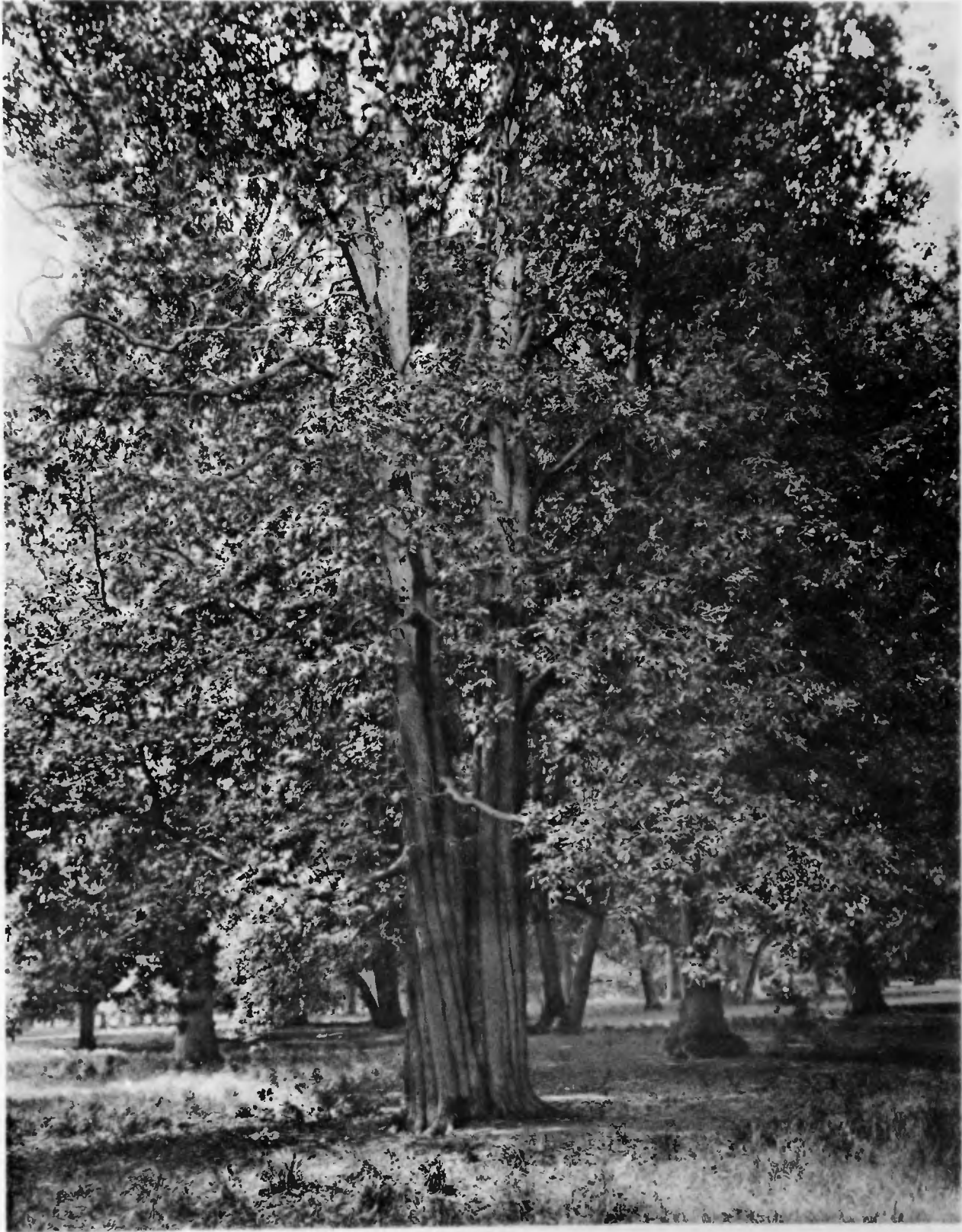
PLATE 322.



CHESTNUT-LEAVED OAK IN ALGERIA



ALGERIAN OAK IN ALGERIA



ILEX AT HOLKHAM

PLATE 324.



ILEX GROVE AT HOLKHAM



ILEX AT MAMHEAD



HYBRID OAK AT AUDLEY END



CORK OAK AT MAMHEAD



SWAMP WHITE OAK AT LYNDON HALL

PLATE 329.



PYRENEAN OAK AT CLONMANNON

PLATE 330.



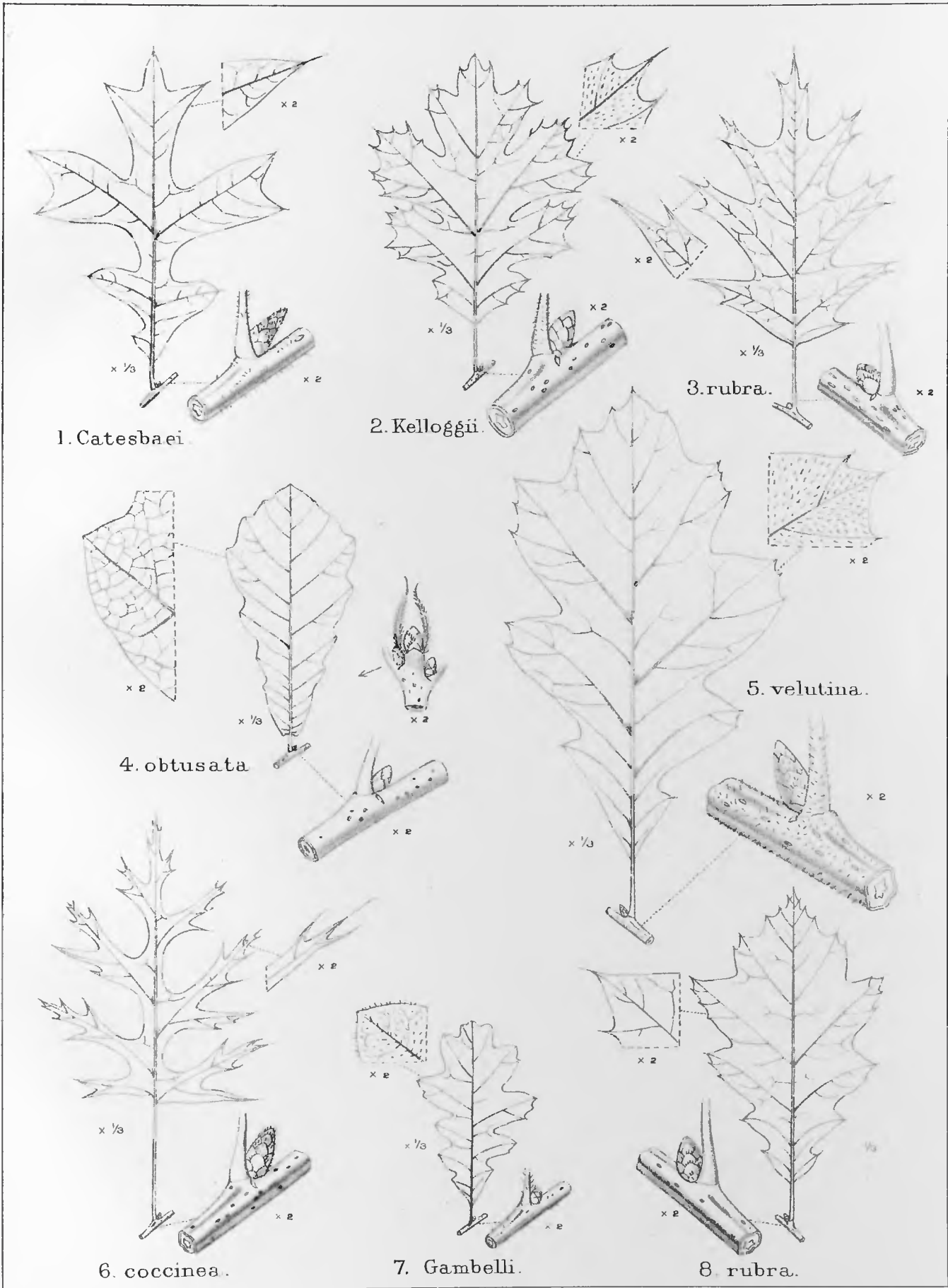
HUNGARIAN OAK AT ORTON HALL

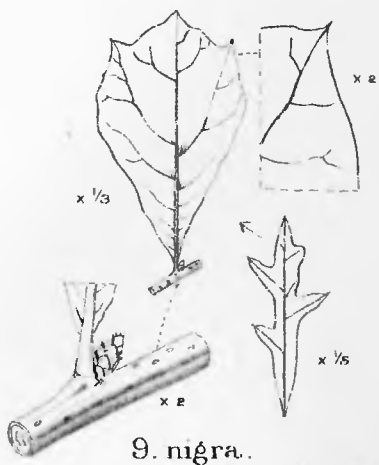
PLATE 331.



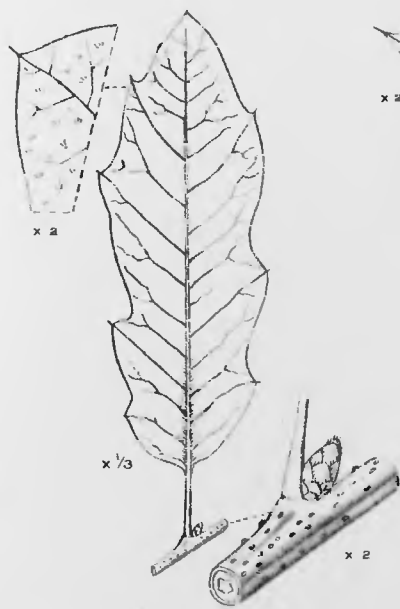
ALGERIAN OAK AT HURSLEY PARK

PLATE 332.

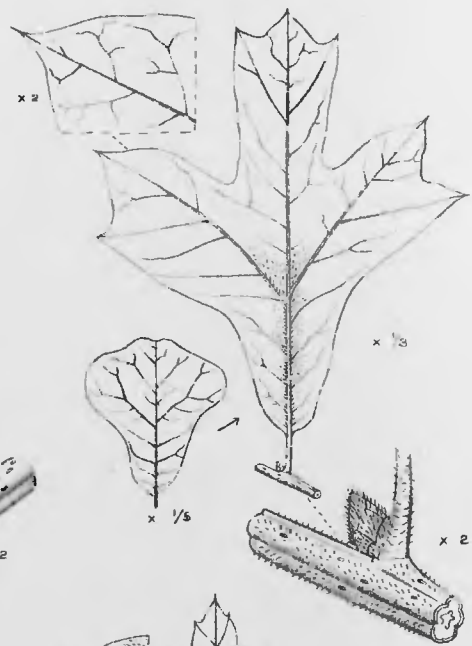




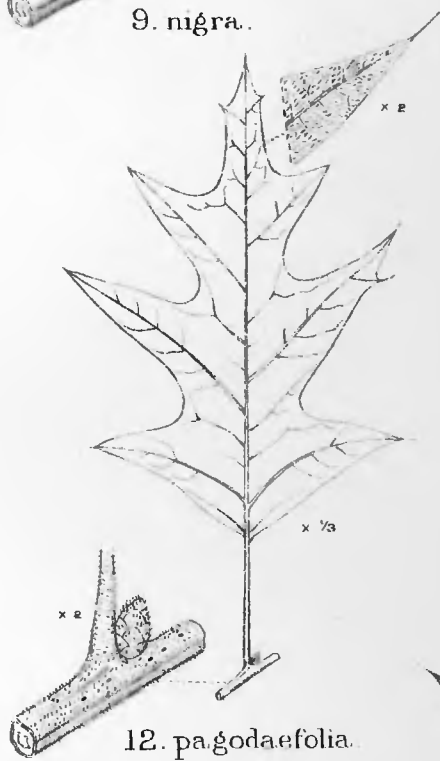
9. nigra.



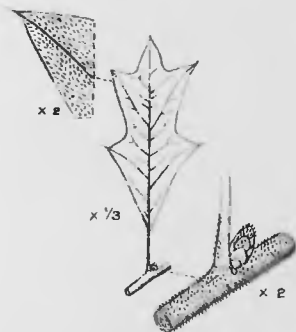
10. leana.



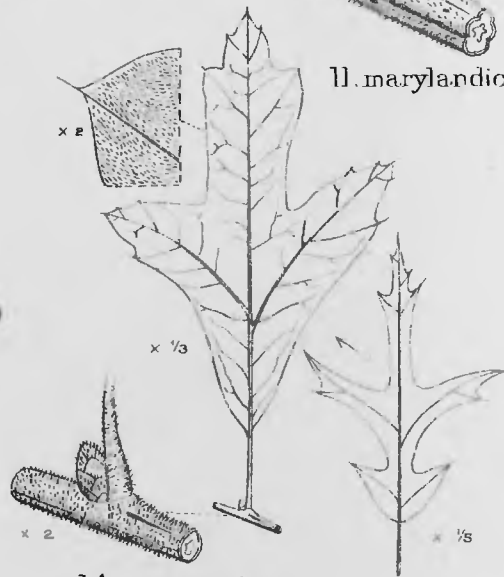
11. marylandica.



12. pagodaefolia.



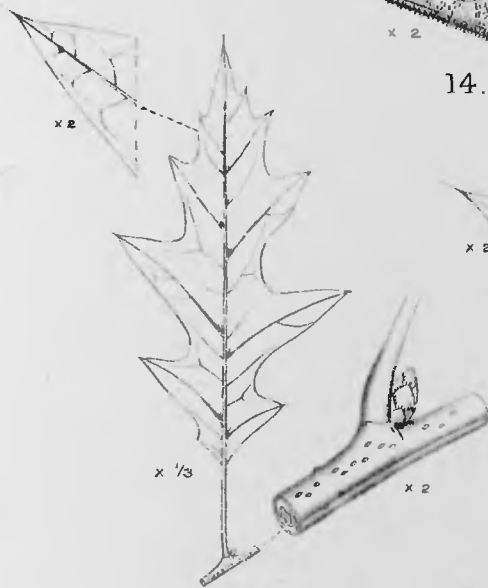
13. ilicifolia.



14. cuneata.



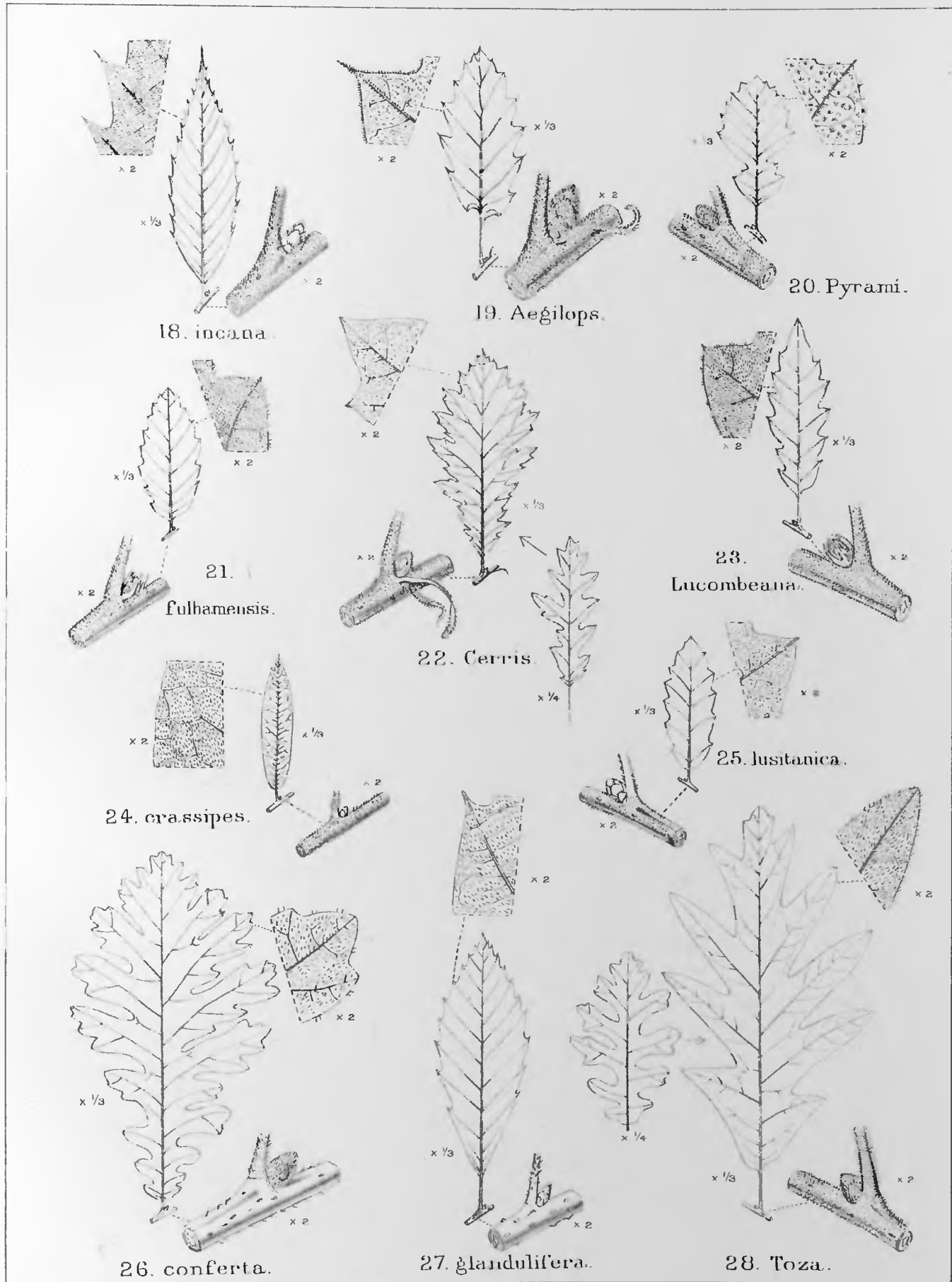
15. Schneckii.



16. heterophylla.



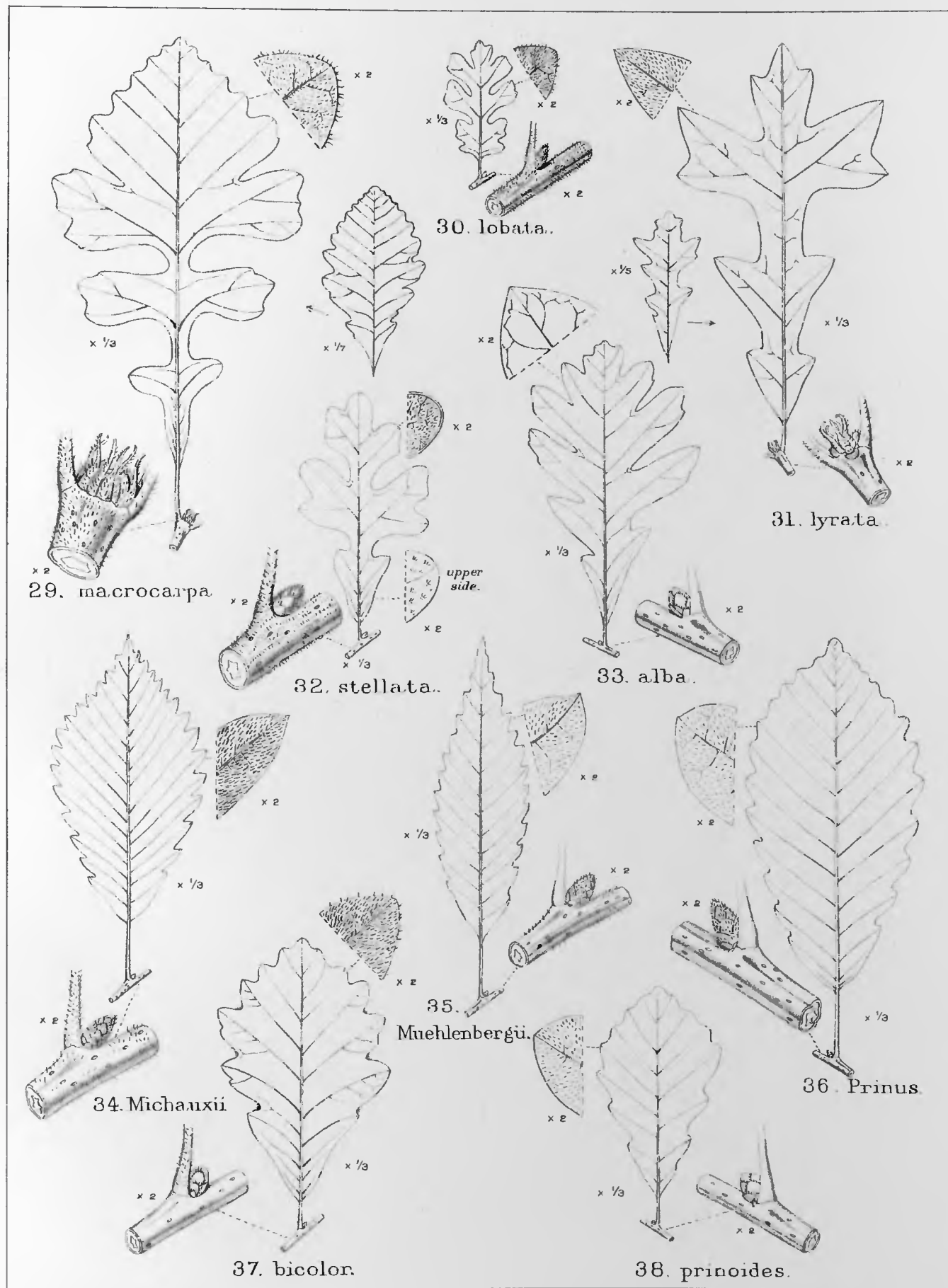
17. palustris.



Huitt, del. Hobb, lit.

PLATE 335.

QUERCUS.



29. macrocarpa

30. lobata.

31. lyrata.

32. stellata.

33. alba.

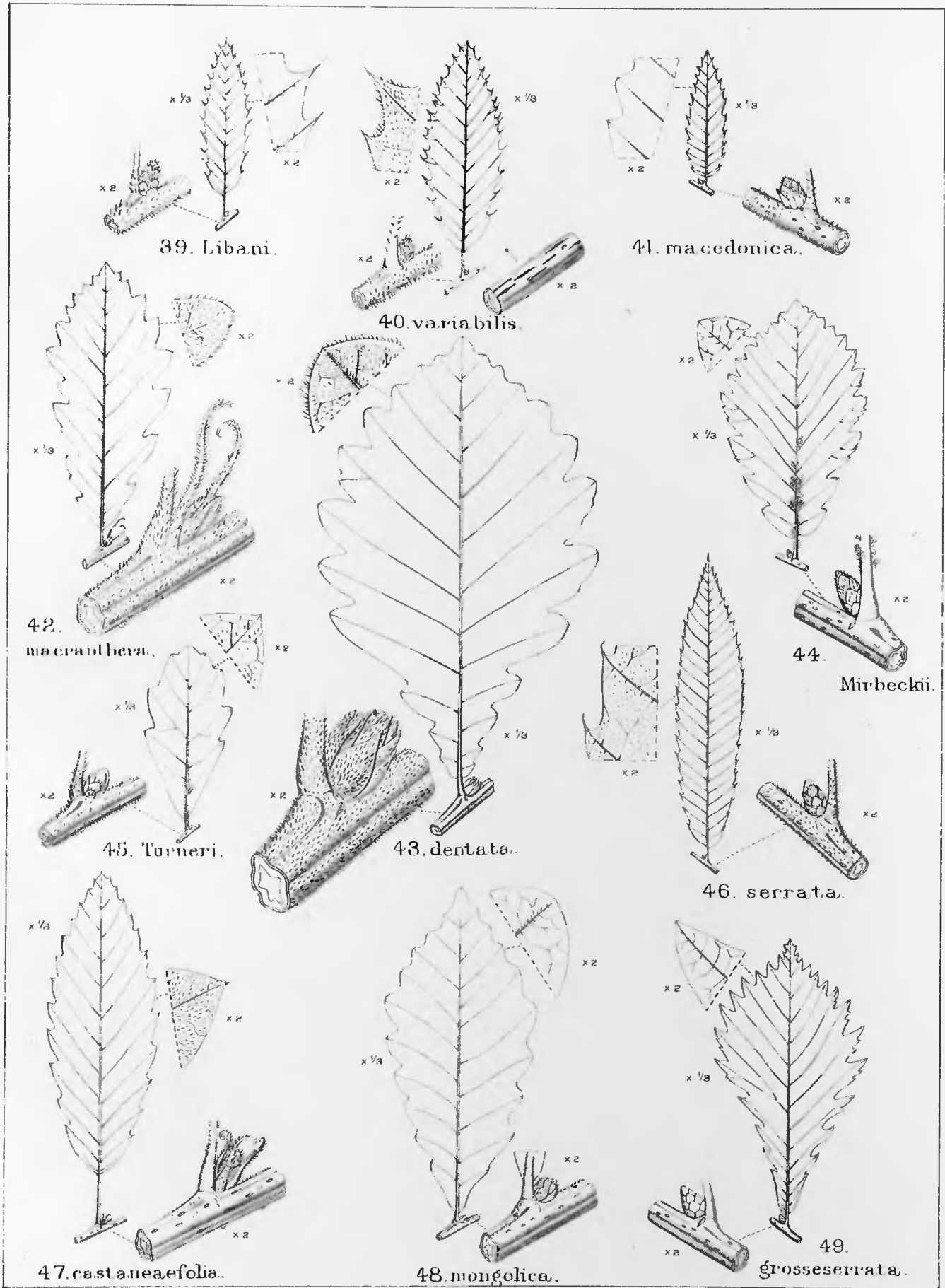
34. Michauxii

35. Muehlenbergii.

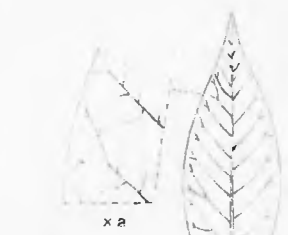
36. Prinus

37. bicolor.

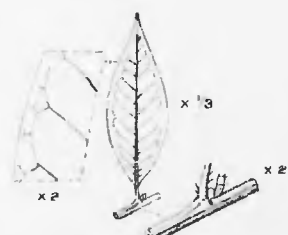
38. prinoides.



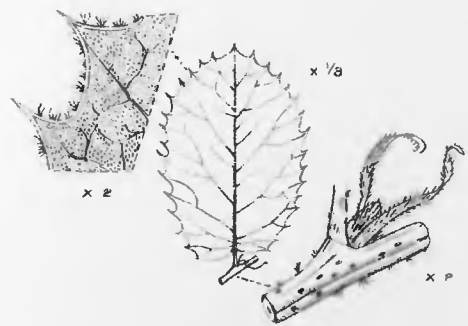
Ratt, del. Roth, lith.



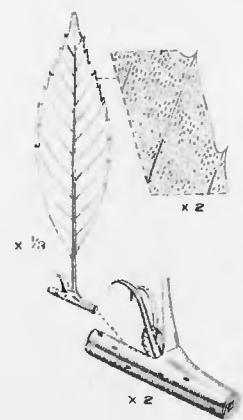
50. *glabra.*



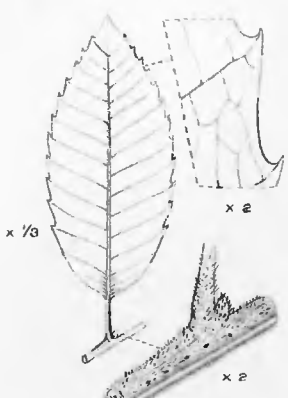
51. *cuspidata.*



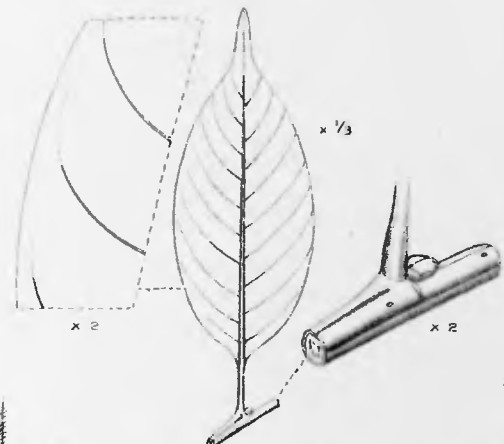
53. *semecarpifolia.*



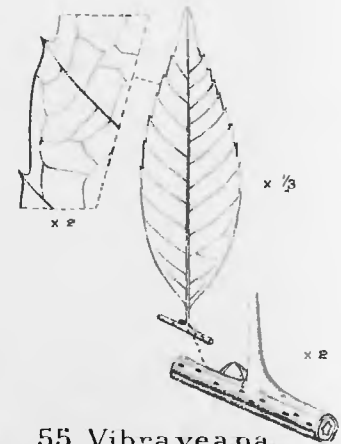
52. *glauca.*



54. *densiflora.*



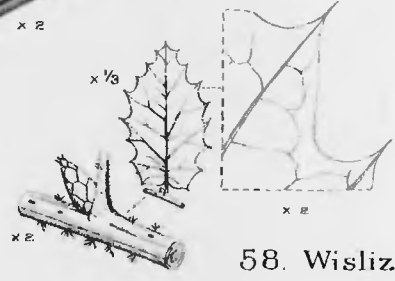
56. *acuta.*



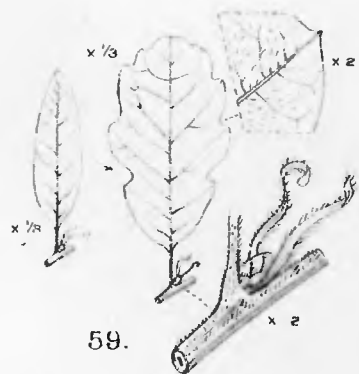
55. *Vibrayeana*



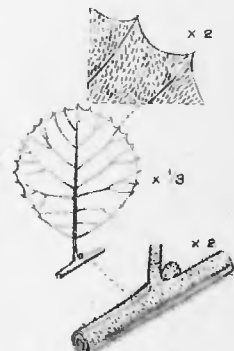
57. *agrifolia.*



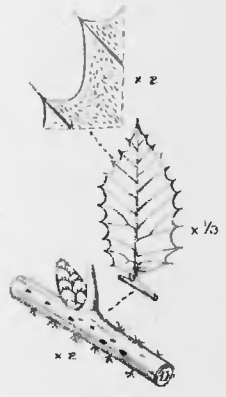
58. *Wislizeni.*



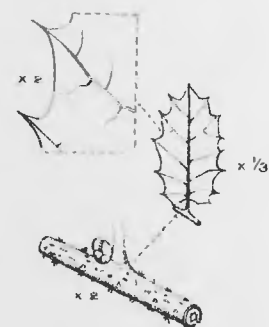
59. *sessiliflora x flex.*



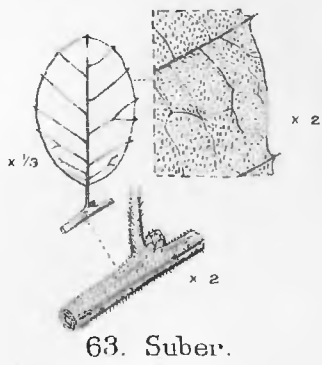
60. *alnifolia.*



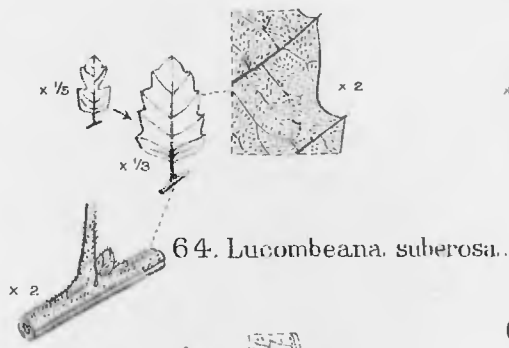
61. *chrysolepis.*



62. *coccifera.*



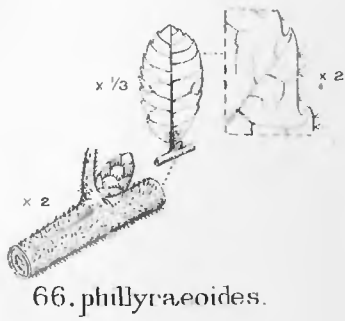
63. *Suber*.



64. *Lucombeana suberosa*.



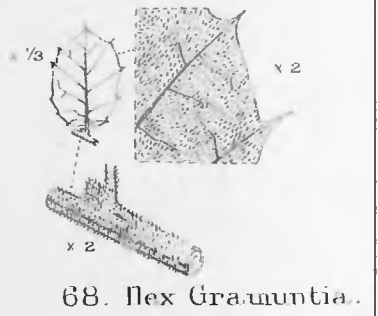
65. *coccifera Auzandri*.



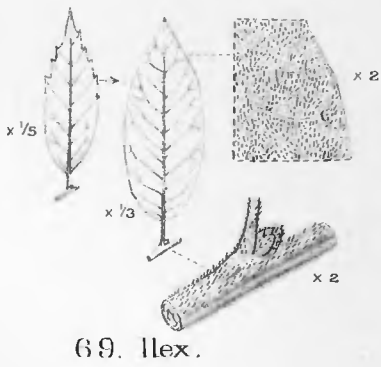
66. *phillyraeoides*.



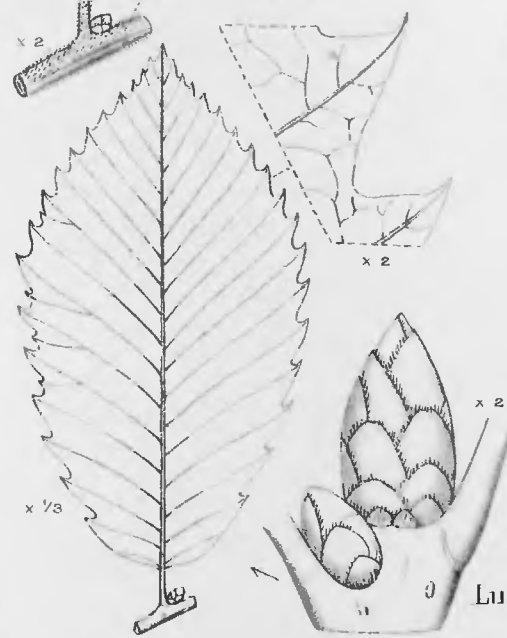
67. *glabrescens*.



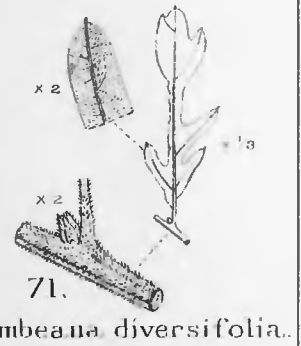
68. *flex Gramuntia*.



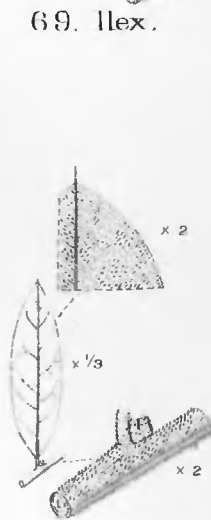
69. *Ilex*.



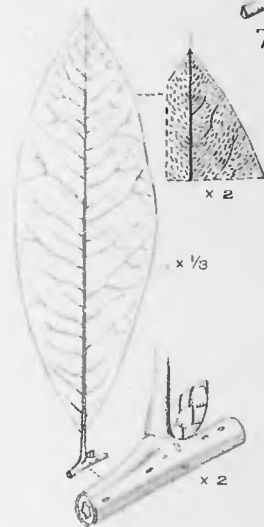
70. *pontica*.



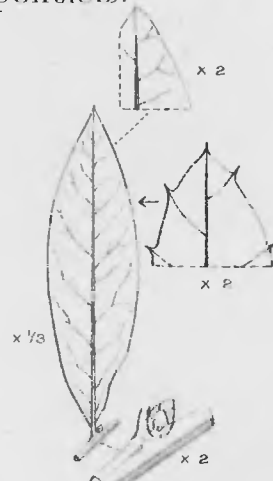
71. *Lucombeana diversifolia*.



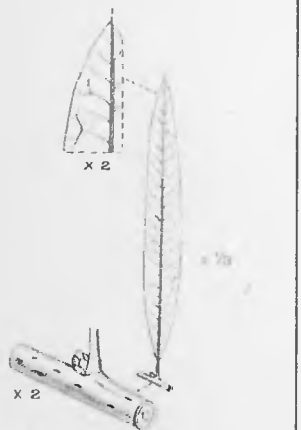
72. *cinerea*.



73. *imbricaria*.



74. *laurifolia*.



75. *Phellos*.

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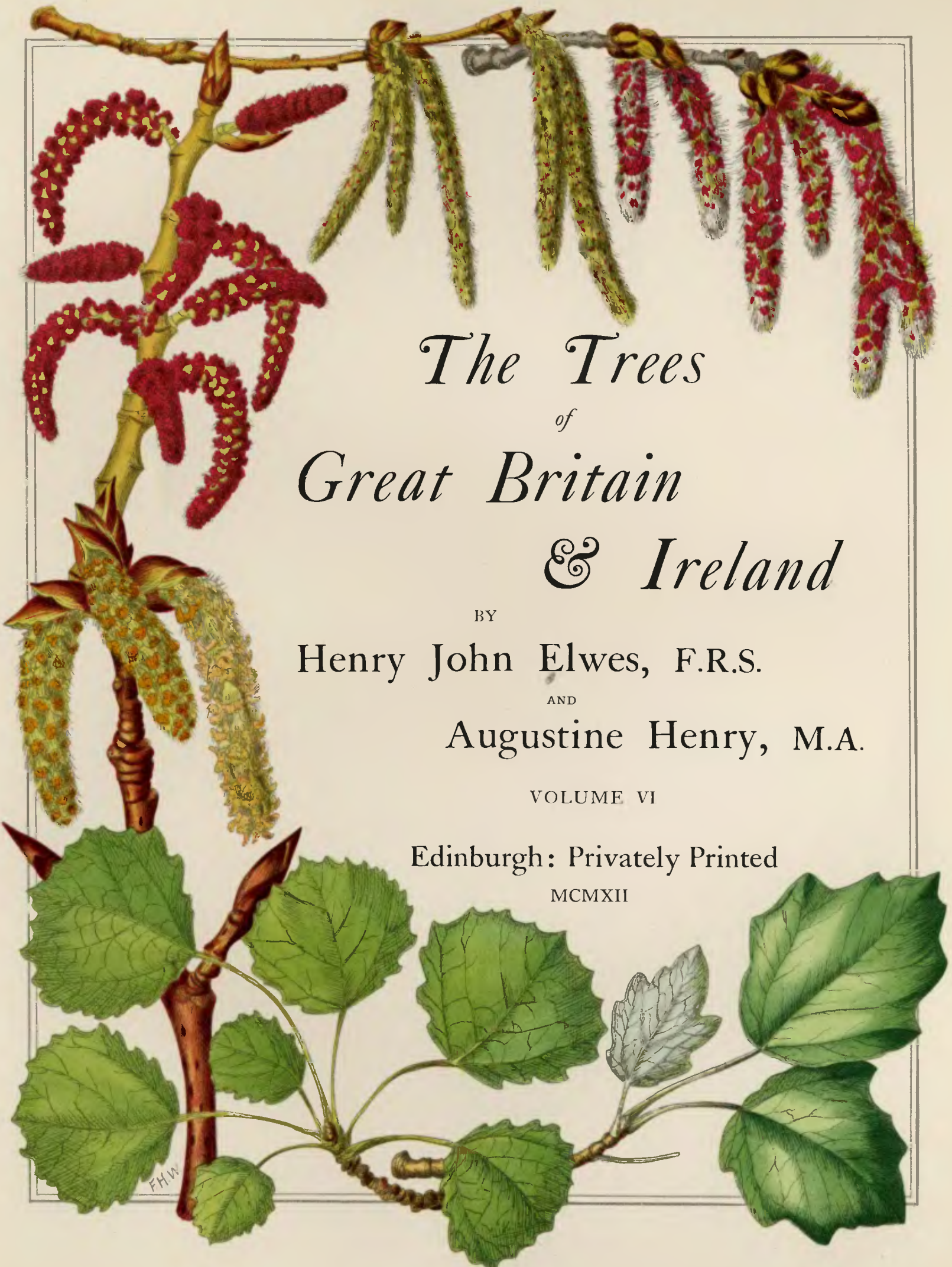
The Trees
of
Great Britain
& Ireland

BY
Henry John Elwes, F.R.S.
AND
Augustine Henry, M.A.

Edinburgh: Privately Printed

THE TREES OF GREAT BRITAIN AND IRELAND





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NOTICE TO SUBSCRIBERS

THE favourable manner in which the Notice to Subscribers issued with the Fifth Volume of this work (*The Trees of Great Britain and Ireland*) was received, leads us to hope for their approval of the course we are now about to adopt, after consultation with some of our best supporters.

In consequence of the great additions to our knowledge, and the extreme difficulty of some of the genera described, the last part of the work has increased to over 500 pages, which, if published in one volume, would far exceed in size and cost those hitherto published. We have therefore decided to complete the work in two volumes. Vol. VII. will be issued, together with a general Index to the whole work, before the end of the year. In accordance with what was indicated in our last Notice to Subscribers the cost of these two volumes and the Index will be Five Guineas.

H. J. ELWES.

A. HENRY.

PICEA

THE characters of the Genus *Picea* and of the two sections into which it is divided have been given in Vol. I. pp. 75-76, with a description of the species belonging to the section *Omorica*. At that time the Sikkim spruce (*P. spinulosa*), one of this section, was imperfectly known, and a full account of it is now given at the end of this article. See p. 1392.

In the section *Eu-picea*, the leaves are quadrangular or rhombic in section, and bear stomatic lines on all their four sides. About fifteen species of quadrangular-leaved spruces are known,¹ which may be readily distinguished by the following key, based on the characters of the branchlets, buds, and leaves.

KEY TO SECTION EU-PICEA

I. *Branchlets quite glabrous.*

* *Leaves on lateral branches radially arranged, spreading uniformly on all sides.*

1. *Picea Smithiana*, Boissier. Western Himalayas. See p. 1366.

Branchlets pendulous, grey. Buds large, resinous, pointed. Leaves slender, about $1\frac{1}{2}$ in. long.

2. *Picea Maximowiczii*, Regel. Japan. See p. 1374.

Branchlets not pendulous, reddish brown. Buds small, resinous. Leaves, $\frac{3}{8}$ to $\frac{1}{2}$ in. long.

** *Leaves on lateral branches in an imperfect radial arrangement, not pectinate in two sets on the lower side of the branchlets, which are not pendulous.*

3. *Picea Schrenkiana*, Fischer and Meyer. Central Asia, in the Alatau and Thianshan ranges. See p. 1364.

Branchlets ashy grey. Terminal buds subglobose, girt with a ring of keeled pointed pubescent ciliate scales. Leaves rigid, sharp-pointed, $\frac{3}{4}$ to $1\frac{1}{4}$ in. long.

4. *Picea pungens*, Engelmann. Wyoming, Colorado, Utah, New Mexico. See p. 1389.

Branchlets at first glaucous, becoming reddish brown. Buds with the tips of their upper scales usually loose and reflexed. Leaves stout, rigid, with a hard sharp-pointed apex, $\frac{3}{4}$ to $1\frac{1}{4}$ in. long.

¹ Not including the spruces of China, of which two or three species introduced by Wilson are in cultivation at Coombe Wood, but are too young to describe.

5. *Picea polita*, Carrière. Japan. See p. 1370.
Branchlets yellow. Buds shining reddish brown, with closely imbricated scales. Leaves rigid, stout, curved, ending in a spine-like point.

*** Leaves on lateral branches, imbricated on the upper side of the branchlet; those below, pectinate and spreading laterally in two sets.

6. *Picea alba*, Link. North America. See p. 1380.
Branchlets greyish or pale brown, usually glaucous. Buds with glabrous non-ciliate bifid scales. Leaves disagreeable in odour when bruised, about $\frac{1}{2}$ in. long.
7. *Picea bicolor*, Mayr. Japan. See p. 1372.
Branchlets yellow, glabrous on lateral branches, pubescent in the furrows on leading shoots. Buds with scarious scales. Leaves, with two conspicuous white stomatic bands, each of five to six lines, on the two dorsal sides, and two bands of two lines on the two ventral sides.

II. Branchlets¹ variable, quite glabrous or with slight scattered pubescence.

8. *Picea excelsa*, Link. Europe. See p. 1337.
Branchlets reddish, usually quite glabrous, or with slight pubescence often confined to the grooves between the pulvini. Terminal buds conical, acute, without resin, girt with a ring of keeled pubescent ciliate pointed scales. Leaves, usually $\frac{3}{4}$ to 1 in. long, with two to three stomatic lines on each of the four sides.
9. *Picea albertiana*, Stewardson Brown. Alberta, British Columbia, Montana, Wyoming. See p. 1385.
Branchlets greyish yellow, either glabrous or with minute pubescence usually confined to the pegs from which the leaves arise. Buds slightly resinous with rounded entire scales. Leaves, in an imperfect radial arrangement on the lateral branches, $\frac{1}{2}$ to 1 in. long.

III. Branchlets always plainly pubescent. Leaves arranged on lateral branches, as in *P. excelsa*.

* Terminal buds with a ring of conspicuous long subulate scales.

10. *Picea nigra*, Link. North America. See p. 1375.
Branchlets covered with dense short glandular pubescence. Leaves bluish or glaucous green, about $\frac{1}{2}$ in. long.
11. *Picea rubra*, Link. North America. See p. 1377.
Branchlets, as in *P. nigra*. Leaves yellowish green or dark green, not glaucous, $\frac{1}{2}$ to $\frac{5}{8}$ in. long.
12. *Picea Glehnii*, Masters. Saghalien, Yezo. See p. 1369.
Branchlets reddish, with short non-glandular pubescence, confined to the furrows between the pulvini. Leaves slender, $\frac{1}{3}$ to $\frac{1}{2}$ in. long.

¹ Cf. *P. bicolor*, No. 7, which has pubescent leading shoots and glabrous lateral branches.

** Terminal buds without long subulate scales.

13. *Picea orientalis*, Carrière. Asia Minor, Caucasus. See p. 1362.
Branchlets slender, pale brown, covered with dense short non-glandular pubescence. Leaves, $\frac{1}{4}$ to $\frac{2}{5}$ in. long, shining dark green, blunt and bevelled at the tip.
14. *Picea Engelmanni*, Engelmann. Western North America. See p. 1387.
Branchlets greyish yellow, with a sparse minute glandular pubescence. Leaves disagreeable in odour when bruised, bluish green, $\frac{7}{8}$ to 1 in. long.
15. *Picea obovata*, Ledebour. Northern Scandinavia, Russia, Siberia; sporadic at high altitudes in the mountains of Central Europe. See p. 1359.
Branchlets reddish brown, covered with a dense minute non-glandular pubescence. Leaves, $\frac{2}{5}$ to $\frac{3}{8}$ in. long, short-pointed, with three to four stomatic lines on each side.

PICEA EXCELSA, COMMON SPRUCE

- Picea excelsa*, Link, in *Linnaea*, xv. 517 (1841); Willkomm, *Forstl. Flora*, 67 (1887); Mathieu, *Flore Forestière*, 540 (1897); Ascherson and Graebner, *Syn. Mitteleurop. Flora*, i. 196 (1897); Schröter, in *Vierteljahrs. Naturf. Ges. Zürich*, xliii. 125-252 (1898); Kent, *Veitch's Man. Conif.* 432 (1900); Kirchner, Loew and Schröter, *Lebensgesch. Blütenpfl. Mitteleuropas*, 99 (1904); Clinton-Baker, *Illust. Conif.* ii. 38 (1909).
- Picea rubra*, Dietrich,¹ *Fl. Berol.* 795 (1824).
- Picea vulgaris*, Link, in *Abhand. Akad. Berlin*, 1827, p. 180 (1830).
- Picea Abies*, Karsten, *Pharm. Med. Bot.* 324 (1881).
- Pinus Abies*, Linnæus, *Sp. Pl.* 1002 (1753).
- Pinus Picea*, Du Roi, *Obs. Bot.* 37 (1771) (not Linnæus).
- Pinus excelsa*, Lamarck, *Fl. Franc.* ii. 202 (1778).
- Abies Picea*, Miller, *Dict.*, 8th ed., No. 3 (1768).
- Abies excelsa*, De Candolle, in Lamarck, *Fl. Franc.* iii. 275 (1805); Loudon, *Arb. et Frut. Brit.* iv. 2293 (1838).
- Abies carpatica*, Lawson, *Pinet. Brit.* ii. 137, t. 20 (1867).

A tree, often attaining in Britain 120 to 140 ft. in height and 10 to 12 ft. in girth, in central Europe attaining 200 ft. high and 15 to 20 ft. in girth. Bark on young stems brownish, thin, smooth; on older trees thick, and scaling off on the surface in thin small scales. Young branchlets, reddish or yellowish brown, glabrous or with a minute scattered non-glandular pubescence, often confined to the furrows between the pulvini. Buds conical, acute, reddish brown, without resin, with rounded scarious scales; terminal bud girt with a few acuminate keeled pubescent ciliate scales.

Leaves on erect shoots radially spreading, more or less appressed to the twigs with their tips directed upwards: on lateral branches, pectinate below, the lower side of the twig being laid bare, most of the leaves being directed forwards and outwards; while on the upper side of the twig, the leaves in the middle line are more or less

¹ Dietrich's name and description apply to the common European spruce, and not to the American red spruce, as is often erroneously supposed.

appressed, with their tips directed forwards and slightly upwards. Leaves, variable in size, usually $\frac{1}{2}$ to $\frac{3}{4}$ in., occasionally 1 in. long, rigid, straight or curved, ending in a short callous point, rhombic in section, with two or three stomatic lines on each of the four sides; resin-canals variable, occasionally absent or only one present, usually two, one at each end of the transverse axis of the rhomb, close to the epidermis.

Staminate flowers solitary in the axils of the leaves of the branchlets of the preceding year, rarely terminal on lateral branchlets, ovoid, about an inch long; stamens numerous, spirally arranged, reddish, each with two pollen-sacs directed downwards and dehiscing longitudinally, and a prominent denticulate connective; pollen grains, each with two air-vesicles.

Pistillate flowers, appearing in summer as brown buds at the tips of the branchlets of the current year, developing in the following spring, about 2 in. long; sessile, erect, cylindrical, purplish red; scales carmine red, oval, with a truncate erose apex; bracts about half the length of the scales, not increasing in size after the time of flowering, ovate-lanceolate, denticulate, with a long acuminate apex. After fertilisation the young cones leave the erect position, and gradually become pendulous, their scales becoming closely imbricated, and in the usual form of the species green in colour.

Cones ripe in October, when they turn brownish; cylindrical, pendulous, variable in size, about 4 to 6 in. in length; usually opening in spring and letting the seeds escape when a dry east wind is blowing; falling from the tree in the subsequent summer or autumn; scales thin and flexible, rhombic, with a truncate emarginate or dentate apex, variable in size, $\frac{5}{8}$ to $\frac{3}{4}$ in. wide, 1 to $1\frac{1}{4}$ in. long, pale brown and glabrous on the exposed part, dark reddish brown and minutely pubescent on the concealed part; bract about $\frac{1}{5}$ in. long, lanceolate, denticulate at the acute or acuminate apex. Seed about $\frac{1}{6}$ in. long, dark dull brown; seed with wing about $\frac{3}{8}$ in. long; wing broadest near the obliquely rounded denticulate apex.

Seedling.—Seeds sown in spring germinate in four or five weeks, the radicle first making its way out of the seed coats, and the caulicle carrying up the cotyledons, which are at first enveloped as with a cap by the albumen of the seed. The cap is soon cast off, and the cotyledons spread in a whorl. The cotyledons are six to ten in number, united at their base by a sheath, about $\frac{1}{2}$ in. long, triangular in section, with the upper edge faintly serrate, without resin-canals, stomatic on the two inner surfaces, deciduous at the end of the second year. The plant at the end of the first year is about 2 to 3 in. high, the young stem bearing, in addition to the whorl of cotyledons, spirally arranged primary needles, which are rhomboidal in section, serrulate on the four angles, with two resin-canals, and inserted on raised pulvini. Branching occurs in the third or fourth year, when the leaves assume their adult form, being entire and not serrulate. No tap root is formed, the root dividing into numerous branches spreading in all directions. Throughout the life of the tree the absence of the tap root, seen in the seedling, persists; and the roots of the spruce are usually spreading and do not penetrate the soil to any great depth.

The spruce is normally monœcious, but instances have been known of

individuals which always bear staminate flowers; and hermaphrodite flowers have been observed. The flowers are pollinated by the wind, the pollen being carried to an immense distance; as far as eight miles in a case which was noticed near Munich. In the vicinity of spruce forests the pollen often descends in enormous quantity, covering the ground and the surface of lakes and rivers with yellow patches.

I. The following variations occur in the form of the scales of the cone:—

1. Var. *europæa*, Schröter, *op. cit.* 142 (1898).

Var. *montana*, Ascherson and Graebner, *op. cit.* 198 (1897).

Picea vulgaris, Link, var. *europæa*, Teplouchoff, in *Bull. Soc. Nat. Mosc.*, xli. pt. ii. 249 (1869).

Cone-scales rhombic, gradually narrowing in the upper third to a truncate, slightly inflexed, emarginate or denticulate apex. This is the common form of *P. excelsa*, widely distributed throughout central Europe, and also occurring in southern Sweden. In the Alps it is rarely found over 5000 feet elevation.

2. Var. *acuminata*, Beck, in *Ann. Nat. Hofm. Wien*, ii. 39 (1887).

Cone-scales, contracted suddenly into a long bifid recurved undulate apex. This variety is of rarer occurrence in central Europe than the preceding; but is found in the Jura¹ and the Alps, and is said to be common in eastern Prussia and in southern Sweden.

3. Var. *triloba*, Ascherson and Graebner, *op. cit.* 199 (1897).

Scales of the cone trilobed at the apex. This is a much less common variation, which has been noticed in a few trees growing at Blankenburg² in the Harz Mountains, at Soglio³ to the north of Lake Como, and in Moravia.⁴

II. There appear to be two races of the common spruce in the continental forests, which are mainly distinguishable by the colour assumed by the unripe cones in August.

4. Var. *chlorocarpa*, Purkyne, in *Allg. Forst. u. Jagdzeit*, liii. 1 (1877). Cones remaining green in August.

5. Var. *erythrocarpa*, Purkyne, *loc. cit.* Cones becoming dark violet in August.

Purkyne considered that important differences in the growth of the tree, in the character of the wood, in the staminate and pistillate flowers, and in the soil occupied by each form, were correlated with the differences in the colour of the cones; but Schröter considers that these are not established, and suggests further investigation.

III. The spruce varies much in habit in the wild state, and several remarkable sports have been described.

6. Var. *viminalis*, Caspary, in *Schr. Phys. Oekon. Ges. Königsberg*, xiv. 126 (1873).

Pinus viminalis, Sparrman, ex Alstroemer, in *Vet. Ac. Handl. Stockh.* xxxviii. 310 (1777).

Pinus hybrida, Liljeblad, in *Svensk Fl.* (1792).

¹ Cf. Aubert, *Flore de la Vallée de Joux*, 345 (1900).

² A. Braun, in *Verh. Bot. Verein Prov. Brandenburg*, xviii. Sitzb. 13 (1876).

³ Ascherson and Graebner, ex Schröter, *op. cit.* 204, fig. 31 (1898).

⁴ Wilhelm, in *Oesterr. Forstzeit.* 1838, p. 169.

Branches in remote almost horizontal whorls, with very long and slender branchlets (often 10 ft., occasionally 20 ft. long) without or with very few lateral branchlets. Leaves radially spreading.

This remarkable form of the weeping spruce was considered by Linnæus¹ to be a hybrid between the spruce and *Pinus sylvestris*. It has been observed in about twenty places in Sweden, where it is vulgarly called *Tysk gran* or German spruce, in about the same number of localities in Norway, and in isolated cases in Livland, East Prussia, Poland, Thuringia, Tyrol, Styria, Carinthia, Carniola, and Switzerland.² When sown, the peculiar habit is occasionally reproduced.³

7. Var. *pendula*, Jacques and Hérincq, *Man. Gén. Plantes*, iv. 340, 341 (1857).

A remarkable form of the weeping spruce, narrow and columnar in habit, with pendulous branches almost appressed to the stem. Conwentz⁴ has described this form, known to him as a single tree⁵ in the Stellan forest near Elbing in West Prussia, another⁶ at Jegothen, near Heilsberg in East Prussia, and two others⁷ near Schierke in the Harz Mountains. Kraemer⁸ found another in a forest near Kreut in Bavaria. Solitary examples have also been found in Switzerland,⁹ in northern Hungary,¹⁰ and in the Bukowina.¹¹ The seed of the weeping spruce near Jegothen, when sown by Conwentz,⁴ gave twelve trees, only one of which showed a tendency to the weeping habit.

A similar tree with longer leaves, lighter in colour than the typical form, was discovered¹² about the year 1860 by Mr. R. Smith Carrington in a plantation near Kinlet Hall, Shropshire, which was propagated by R. Smith and Company, Worcester, who sold it under the name *Abies excelsa inverta*,¹³ Gordon, *Pinet. Suppl.* 4 (1862), a name scarcely worth keeping distinct from var. *pendula*, Jacques and Hérincq, which antedated it a few years. A fine example, about 30 ft. high, was growing¹⁴ in 1897 at Ide Hill, Sevenoaks, Kent; and a good specimen exists at Murthly Castle. There is also a good example¹⁵ at Barbier's nursery, Orleans.

Other kinds of weeping spruce, probably including *Abies excelsa pendula*, Loudon, a form introduced by Booth, are irregular in habit and much more spreading. A very fine example occurs at Durris.

¹ Linnæus refers to it as *Abies procera viminalis* in *Fl. Suec.* 288 (1745).

² Cf. Schröter, *op. cit.* 151, who draws attention to the fact that *P. Breweriana*, of the Siskiyou Mountains, has this habit as a constant specific character.

³ Cf. Wilhelm, in *Verh. K. K. Zool. Bot. Ges. Wien*, xxxvii. (1887).

⁴ *Beob. Seltene Waldbäume W. Preussen*, 135 (1895).

⁵ Figured in *Gartenflora*, 1899, p. 618, fig. 86; and by Conwentz, *op. cit.* 141, figs. 12, 13.

⁶ Figured by Conwentz, *op. cit.* 147, fig. 14.

⁷ Figured in *Gartenflora*, 1901, p. 315, figs. 48, 49; and by Conwentz, *op. cit.* 150, 152, figs. 15, 16.

⁸ In *Flora*, 1841, p. 700.

⁹ Schröter, *op. cit.* 156 (1898).

¹⁰ Schilberszky, in *Kertészeti Lapok*, vii. (1892), describes a weeping spruce near Leutschau.

¹¹ Cf. *Oesterr. Forst. u. Jagdzeit.* 1897, p. 356.

¹² Nicholson, in *Woods and Forests*, 1884, p. 691; and *The Garden*, xxv. 229 (1884).

¹³ *Picea excelsa inversa*, Beissner, *Nadelholzkunde*, 361 (1891).

¹⁴ *Gard. Chron.* xxii. 368, fig. 109 (1897). Cf. also *Gard. Chron.* xxix. 263, fig. 98 (1901).

¹⁵ Figured in *Gartenflora*, 1899, p. 617, fig. 87; and by Conwentz, *op. cit.* 163, fig. 17.

The "Cornish fir" which was mentioned by Hayes¹ as growing in 1794 at Avondale in Co. Wicklow, was pendulous in habit and bore large cones, sometimes nearly a foot in length. The remarkable pendulous spruce² at Shelsley Walsh, in the Teme Valley in Worcestershire, bears cones 9 in. in length, and appears to be identical with Hayes' variety.

8. Var. *columnaris*, Carrière, *Conif.* 248 (1855). Narrowly columnar in habit, with short horizontal branches, clothed with dense short branchlets and foliage.

This form, which has been known a long time in cultivation, exists in the wild state in Switzerland, where six trees are known by Schröter in the five localities of Stanserhorn, Stockhorn, la Brévine, Chavannes, and la Berboleuse, all at high altitudes between 4000 and 5800 ft.

The columnar spruce³ is to be carefully distinguished from the narrow spruce, known as the *spitzfichte*,⁴ in which the habit does not result as a sport, but is due to a severe climate, which checks the growth of the branches. The *spitzfichte* is similar to the columnar spruce in form, being narrowly cylindrical, but the stem is sparingly clad with short branches, wide apart, and forming a thin crown of foliage. The *spitzfichte* is never seen at low levels in the Alps and Jura, but occurs near the timber line, often forming small groves in exposed situations. This climatic form is much more common in *P. obovata* in Lapland, Finland, and northern Scandinavia.

9. Var. *pyramidata*, Carrière, 247 (1855).

Var. *stricta*, Schröter, *op. cit.* 158 (1898).

Branches ascending at a narrow angle, forming a nearly fastigiate tree. Trees of this kind are occasionally seen in the forests of central Europe, and are rarely found in the seed bed in nurseries.

10. Var. *strigosa*, Christ, in *Garden and Forest*, ix. 252 (1896).

A form with numerous slender horizontal branchlets, spreading from all sides of the branches, giving the tree the habit of the common larch. This variety occurs in one locality in the canton of St. Gall in Switzerland.

11. Var. *eremita*, Carrière, in Jacques and Hérincq, *Man. Gén. Plantes*, iv. 341 (1857).

A tree of slender pyramidal habit with numerous branches, directed upwards at a small angle with the stem, short stout branchlets, large buds, and distant short thick sharp-pointed needles.

Var. *Remonti*, said by Kent⁵ to be a dwarf modification of this, is described by Masters⁶ as of dense compact pyramidal habit, recalling that of *Cupressus Lawsoniana*, var. *erecta viridis*.

¹ *Planting*, 165 (1794). It is first mentioned apparently in *London Catalogue of Trees* (1730), as the long-coned Cornish fir, said to have been "brought from America some years previously and planted in Devon and Cornwall."

² Erroneously referred to *P. Smithiana* (as *P. Morinda*) in *Gard. Chron.* 1869, p. 713, and xix. 132 (1896).

³ Dr. Christ, in *Garden and Forest*, ix. 252 (1896), uses the term columnar spruce for the *spitzfichte*, which is not strictly accurate.

⁴ First named and described by Berg, in *Jahrbuch K. Sächs. Akad. Forst. Tharand.* xiii. 83 (1859).

⁵ Veitch's *Man. Conif.* 433 (1900).

⁶ In *Gard. Chron.* vii. 578 (1890).

12. Var. *virgata*, Caspary, *op. cit.* xiv. 125 (1873).

Abies excelsa, De Candolle, var. *virgata*, Jacques, in *Ann. Soc. Hort. Paris*, xlv. 653 (1853).

Abies excelsa Cranstonii, Knight and Perry, *Syn. Conif.* 36 (1850).

Picea excelsa, Link, var. *denudata*, Carrière, in *Rev. Hort.* iii. 102, fig. 7 (1854).

Branches very few and usually not in whorls, elongated, straight or curved, with very few or without branchlets. Leaves radially arranged, either longer or shorter than in the common spruce, persistent ten or twelve years.

This variety,¹ which is known as the snake spruce, owes its peculiarities to the arrest of nearly all the buds, which do not develop. Most of the examples recorded are young trees, but one² forty years old at Buttes, near Neuveville in the Swiss Jura, was 40 ft. high in 1898. The snake spruce is not uncommon in Norway, where Schübeler found it in seventeen localities between lat. $59\frac{1}{2}^{\circ}$ and $61\frac{1}{2}^{\circ}$; and also occurs here and there in Sweden between lat. 58° and 63° . Isolated examples are reported from Finland, Livland, and Courland which are probably *P. obovata*; and others occur in different parts of Germany. It is common in Bohemia; and one example is known in Moravia. Schröter mentions seventeen trees growing in ten localities in Switzerland. Carrière knew only one example, growing in Cochet's nursery at Suynes, near Brie-Comte-Robert, in Seine-et-Marne.

Varieties intermediate between the snake spruce and vars. *pendula*, *monstrosa*, and *viminalis* also occur, but are very rare.

13. Var. *monstrosa*, Schröter, *op. cit.* 170 (1898). (Not Carrière.³)

Abies excelsa, De Candolle, var. *monstrosa*, Loudon, *Arb. et Frut. Brit.* iv. 2295 (1838).

Abies adada, Salvi, in *Flora*, 1844, p. 519.

Picea excelsa, Link, var. *monocaulis*, Nördlinger, *ex Willkomm, Forstl. Flora*, 76 (1887).

This variety, which never develops any lateral branches, has a single thickened stem, bearing leaves near the apex, persistent for many years, and about $1\frac{1}{3}$ in. in length.

This variety was first described by Loudon, who mentions a single specimen growing in the Chiswick garden, twelve years planted, and about 3 ft. in height. A specimen at High Canons, Hertford, produced cones of the ordinary form in⁴ 1907. Salvi found in 1842 four specimens, growing wild in the Euganean Hills, west of Padua. One of these which was transplanted to Isola Bella in Lake Maggiore, where I saw it in 1909, is attached to a bamboo, and trained up the wall of the château; it measures about 30 ft. in height and is nearly as thick ($1-1\frac{1}{2}$ inch) at the top as at the bottom, bearing leaves with very sharp points only on the upper two feet of the stem. Schröter records another specimen at Stockach in Baden, another in Bohemia, and another at Ansbach in Bavaria. A form of this variety is recorded

¹ An analogous form of the common silver fir, *Abies pectinata*, var. *virgata*, Caspary, in *Bot. Zeit.* 778, t. ix. (1882), occurs; but only four examples are known—two in Alsace, one in the Bohemian forest, and another in the Swiss Jura near Neuveville. The latter is described and figured by Schröter, *op. cit.* 168, fig. 15 (1898). Cf. vol. iv. p. 722.

² The oldest known to Schröter was one near Dorpat, in Livland, said by Berg, in *Schrf. Naturf. Ges. Univ. Dorpat*, ii. t. 2 (1887), to be sixty years old.

³ Carrière, *Conif.* 248 (1855), wrongly applied the name *monstrosa* to var. *virgata*, Caspary.

⁴ According to *Gard. Chron.* xxv. 146 (1886), var. *monstrosa* at Lucombe, Pince and Co.'s Nursery, Exeter, produced cones in 1886 which were similar to those of the ordinary spruce.

from Silesia and Thuringia, which bears a few undivided branches at the base, the upper part being without branches.

14. Var. *globosa*, Berg, in *Schrift. Naturf. Ges. Univ. Dorpat*, ii. 19, 20 (1887).

In this variety, normal growth is replaced by numerous close branches, irregularly dividing into a great number of branchlets, similar to a witches' broom, and forming either a globose bush without any leader, or a conical bush with a leader arising out of a globose base. I saw a remarkable example of the globose spruce in 1909 at the Forestry Experimental Station, Zurich. Seedlings had been raised, one quarter of which had reverted to the habit of the ordinary spruce, the others being very various in appearance and intermediate between the parent form and the normal habit of the species.¹

In the true dwarf forms² of the spruce, the branching is regular, but the growth of the shoots is very small, and the needles are very short. The most important are:—

15. Var. *Clanbrassiliana*, Carrière, in Jacques and Hérincq, *Man. Gén. Plantes*, iv. 341 (1857).

Abies excelsa, De Candolle, var. *Clanbrassiliana*, Loudon, *Arb. et Frut. Brit.* iv. 2294 (1838).

A compact low dense globose bush, seldom higher than 5 or 6 ft.; branches and branchlets, much shortened; leaves about $\frac{1}{4}$ to $\frac{1}{2}$ in. long; buds very red in colour. This is supposed to have been found on the Moira estate, near Belfast, about the end of the eighteenth century, when it was introduced into England by Lord Clanbrassil. This dwarf form has been found growing wild in Thuringia, and near Stockholm, and in Jemtland in Sweden. It is always sterile, and is propagated by cuttings.

Elwes found at Tullymore Park, Co. Down, a large bush of this form measuring 10 ft. high and 28 ft. in circumference, which he was informed was either the original or a part of it, and was supposed to be about one hundred and fifty years old. A specimen at Aldenham has reverted to the normal type, and is now growing rapidly into an erect tree.

16. Var. *tabulaformis*, Carrière, *Product. et Fixat. Variétés*, 52 (1865), *Conif.* 333 (1867).

A prostrate form, with slender branchlets spreading horizontally over the ground. This is said by Carrière to have been taken, probably as a cutting, from a witches' broom, growing on an ordinary spruce in the Trianon. Torssander³ found a similar plant in Södermanland in Sweden, thirty years old, and only 20 in. high.

17. Other dwarf forms have been named, as vars. *pumila*,⁴ *pygmaea*,⁵ *Gregoryana*,⁶ *Maxwelli*,⁷ etc.

¹ Cf. Engler, in *Mitt. Schweiz. Forst. Versuch.* viii. pt. ii. 117, figs. 8, 9 (1904).

² See under *Witches' Brooms*, p. 1345.

³ In *Södermanland Botan. Notiser*, 1897, p. 169.

⁴ Beissner, *Nadelholzkunde*, 365 (1891).

⁵ Loudon, *op. cit.* 2295 (1838).

⁶ Said by Gordon, *Pinetum*, 9 (1875) to have been raised in the Cirencester Nursery.

⁷ Originated as a seedling in Messrs. Maxwell's nursery, Geneva, New York. Cf. *Woods and Forests*, 1884, p. 502, and Rehder, in Bailey, *Cycl. Amer. Hort.* iii. 1333, fig. 1798 (1901).

IV. Several varieties are known in which the leaves are coloured :—

18. Var. *aurea*, Carrière, *Conif.* 246 (1855).

Leaves yellowish white, shining. The golden spruce has been found wild in Carinthia.

19. Var. *finedonensis*, Gordon, *Pinet. Supp.* 4 (1862).

Leaves pale yellow at first, changing to a bronze colour, and ultimately becoming green.¹ This originated at Finedon Hall, Northamptonshire, where it came up accidentally in a bed of common spruce. It often loses its colour in cultivation, and at Colesborne has entirely reverted to the normal green. Var. *mutabilis*² has the young shoots creamy yellow in colour, changing to green by the end of the season. Mr. Bean³ saw in Hesse's nursery, Weener, Hanover, a very beautiful variety, with creamy white young shoots, which is called var. *argenteo-spica*.

20. Var. *variegata*, Carrière, *Conif.* 246 (1855).

Leaves variegated with pale yellow. A variegated form is mentioned by Loudon; and Wittrock⁴ found a tree with leaves variegated white at Helsingfors.

V. The colour of the bark of the common spruce varies from whitish grey to brown, probably due to influence of soil and climate. The following sports have been observed.

21. Var. *corticata*, Schröter, *op. cit.* 184 (1898).

Bark thick, up to $3\frac{1}{2}$ in., longitudinally fissured, and resembling that of a pine in external appearance, though in microscopical structure like the ordinary spruce. Schröter knew in 1898 only six spruces with thick bark, occurring in Austria, Bohemia, Hesse, Bavaria, and Switzerland; but more than twenty are now known⁵ in the latter country alone.

22. Var. *tuberculata*, Schröter, *op. cit.* 190 (1898).

Lower part of the stem covered with corky excrescences, projecting about an inch above the surface of the bark, where side branches are given off.⁶ Four examples only were known to Schröter in 1898, two in Austria, one in Bavaria, and one in Switzerland; but Badoux⁵ states that many more have since been found in Switzerland.

VI. In addition to the varieties and sports just described, which are of unknown origin, there are many peculiar forms of the spruce which are due to external influences, and which cannot, properly speaking, be named varieties or sports.

1. The candelabra spruce is often produced, when the leading shoot is broken off by the force of the wind or by other causes. A whorl of secondary branches becomes erect below the broken part of the stem, and forming a series of leaders, grows up, giving the tree a candelabra-like appearance.

2. Dwarf spruces,⁷ which are mere bushes, with irregular branches, dense

¹ Fowler, in *Gard. Chron.* 1872, p. 76, speaks of the inconstancy of the colour in different parts of the tree.

² Cf. Masters, in *Gard. Chron.* vii. 578 (1890).

³ *Kew. Bull.* 1908, p. 391.

⁴ In Hartman, *Skand. Flora*, 35 (1889).

⁵ Badoux, in *Journ. Forest. Suisse*, 1907, quoted by Beissner, in *Mitt. Deut. Dend. Ges.* 1910, p. 122.

⁶ Cf. Cieslar, in *Centralblatt Gesamte Forstwesen*, xx. Heft 4, pp. 145-149 (1894). Schröter compares these corky excrescences with those developed on the stems of *Zanthoxylum*, studied by Barber, in *Ann. Bot.* vi. 155 (1892).

⁷ *Picea ellipsoconis*, Borbas, *Magyar Bot. Lapok*, i. 26 (1902), a shrub-like spruce growing as scrub near tree-limit in the western Carpathians, with short broad cones, is considered by Pax, in *Pflanzenverw. Karpathen*, ii. 177 (1908), to owe its peculiarities to the high altitude, similar shrubs being recorded for the eastern Alps by Beck.

foliage, and numerous leaders occur in alpine regions, and are due either to the severe climate or to constant cropping by goats and sheep.

3. Witches' brooms on the spruce have hitherto been supposed to be due to the irritation of fungi, bacteria, or mites. Tubeuf,¹ in January 1907, sowed seed which he obtained from a witches' broom that had borne cones. The greater part of the seedlings are normal, but a certain number are dwarf and bushy. Tubeuf supposes that some of the former will in time develop witches' brooms on some of their branches, and that the latter will probably remain dwarf, resembling the varieties² *Clanbras-siliana*, *pumila*, etc., already referred to as of unknown origin.

4. Masters³ gives a figure of a remarkable branch of a spruce, in which the leading shoot had split into two portions for some distance, re-uniting above to form again one stem.

DISTRIBUTION

P. excelsa is a native of Europe, extending from the Pyrenees, Alps, and Balkans northward through south Germany and east Prussia to Scandinavia, and eastward through the Carpathians and Poland to western Russia.

In France, the spruce occurs in the mountains, mixed with the silver fir, and in the zone above it, the lower limit in the Vosges and Jura being about 2000 ft. It is not at all abundant in the Vosges, where it ascends to 4300 ft.; but in the Jura covers large areas, and reaches 5000 ft. altitude. It attains its greatest importance in Savoy, which is the only region in France where the spruce is the dominant tree, forming one half of the whole area occupied by forests. The forest of Thônes,⁴ near Annecy, which I visited in 1904, is one of the best examples of a spruce forest in France; and is treated on the selection system. It contains about 320 acres, lying between 2500 and 4300 ft. elevation on a steep slope, and is a mixture of two-thirds spruce and one-third silver fir. The standing timber is estimated at 7000 cubic ft. per acre, the annual felling averaging 53 cubic ft., with a revolution fixed at 144 years.

The spruce is absent in the Cévennes, and is extremely rare on the north side of the Pyrenees, where it is replaced by fine forests of *Pinus montana*. Willkomm records it for the Pyrenees of Catalonia and Aragon, where it is not at all common. Its most southerly point in western Europe is the forest of La Cinca, south of Mt. Maladetta in lat. 42° 30'.

In Germany, the northern limit of distribution, beginning in the Vosges, passes through the Pfalz, and after crossing the Rhine at lat. 50°, makes a bend to the westward through Westphalia, and reaches the Weser Mountains, where, near Minden, the spruce attains its most northerly point as a wild tree in western Germany, lat. 52° 20'. From here the limit passes through Hildesheim, Wolfenbüttel, Walbeck near Magdeburg, and Halberstadt to Altenburg; whence, taking a north-easterly direction, it is continued through Spremburg and Soran to Ostrowo, reaching the Russian frontier at lat. 52°. It then passes northward, parallel with the frontier, to

¹ Cf. Prof. Somerville, in *Quart. Journ. Forestry*, iv. 309 (1910).

² Cf. var. *tabulaformis*, Carrière, *ante* p. 1343.

³ In *Gard. Chron.* xxiii. 274, fig. 52 (1885).

⁴ Cf. *Bull. Soc. Forest. Franche-Comté*, vii. 630 (1904).

Gilgenberg in the province of East Prussia, and reaches the Gulf of Danzig at Elbing. In southern Germany it is scattered, or in small woods in the plains and valleys, being probably planted;¹ and as a wild tree is nearly confined to the mountains, where it occupies a distinct zone, with clearly defined upper and lower limits. The largest pure forests in Germany occur in the Harz mountains, which are almost entirely covered with spruce, ascending to 3300 ft., and in the Iser and Riesen mountains, up to 3900 ft. In the other great forest regions of Germany, as in the Thuringian, Bavarian, and Bohemian forests, the Fichtel and Erz mountains, central Saxony, etc., the spruce, in mixture with the silver fir, covers immense areas. In the province of East Prussia, there are very large forests on the plain, in which the spruce grows in company with the common pine, birch, alder, and willows; but it is absent on pure sandy soils, where the common pine reigns supreme.

The spruce is met with throughout the Alps in Switzerland and Italy, ranging in Tessin between 2700 and 6000 feet, and occupying a small outlying area in the Euganean hills in Lombardy. It is quite unknown in the Apennines.

In Austro-Hungary, extensive forests of spruce, often almost pure, occur in the Carpathians from Silesia to Bukowina, and in the Transylvanian mountains. The largest spruce recorded² is one which grew in the Carpathians, measuring 226 feet in height and 11½ feet in girth at breast height.

In the Balkan peninsula³ the spruce reaches its most southerly limit, a line extending from the mountains of northern Albania to the Kopaonik mountain in Servia, whence it is prolonged eastward to the Rhodope mountains in Rumelia about lat. 42°. In Bosnia, Servia, Montenegro, Croatia, and Herzegovina, the spruce usually grows in mixture with the beech and silver fir, occupying a zone on the mountains between 3000 and 6000 feet; but in northern Albania the lower limit rises to 4000 ft. Huffel⁴ states that in Roumania, the spruce attains enormous dimensions, a tree, which was cut down in 1888 in the forest of Tarcau, measuring 195 ft. in height by 3 ft. 3 in. in diameter at breast height; it was 392 years old. The spruce is much less common in Roumania than the silver fir, ascending to 6000 ft. in Wallachia and to 5000 feet in Moldavia; while in Bukovina the spruce is more abundant than the silver fir, and occupies a zone between 2600 and 5200 ft.

In Russia the southern limit of the spruce (including *P. obovata* and *P. excelsa*) extends from the frontier of Galicia, at lat. 50°, eastwards through northern Volhynia and Starodul in the government of Chernikof, crossing the river Oka at lat. 53° or 54°, to the southern boundary of the government of Kazan. From this northwards to the Arctic circle, the spruce is prevalent; but the exact boundary of the two species is unknown. So far as I have seen specimens, the spruce in Finland and near St. Petersburg is *P. obovata*, which all authors agree is the only spruce found in north-eastern Russia, as nothing like *P. excelsa* is seen to the eastward of the rivers Dwina

¹ It is supposed never to be native in situations below 1300 ft., though it thrives when planted. Left to nature the beech speedily supplants it on all soils at low elevations in southern Germany.

² Wessely, quoted by Mathieu, *Fl. Forestière*, 541 (1897). I have not been able to verify this record; but Schröter and Kirchner, *op. cit.* 115 (1906) state that Enderlin measured in the Grisons two trees as follows:—one, 143 ft. high, 6 ft. 3 in. in diameter, with a volume of 1300 cubic feet; the other, 152 ft. high, 4 ft. 11 in. in diameter, with a volume of 1150 cubic feet.

³ Beck von Mannagetta, *Veg. Illyrisch. Länd.* 287 (1901).

⁴ *Extrait Bull. Minist. Agric. Paris*, 1890, p. 6.

and Viatka. Korsinsky states¹ that the typical form of *P. excelsa* occurs only in western Russia in the region adjoining the German plain; and the varieties which he describes as occurring in central and northern Russia, and linking *P. obovata* with *P. excelsa*, seem to me to be simply *P. obovata* with cones slightly larger than those occurring in the Ural range.

Von Sievers² says that the spruce is the only shade-bearing tree in the Baltic provinces, and attains in favourable situations a height of 160 feet. It occurs naturally on better soil than the pine (which occupies poor sandy soil) and competes with the birch and alder on clay, thriving well on deep peat, if this is rich in mineral salts.

The original conifer of Norway was *Pinus sylvestris*, the remains of which are found everywhere in peat mosses. The spruce is a late emigrant from Sweden and Lapland. It occupies in Norway three distinct regions:³—

A. The spruce is found in the far north in isolated stations, as on the Varangerfjord, lat. 69° 30', at Karasjok, lat. 68° 30', and at Saltdalen, on the west coast, lat. 67° 10'.⁴ The spruce here is *P. obovata*, these stations being outposts of the north Russian spruce, which extends eastwards through Enara Lapland to the Kola peninsula, and through Swedish Lapland from Sulitjelma to Palojuensun on the Muonio river.

B. In the Trondhjem district the spruce reaches the coast, and is connected with the northern Swedish spruce, through four passes in the range separating Norway from the Swedish province of Jemtland. This spruce is *P. obovata*.⁵

C. In southern Norway the spruce, which appears to be *P. excelsa*, occupies a distinct area, separated from the last by the Dovrefjeld, and continuous with the spruce forests of south Sweden, there being no high mountains intervening between the two countries for a considerable distance north of Svinesund. Throughout this region, no remains of the spruce have been found in peat mosses, though those of the common pine are plentiful; and the spruce is evidently a late emigrant, not having yet reached the west coast. Through Romsdal, Bergenhus, and Stavanger provinces, and the district of Lister, the area covered by forest is not extensive, the principal trees being pine and birch, while the spruce is rarely if ever found wild, except in the inland district of Voss, situated about 40 miles east of Bergen. According to Schübeler, the spruce ascends on the Jotunfjeld to 3250 feet, and in Hallingdal to 3400 feet. South and east of the mountains, the greater part of the very extensive forest area consists of spruce, mixed to some extent with pine and birch. The Norwegian spruce is said to contain a relatively small amount of resin, and is therefore largely used in the production of mechanical and chemical wood-pulp, an industry, which in some places has begun to threaten the continued existence of the spruce forests. The spruce bark is also used for tanning.

¹ *Tent. Fl. Ross. Orient.* 494 (1898).

² *Forst. Verhüll. Balt. Prov.* 18 (1903).

³ Cf. Semander, in Engler, *Bot. Jahrbüch.* xv. 3 (1893).

⁴ Elwes found it here in 1903 only as a rare isolated tree, and was told that the Rancenfjord, 50 miles south was its real northern limit.

⁵ Specimens collected at Trondhjem and at Bräcke in Sweden are identical, and are indistinguishable from specimens gathered in Perm in north-eastern Russia.

In Sweden the exact limits¹ between *P. obovata* and *P. excelsa* are unknown to me; but there is no doubt that in the northern part of the country, from Jemtland northwards, *P. obovata* is the sole species. In southern Sweden, the tree appears to be *P. excelsa*,² and its distribution³ is peculiar, as it does not extend to the extreme south, not occurring in Skåne north of lat. 56° 10', and not extending to nearer the west coast, from Strömstad to Halmsted, than fifteen miles at any point. Its remains have not been found in the peat mosses south of Jönköping on Lake Wetter; and it is supposed to have spread southward of this point in quite recent times; and this is confirmed by ancient maps of North Skåne, which show that there were no spruce forests in this district at the beginning of the 17th century. (A. H.)

In Scandinavia the spruce is called *gran*, or *rödgran*. From what I have seen in the forests of north and south Trondhjem it is usually found on the better class of land, and even there does not grow so large as farther south, ascending to about 2000 ft. in Tydal and Stordal, and attaining about 100 ft. in height by 8 to 10 ft. in girth. I have not noticed, even near the coast, that the trees are browned by the west wind, as they are sometimes even, far inland, in England, but the tree is rarely seen on the exposed parts of the coast, or on the islands, where the Scots pine grows alone. Schübeler, *Viridarium Norvegicum*, figs. 66, 68, 69, figures three trees remarkable for their habit, one having the branches very short and crowded on the upper part of the stem, and another a good example of the snake spruce, var. *virgata*, Caspary. Figures 73, 74, and 75 show instances of natural layering; and figures 76 and 77, trees grown from a fallen stem. Figure 78 shows a candelabra-shaped tree growing near Horten in the Christiana fjord.

It is stated that the varieties known in cultivation as vars. *nana*, *inverta*, and *Clanbrassiliana* have all been found wild on the coast of Norway.

The tallest spruce mentioned in Norway by Schübeler was in Hurdalen (lat. 60° 24'), and measured 130 ft. high by 3 ft. 5 in. in diameter; and I am informed of one recently cut in South Rendalen, which was 125 ft. high, and 15 in. in diameter at 80 ft. from ground, and 25 in. at 20 ft. Five logs over 20 ft. long were cut from this one tree.

The largest spruce I have heard of in Sweden is mentioned by Schübeler (p. 409). It grew in Oster Gotland (lat. 58°) and measured 150 Swedish feet (44.54 m.), with a diameter of 6 ft. (1.78 m.).

In Professor Göppert's memoir⁴ on the *Primeval Forests of Silesia and Bohemia* there are many illustrations of the remarkable forms which the spruce assumes when left absolutely in a state of nature, in regions where the snow lies long and deep. These forests are not described in detail, but are above the region of deciduous trees, and consist mainly of spruce and silver fir, with *Sorbus Aucuparia*, *Salix silesiaca*, and *Lonicera nigra* as underwood. Many of the fallen and rotting

¹ Wittrock, in *Act. Hort. Berg.* iv. No. 7, p. 69 (1907), agrees with me in laying stress on the character of the twigs in the discrimination of the two species, *P. obovata* and *P. excelsa*, which he considers to exist in Sweden. Cf. his article in Krok, Hartman's *Skand. Flora*, 1889, p. 34.

² Cf. Sylven, in *Skog. Tidsk.* 1909, Fack. pp. 201-261.

³ Cf. Hesselman and Schotte, in *Medd. Stat. Skogsforsöksanstalt*, Heft 3, pp. 1-52, with maps (1906).

⁴ Göppert, *Skizzen zur Kenntniss der Urwälder Schlesiens und Böhmens*, in *Nova Acta Acad. Leop. Carol. Nat. Cur.* xxxiv. (1868).

stems are covered with trees which have sprung from seeds germinating in the moss on these trunks. Göppert mentions one about 50 ft. long on which he counted thirty-six living trees of various ages from 4 ft. to 80 ft. high. On another 70 ft. long, there were thirty-two trees from eighty to one hundred years old, all of which had their roots resting on the fallen tree which had given them birth. Such examples are figured in his plates vii., viii., and ix.

Another form is shown in plate ii., figs. 7, 8, and 9, which illustrate trees which have grown from seeds falling on stumps of broken or dead trees at a considerable height from the ground, and which have forced their roots down through the decaying wood, in one case from a height of 16 feet, to the ground. When the stump decayed the roots were strong enough to support the young tree, which eventually was left standing like a Pandanus on a pyramid of its own roots.

In some cases, as shown in plate iv., fig. 11, two trees which had originated separately on the same stump became perfectly inarched at the root. Plate iv., fig. 12, shows a remarkable instance of a stump no less than 6 ft. in diameter, which had become covered with a thick layer of moss, and assumed the appearance of a gigantic mushroom, on the top of which no less than seven young spruces from 2 to 40 ft. high were growing without their roots having reached the ground at all.

Plate ix., fig. 22, proves, according to Göppert, the immense period which may elapse in these forests before the fallen trees are absolutely decayed and resolved into humus. It shows, *A*, a fallen tree, of which the wood was nearly all dissolved into long brown pieces, only held together by the overgrowing thick moss, into something like the original shape of the trunk; *B* is a tree which had fallen on the top of it at a later period, and was decayed about half through; *C* is a living tree estimated at 300 years old, which had germinated on *B*, and buried its roots partly in and partly on one side of it. Göppert believes that from 1000 to 1200 years may have elapsed since the germination of the lowest tree, *A*; but it seems to me that even if it was 400 years old when it fell, the second, *B*, may have fallen soon afterwards, and owe the slower decay of its wood to the comparative dryness of its position above *A*. Still it proves that the decay of such a comparatively soft wood as spruce or silver fir (the species is not in this case specified) is extraordinarily slow under the conditions prevalent in these forests.

As a proof of its slowness of growth in some instances Forstmeister John remarked that the spruce in the densest parts of the forest attained an age of 120 to 160 years without exceeding 5 to 7 in. in diameter. I have myself cut in Norway a spruce which showed over forty annual rings, and was still thin enough to serve as a walking-stick, which I used through three seasons of elk-hunting before it broke under my weight.

In the Böhmerwald the spruce comes to perfection at a higher level than the beech and silver fir, from 3000 to 3400 feet; and in the Kubany forest there are thousands of trees from 120 to 150 ft. high, and 12 to 16 ft. in girth. It attains a greater age than the silver fir, some trees showing no less than 700 annual rings, though still quite sound. From 3600 ft. up to the highest peaks, which in this range of mountains attain little over 4500 ft., the spruce changes its habit, the stems

becoming shorter and the branches more spreading and drooping on account of the heavier snowfall, so that when adult they assume a regular pyramidal or conical shape. At 3500 ft., a tree 3 ft. in diameter showed 420 rings; and on the top of Kubany at 4100 ft., another with a diameter of 2 ft. had 235 rings. On the Arber mountain, the highest peak of all, at 4200 ft., Göppert saw a tree 3 ft. thick, but only 40 ft. in height; but even at this elevation the majority of the trees are neither crippled nor diseased, as is often the case near the limit of trees in the Alps and Riesengebirge, where they are covered with lichens.

Above these altitudes the lower branches often spread on the ground and form natural layers, which grow upright and make a colony of small trees around their parent. Such an instance is shown in plate i. fig. 2, and another even more curious on fig. 3, where the main trunk of a tree about 5 ft. in girth curved to one side and threw up a secondary straight stem from the nearly horizontal part of its bole. Figure 4 shows a fallen stem 32 ft. long, which remained living and bore no less than five erect trees from 10 to 37 ft. high, which apparently drew the whole of their nourishment from the original roots of the parent tree.

Another peculiarity which occasionally appears in these forests are trees with immense swellings on their trunk, in the form of irregular burrs equally developed all round the trunk. Plate i. fig. 5, shows a spruce 18 in. in diameter at the ground, which has a regular swelling, shaped like a flattened orange, no less than 12 ft. in diameter, and from the centre of which the straight trunk again emerges with a diameter of 16 in. Göppert saw in Silesia an even more extraordinary tree (plate i. fig. 6), which was 45 ft. high and 2 ft. in diameter near the ground. At 7 ft. a regular swelling suddenly began (which is described as covered with many branches, but in the drawing shows none on one side) with a diameter of 10 to 12 ft. and 23 ft. high, above which it tapers off into a normal stem. No disease could be found in the bark or wood, which appeared completely sound, and the upper part of the tree is shown crowded with healthy branches.

A remarkable group of four spruces growing at timber line (about 1850 metres altitude), on the north side of the Great Scheidegg, is figured by Dr. Klein,¹ which from their position appear to have all sprung from seeds which have grown on a rotting trunk. Another remarkable illustration of the effect of wind on the growth of the spruce at high elevations is shown in plate 54 of the same work. A group of trees growing at about 4600 ft. on the Feldberg in the Black Forest, from 10 to 16 ft. high, have the branches cut off clean on the west side, which is attributed by Dr. Klein not alone to the drying effect of the wind in winter and spring, but also to the heating of the branches on one side only by the sun. In the same work are several illustrations of the dense spruce bushes, called "feisstannli" by the Swiss, which are common in alpine regions, and are caused by the constant cropping of goats and sheep.

In the virgin forests of the Capella Mountains in Croatia I saw, in 1910, some spruce of immense height;² and measured one of about 170 ft. by 12½ ft. I was informed that, in this forest, spruce had been felled 190 ft. high and about 12 ft. in

¹ Karsten and Schenck, *Vegetationsbilder*, 11, t. 38 (1905).

² Cf. *Quart. Journ. Forestry*, v. 31 (1911).

girth, and that about 300 years is the maximum age at which this tree remains sound.

The spruce is not a native of Britain at the present epoch; but remains of it have been found in pre-glacial beds at Cromer, Mundesley, Bacton, and Happisburgh in Norfolk.¹

CULTIVATION

It appears to have been introduced early in the sixteenth century, as Turner includes it in his *Names of Herbes* published in 1548; and both Gerard and Parkinson state that it was found in different parts of Britain.

The spruce is easy to raise from seed, but the seedlings grow very slowly for the first three or four years, and are rarely large enough to plant out until they are four to six years old. I have noticed a great deal of variation in the time at which their new growth appears, and it is well to separate the earliest, which are very liable to be injured by spring frost, whilst those which do not start into growth till June remain uninjured. Few conifers are easier to transplant either in spring or autumn, provided the roots are not allowed to become dry; but if exposed to the air in dry or cold weather a good many will die, or languish for two or three years after planting.

The tree grows on almost any soil, but requires a sheltered situation to attain a great height and only comes to perfection where the soil is moist and not liable to dry up in summer. Grown in dense woods, the spruce is liable to be blown down by the wind; but isolated trees make much stronger roots and are moderately storm-firm. In places near the sea the foliage is often injured by the salt contained in the air, and even as far as forty miles from the Bristol Channel I have seen the spruce completely browned on the side exposed to the wind in March.

Though the seed ripens freely in most seasons and germinates readily, the spruce rarely reproduces itself from seed in England owing to its slow growth at first and the weak hold of its young roots on the soil, which cause the seedlings to wither up in summer or to be thrown out of the ground in winter. I only know a few places on my estate where self-sown spruce can be found; and the seedlings have grown so slowly that I am convinced it is not an economic practice to reproduce spruce by seed, except in places where the ground is under snow for a long period. In the Highlands among heather self-sown seedlings are much commoner; and on the shores of Loch Rannoch and in some of the old pine woods at Castle Grant there are considerable numbers of self-sown seedlings, but nothing like the number seen in Scandinavia or in the German forests, where they are protected by deep snow for a long period in winter.

The spruce is a tree which has been planted more largely in England than it deserves to be; for though it will, when established, grow on poor ill-drained soil faster than most conifers, yet the value of its timber when felled is less than that of almost any other tree; and it is, on account of its shallow rooting habit, very likely to be blown down if the wind once gets into the plantation.

¹ C. Reid, *Origin of British Flora*, 151 (1899).

As a nurse it is, on land unsuitable for Scots pine, one of the best we have, if not allowed to overcrowd the hardwoods planted with it; because its branches protect the ground from frost and drought, and its rapid growth acts as a wind-break and draws up the other trees. Its roots are more superficial than those of larch or Scots pine; and it is much cheaper to plant and less liable to injury from frost than silver fir. Loudon quotes (*Arb. et Frut. Brit.* p. 2305) the experience of W. Adam, Esq., of Blair, Kinross-shire, who was a great advocate of planting spruce as a nurse to oak and elm; but it must be cut out or its lower branches lopped before it becomes large.

In the east and north-east of Scotland the tree seems more promising as a forest tree; and in the opinion of Mr. Crozier may produce a more valuable crop than either larch or Scots pine at considerable elevations. He gives me particulars of a plantation of 400 acres on the Durriss estate, at an elevation of over 800 ft., which was marketed under his own supervision. The age of the trees was sixty years, the number per acre 560, averaging 10 cubic feet each. Sold standing at 5d. per foot they realised £116 per acre. Some parts of this plantation planted with Scots pine only made £15 per acre, and the best of it under larch was estimated at £70 per acre. In this plantation the spruce was planted in patches, none over three or four acres, usually on sites unsuitable on account of excessive moisture for larch or Scots pine. The greater parts of the area, however, might well have been planted with spruce, as the locality is favourable to its growth, and similar results to the above are the rule rather than the exception on the whole estate. I have lately received from Mr. D. Munro of Banchory a photograph (Plate 371) of this plantation, most of the trees in which were blown down after it was sold. Mr. Crozier states that there is a large demand for home-grown spruce boards for box-making in Scotland, but that the wood must be fairly free from knots and discoloration; and he considers it one of the most useful timbers for house-building. He adds that when planters realise that the limit of altitude for spruce planting lies above the pine belt, and not below it as seems to have been the general idea, and that it must be grown thicker than larch or Scots pine, its economic merits will become more evident than they are at present.

In confirmation of Mr. Crozier's opinion that spruce is a valuable tree for planting for profit at a high elevation, I may refer to Messrs. Robinson and Watt's very full report¹ on the Coombe Plantation, which lies between 900 and 1500 ft. altitude near Keswick in Cumberland. This plantation, which was sixty-one years old in 1910, consists mainly of larch, with a mixture of spruce, amounting to only one or two per cent at the lower levels, but to ten per cent at over 1250 ft. These authors state that here "spruce grows well at all elevations, and everywhere attains a greater volume than larch under the same conditions." At the higher altitudes it much exceeds the larch in volume. The influence of altitude and exposure on the spruce itself is shown in the following table:—

¹ *Journ. Board of Agric.* xvii. 273, 360 (1910).

Elevation : feet.	Height of tree in feet.	Quarter-girth measurement, in cubic feet.
900	80	44
1150	not stated	32
1250	"	26
1450	48	8
1520	35	4

I have failed to obtain any other exact and reliable figures as to the value of a crop of spruce grown in England, except on such small and isolated patches of land, that they would give no fair criterion.

As a shelter tree it makes a good edging to the roads in a plantation, and can be headed down or clipped when it has grown tall enough to keep the wind out. It bears clipping well and makes a good dense hedge on soils not liable to drought.

Sargent¹ states that as an ornamental tree in America, it loses vigour at twenty-five to thirty years old, except in the most favourable situations; and he only recommends it as a nurse for other trees, as it is very hardy and grows rapidly at first. As a proof, however, of the extremely vigorous growth of the spruce in America, I may say that the tallest tree in Mr. Hunnewell's Pinetum at Wellesley, Mass., which I had the pleasure of visiting with Professor Sargent in 1904, was a Norway spruce which was planted about 1852, and was in 1894 80 ft. high with branches spreading over a circle 60 ft. in diameter. When I saw it, it had increased little in height, but its lower branches had spread to 75 ft. diameter and some of them had rooted; flowers were just showing on May 9, and cones were produced on branches close to the ground, which is rarely the case in Europe. This tree is figured on Plate 340.

According to Pinchot,² it thrives throughout the entire north-east of the United States and southward at the higher elevations; but in the west, favourable results have been attained only as far as the eastern part of the prairie region, and then only in the more protected localities. He considers that it should be planted on a large scale in the cut-over land in the north, where the tree will provide a future supply of wood pulp, as it is in every way superior to the native spruces.

REMARKABLE TREES

If I could trust the measurements which have been given me I should say that the tallest spruce in this country is a tree at Rooksbury Park, Hants, the seat of J. C. Garnier, Esq. It is in a densely crowded thicket of rhododendron, surrounded by beech, and was said by Mr. A. Arnold to measure no less than 178 ft.; but after seeing it twice I could not believe that it was over 150 ft., and, owing to its position, could not measure it myself.³

In Oates Wood at the top of Cowdray Park, near the superb silver fir figured

¹ *Silva N. Amer.* xii. 24, note (1898).

² *U.S. Forest Service, Planting Leaflet*, No. 20 (1908).

³ At my request Mr. Arnold has recently re-measured this tree with a theodolite, and informs me that though he could not get a clear view of its top, he now estimates it at 149 feet.

on Plate 208, there are two remarkably tall trees, which in 1903 I estimated at 140 to 150 ft., but owing to the steep slope on which they grow, and to the adjoining trees, I could not measure a base line. They were 11 ft. 6 in. and 10½ ft. in girth in 1906. Mr. Harold Pearson has recently had these measured by Mr. T. Roberts, forester at Cowdray, who informs me that he levelled a base line, and found the height in January 1911 to be 153 ft.; but this tree which has three leaders is not so handsome as the other, which he thought was about 148 ft. high.

The tallest which I have myself measured are two trees growing on the edge of the lake near Fountains Abbey, Studley Royal, Yorkshire, which Loudon describes as the tallest spruces known to him, and says were 132 ft. high. When I saw them in 1905 I found one to be 140 ft. by 12 ft. 10 in., and the other 137 ft. by 11 ft. They are free from branches for 30 to 40 ft., and seemed in excellent health, though probably over 150 years old (Plate 341).

In Earl Bathurst's woods at Cirencester there are two narrow avenues of spruce known as the Cathedral firs, because they resemble the cross aisles of a cathedral. Of these Plate 342, from a negative taken by Mr. T. E. Gerald Strickland, gives an excellent picture as they were four years ago, but since then several have been blown down, one of which was over 100 ft. high, and showed on the stump 134 annual rings. Those standing average from 110 to 120 ft. high by 8 to 10 ft. in girth.

On my own land at Lyde near Colesborne, in a deep sheltered valley, there is a tree about 125 ft. by 8 ft., but this is beginning to decay at the base, though not much over 100 years old.

At Bowood, Wilts, I saw a very fine tree which measured, in 1908, 125 ft. by 10 ft. 8 in.; but there may be better ones here.

On the Earl of Powis's estate at Walcot, Shropshire, there is a wood of spruce about 100 years old on a steep hill-side next to the Plassey plantation, a photograph of which has been reproduced in the *Quarterly Journal of Forestry*, iii. p. 358. I have seen no spruce plantation in England which equals this, and am indebted to Mr. R. H. Newill, agent for the estate, for the following account:—

“When I came to measure up an area in the Spruce Plantation, near Plassey, I found it difficult to find a piece without any gaps in it, as the wind has been busy of late years, and has blown down many trees. Eventually I chose a piece near the top and squared 1½ chain along the bank and 1 chain down it, an area of 0.15 acre. On this were twenty-two trees standing, of which I enclose measurements.¹

No.	Length, Feet.	Quarter-girth, Inches.	Cubic Feet.	No.	Length, Feet.	Quarter-girth, Inches.	Cubic Feet.	No.	Length, Feet.	Quarter-girth, Inches.	Cubic Feet.
1	80	9½	50.1	9	80	12	80	16	78	12	78
2	76	9½	47.7	10	82	13½	103.9	17	80	11½	73.5
3	79	12	79.	11	75	11	63	18	81	8½	40.7
4	80	8	35.6	12	80	14	108.10	19	76	13½	96.2
5	71	9	39.11	13	80	12	80	20	39	13½	49.4
6	84	10	58.4	14	35	9	19.8	21	21	7	7.1
7	81	9½	50.9	15	70	13½	88.7		15	5	2.7
8	83	9½	52.		12	6½	3.6	21	75	9	42.2
								22	74	10	51.4

Total 22 trees, 1401 cubic feet.

These vary from 19 to 103 cubic feet, and average 63.7 cubic feet. I found stumps of seven more trees on the area, and taking them at the same average there would be about 1849 feet; or about 193 trees measuring 12,326 cubic feet per acre.

The age of the trees is about 100 years; the rings are well marked to eighty-five years, afterwards so very close together that it is difficult to count them. All the trees are going back very fast, I believe every one is decayed at the butt; and in the lower part of the plantation many are blown down or broken off each year. We could only obtain 3d. to 4d. per foot for this class of timber, and it was in order to turn it to a more profitable use, that I put down the creosoting plant.”

Assuming that this plantation had been clean felled at eighty years of age and that it had then contained 10,000 cubic feet per acre, the annual increment would have been 125 feet per acre; and taking the price at 4d. per foot standing the value of the crop would have been £166 per acre.

The trees are facing north-east at an elevation of 600 to 900 ft., and the old red sandstone here seems to suit all kinds of trees, both hardwoods and conifers, as well as any soil in England.

At Kyre Park there is a remarkable old spruce of the candelabra type which has an immense rugged bole broken off at about 30 ft., and 15 ft. 9 in. in girth. One of its upright branches is no less than 10 ft. 4 in. in girth, and twelve others have naturally layered themselves in a circle 64 ft. in diameter, and grown up into trees, two of which are 90 ft. high by 8 ft. in girth.

Another remarkable instance of layering in the spruce is at Langley Park, Slough, where a tree on the lawn has been broken off at about 20 ft. and whose lower branches have formed a complete bower, resembling on a smaller scale that formed by the Whittingehame yew. Some of the small branches, only one to three inches thick, have formed a woody mass and thickened enormously at the point where they have taken root.

In Wales the finest spruce we have seen are in a wood above Gwydyr Castle, where in 1905 I measured two trees in a grove round the bowling green, which were about 125 ft. high by 9 ft. 8 in. and 6 ft. 10 in. in girth. In this grove, which is shown in Plate 343, the spruce seems to clean itself better than in England, and I estimated that there might be 8000 to 10,000 cubic ft. per acre. Mr. Richards, forester to Lord Penrhyn, informed me that at Tyn-y-Coed in the same district of North Wales, a spruce plantation was felled in 1902 and sold to Mr. J. Jones of Liverpool, a tree in which is said to have been 149 ft. high, and that 158 trees in this wood contained 11,937 cubic ft., an average of over 75 cubic ft.; two of them measuring respectively 80 ft. by 23 in. quarter-girth = 294 cubic ft., and 67 ft. by 27 in. = 338 cubic ft. It is evident from these figures that even if the value of the timber is low as compared with imported spruce, yet that it may pay well in this particular district, provided the trees are grown thickly enough.

In Scotland the largest spruce of which we have any record grew at Blair Atholl, and was visited by the Scottish Arboricultural Society in 1879. It was then said to measure 142 ft. high, and to contain over 420 cubic ft. of timber.¹ I

¹ Hunter, *Woods of Perthshire*, 60 (1883).

was informed by the late Mr. Pitcaithley, forester to the late Earl of Mansfield, that this tree was blown down about 1893, when the height above given was verified.

The tallest that we now know of, are probably some trees on the banks of a deep glen at Dupplin Castle, which I saw in 1907, and on account of their leaning to one side could not measure accurately, but thought must be from 130 ft. to 140 ft. high. A fine tree in the same place, dividing into two stems at thirty feet from the ground, measured about 100 ft. by 12 ft. 10 in.

At Methven, Henry measured a tree in 1904 as 125 ft. by 8 ft. 3 inches.

At Inveraray I saw trees over 120 ft. by 8 to 10 ft., and the forester, Mr. Campbell, told me that he had measured one blown down on Ben-y-Cuach 130 ft. long. In the woods of Glenarary the spruce seems to grow very well, being sheltered from the westerly gales; but I do not remember to have seen such large or thriving trees elsewhere on the west coast of Scotland.

In the east of Sutherlandshire, I am told by Mr. Gillanders that spruce grows well and cleans itself better than in the south.

In Ireland we have not seen any trees of extraordinary size, and as a rule the climate is not adapted to the production of high-class spruce timber. But Mr. A. E. Forbes has sent me an account of a remarkable plantation near Fermoy, which I reproduce verbatim, and am indebted to Lieut. and Quartermaster T. Smith, R.E., for a negative which gives a good idea of this plantation (Plate 344).

"A very fine clump of common spruce is growing in Glenshiskin Wood, which forms part of the property purchased by the War Department a few years ago near Kilworth. This wood occupies a valley running into the Kilworth mountains, a low range of hills formed from the Old Red Sandstone formation. A small mountain stream flows down the centre of this valley, and at one point, about 300 feet above sea-level, an alluvial deposit has been formed along its course of about an acre in extent. In this deposit a clump of almost pure spruce was planted about eighty years ago, and judging from appearances was never thinned or attended to in any way. From time to time poles were doubtless removed from it as required; but no systematic thinning could have been carried out, as many of the trees still stand within four or five feet of each other.

"This clump probably presents as fine an example of spruce growth in Britain as can be found anywhere. The trees vary in height from 90 to 110 ft., and form long clean poles with little taper, and ranging from 8½ to 18 in. quarter-girth at 4½ ft. from ground. The trees in two-thirds of an acre were carefully measured by Mr. M'Rae, forester at Dundrum, Co. Tipperary, in the spring of 1910, and the summary of the results obtained is given below:—

	No.	Age.	Average Height.	Average Quarter-girth at 4½ ft.	Total Cubic Contents.
Spruce	161	78 years	98 feet	12½ in.	8050
Larch	11	"	99 "	12½ in.	550
Stumps of Felled Trees	110	...	...	...	...
					8600

"By dividing the trees into three stem classes, a volume of 9600 cubic feet was obtained. Assuming the estimate of 8600 ft. to be correct, the average contents of the trees is about 50 ft., and the total yield per acre would be over 12,000 cubic ft., which for the period of eighty years is higher than anything I have heard of in Great Britain.

"Within recent years, trees similar in size to those still standing have been removed, and the stumps still exist. It is quite possible, therefore, that the existing crop is smaller in volume than that which stood on the ground a few years ago. The high yield is, of course, largely due to the exceptionally favourable soil and situation of the site on which the trees were grown. A fine, rich, and well-drained soil, well provided with soil and atmospheric moisture, and a situation sheltered from all winds, provide ideal conditions for the growth of spruce or any other tree able to thrive with a moderate amount of summer heat. Oak and beech growing in the immediate vicinity of these trees are very poorly developed and covered with lichen and moss, indicating the cool and humid conditions which prevail."

TIMBER

Next to that of the Scots pine, the wood of the spruce is the largest import from the Baltic; and from Norway the proportion of spruce timber is probably greater. On account of climatic and economic causes, it seems probable that this will always be the case, though in the west coast ports American spruce takes its place. For scaffold and ladder poles, small spars and masts, and oars, we cannot hope to compete with the north of Europe; whilst for flooring, joists, and almost all purposes except those for which knotty boards are not objected to, it seems equally hopeless for British growers to attempt to compete with the well-known white deal of commerce.

The reasons why the value of home-grown spruce timber is so low are, first, its very knotty character, caused by the persistence of the branches, which die more slowly than those of other conifers; and, secondly, its want of strength and durability as compared with larch. Continental foresters tell us that the first defect may be obviated by close planting, and cite the large profit which is derived from this tree in Germany and Scandinavia. I have inquired of many of our best practical foresters; but I have never been able to find any plantation in England, and only very small areas in Scotland, Wales, and Ireland, where spruce, which stood close

enough to kill the branches, have attained a considerable size, or where a spruce plantation has been a really profitable investment.

My own experience is, that land where spruce may be well grown is fit to produce a much more valuable timber, and that on ordinary land it will starve to death before it will clean itself from branches. The late Mr. Philip Baylis, Deputy-Surveyor of Dean Forest, told me that spruces there, 50 to 60 ft. high, and so thickly planted that no vegetation would exist under them, still retained the dead branches to within 5 or 6 ft. from the ground; and I think that this will apply to most places in England and Scotland.

When the tree is of large size it usually becomes rotten at the heart near the ground; and the top is often broken by the wind. Though the timber may be worth 4d. to 6d. per cubic foot for rough boarding or packing-cases, or for temporary sleepers and pit props in collieries or railways under construction, yet in quantity it is the most unsaleable wood we have. When, as often happens, large quantities are blown down by a heavy gale, I have known cases where no one would go to the expense of cutting up and removing the trees if they had them for nothing, and the proprietor has had considerable expense in doing so without any return whatever. When blown down, the shallow spreading roots tear up the ground for some distance round the tree and are very costly to get rid of, or if left leave the ground in a bad state for re-planting.

Where, however, the soil and climate allow the spruce to be crowded closely enough to clean itself, before it becomes rotten at heart or is blown down, spruce timber may be used for estate building purposes, if not with actual economy, yet in many cases more advantageously than by selling it. Sixpence per foot is something like the average price, though 3d. to 4d. often has to be accepted.

On shallow and dry soils the spruce often begins to decay at the heart for some feet from the ground at the age of fifty to seventy years, and on such soils should not be planted at all. Its spreading roots, which are extremely tough and elastic, are used in Scandinavia for the knees of boats, though rarely so utilised in England. The tough and durable branches made into a wattled fence will last for a long period, and are the common farm fence in many parts of Norway and in the Alps.

When facilities exist for creosoting, spruce may be used for fencing and other outside work, such as sheds and outbuildings; but unless treated with some preservative it soon decays when exposed to wet and dry.

The spruce trees which produce the *bois de resonance*, used for sounding-boards in musical instruments, grow at high elevations in the Alps, the Jura, and in the Bohemian and Bavarian forests. These are very old trees, the growth of which has been extremely slow and very uniform, the annual rings not exceeding $\frac{1}{2}$ in., and containing only a slight amount of autumn wood. These trees are usually covered with lichens, and their selected timber sells at very high prices, as much as 9s. to 12s. per cubic foot.

Burgundy pitch is a resinous product of the spruce, well known under the name of *Burgony Pitch* and *Pix Burgundica* as long ago as 1640. It was formerly

produced in the Vosges Mountains, but now, according to Flückiger and Hanbury,¹ mainly in Finland, the Black Forest, Austria, and Switzerland. Flückiger states that at Oppenau, in Baden, the principal place of its manufacture in Germany, it is mixed with French turpentine from Bordeaux and with rosin from N. America; and the tapping of the trees in Government forests in Baden and Württemberg is now prohibited on account of the injury caused thereby to the timber. It is very generally adulterated in England, and is mainly used as an ingredient in plaisters.¹

(H. J. E.)

PICEA OBOVATA, SIBERIAN SPRUCE

- Picea obovata*, Ledebour, *Fl. Alt.* iii. t. 499, iv. p. 201 (1833); Trautvetter, in Middendorf, *Reise*, i. pt. ii. 87, 170 (1847); Maximowicz, *Prim. Fl. Amur.* 261 (1859); Regel, *Tent. Fl. Ussur.* 137 (1861); Herder, in *Bot. Jahrb.* xiv. 160 (1891); Willkomm, *Forstliche Flora*, 93 (1887); Kent, Veitch's *Man. Conif.* 441 (1900); Komarov, *Fl. Mansh.* i. 197 (1901); Clinton-Baker, *Illust. Conif.* ii. 42 (1909).
Picea vulgaris, Link, var. *altaica*, Teplouchoff, in *Bull. Soc. Nat. Mosc.* xli. pt. ii. 250 (1869).
Picea excelsa, Link, var. *obovata*, Schröter, in *Viertelj. Naturf. Ges. Zürich*, xliii. 138 (1898).
Pinus Abies, Pallas, *Fl. Ross.* i. 6 (1784) (not Linnæus).
Pinus obovata, Antoine, *Conif.* 96 (1840-1847).
Pinus orientalis, Ledebour, *Fl. Ross.* iii. 671 (in part) (1847-1849) (not Linnæus).
Abies obovata, Don, *ex Loudon, Arb. et Frut. Brit.* iv. 2329 (1838).

A tree, attaining in Russia and Siberia the dimensions of *P. excelsa*, which it resembles in habit of growth and in bark. Young branchlets reddish brown, covered with a dense minute pubescence, which is retained for several years, the older branchlets becoming greyish yellow. Buds, about $\frac{1}{2}$ in. long, conic, composed of closely appressed scales, rounded at their apices; terminal bud girt with a ring of keeled acuminate ciliate scales, and closely surrounded at the base by the uppermost leaves. Leaves, arranged as in *P. excelsa*, deep green in colour, $\frac{2}{3}$ to $\frac{3}{4}$ in. long, ending in a short point, quadrangular in section, with three to four stomatic lines on each side.

Cones $2\frac{1}{2}$ to $3\frac{1}{2}$ in. long, $1\frac{1}{4}$ to $1\frac{1}{2}$ in. in diameter when open, shining brown when ripe; scales numerous, thin, tough, flexible, longer than broad, $\frac{6}{10}$ to $\frac{7}{10}$ in. wide, and $\frac{7}{10}$ to $\frac{9}{10}$ in. long, fan-shaped, widest near the upper edge, tapering to the base on each side; upper margin thin, undulate, rounded or with a slightly projecting occasionally bifid apex; exposed part pale brown, glabrous; concealed part reddish brown, minutely pubescent; flat or slightly concave internally from side to side; bract $\frac{1}{2}$ in. long, lanceolate, narrowing to an acute denticulate apex. Seed $\frac{1}{2}$ in., brownish black; seed with narrow wing $\frac{2}{3}$ to $\frac{3}{4}$ in. long, broadest near the rounded denticulate apex.

The description of *P. obovata* given above is drawn up from specimens procured from Siberia, and from Perm in Russia, by Mr. H. Clinton-Baker, from specimens collected in Finland by Mr. M. P. Price, and from specimens which I gathered in

¹ *Pharmacographia*, 616 (1879).

northern Sweden, near Bräcke, and in Norway, near Trondhjem; all agreeing in the character of the cones, branchlets, buds, and leaves, and constituting, in my opinion, a species distinct from *P. excelsa*, of which *P. obovata* is generally considered to be a variety by Schröter and other modern botanists. These authorities have apparently paid no attention to the characteristic pubescence of *P. obovata*, a matter of importance, as in the genus *Picea* the presence or absence of pubescence on the branchlets is one of the most diagnostic features in the discrimination of the different species. The cones, moreover, are amply distinct in the two species.

P. obovata varies somewhat in the size of the cones and in the shape of their scales; and two main varieties have been distinguished, which are, however, connected by intermediate gradations. These varieties are: (a) the typical form described above, which is characterised by the scales of the cone being entire on margin; and (b) var. *fennica*.

1. Var. *fennica*, Henry.

Picea excelsa, Link, var. *fennica*, Schröter, in *Viertelj. Naturf. Ges. Zürich*, xliii. 138 (1898).

Picea excelsa, Link, var. *medioxima*, Willkomm, *Forst. Fl.* 75 (1887).

Picea vulgaris, Link, var. *uralensis*, Teplouchoff, in *Bull. Soc. Nat. Mosc.* xli. pt. ii. 250 (1869).

Pinus Abies, Linnæus, var. *fennica*, Regel, in *Gartenflora*, xii. 95 (1863).

Pinus Abies, Linnæus, var. *medioxima*, Nylander, in *Bull. Soc. Bot. France*, x. 501 (1863).

Pinus Picea medioxima, Christ, *Flore de la Suisse*, 254 (1883).

Abies medioxima, Lawson, *Pinet. Brit.* ii. 159 (1867).

Cone-scales, with their upper margins rounded and finely denticulate. Leaves dark green in colour.

According to Schröter this variety occurs sporadically in Amurland and Siberia, and is the common form in the Ural range and throughout Russian Lapland, northern Sweden, and northern Norway, occurring with less frequency in Finland, Livland, Kazan, and Poland. Solitary trees with cones similar to this variety have also been recorded from numerous stations in the mountains¹ of central Europe, from the Vosges and Jura throughout the Alps to the Carpathians and Bosnia.

2. Var. *alpestris*, Henry.

Picea alpestris, Stein, in *Gartenflora*, xxxvi. 346 (1887).

Picea excelsa, Link, var. *alpestris*, Schröter, *op. cit.* 141 (1898).

Abies excelsa alpestris, Brügger, in *J. B. Naturf. Ges. Graubundens*, xvii. 154 (1874), and xxix. 122 (1884).

Abies excelsa medioxima, Heer, in *Verh. Schw. Nat. Ges.* 1869, p. 70 (not Nylander).

Cones 3 to 5 in. long, with scales rounded and entire in upper margin. Leaves short, $\frac{1}{2}$ to $\frac{2}{3}$ in. stout, very glaucous.

Trees with a whitish grey bark, and with remarkable bluish white foliage, which have been found at high elevations (between 4400 and 6400 ft.) in a few localities in the Swiss Alps, from Landbeck in the Tyrol² to Engstelnalp in the Bernese Oberland, and from Lake Walen to Lake Como. These trees were first investigated by Heer and Brügger on account of the special name given to them by

¹ Cf. Christ, in *Garden and Forest*, ix. 273 (1896).

² Beissner, in *Mitt. Deut. Dend. Ges.* 1905, p. 143, describes trees like var. *alpestris* in the Engadine.

the peasants, *aviez selvadi*, or wild silver fir, the common spruce being known as *pign*. I have seen no specimens, but apart from the glaucous foliage, which is a trivial and inconstant character in conifers, *P. alpestris* would seem to be identical with *P. obovata*.

A vast amount of literature¹ has been written on the relationship of *P. obovata* to *P. excelsa*, the general result of which shows that a complete series of transitional forms connecting the two species may be found; but these are only met with in the regions where the two spruces come in contact—elsewhere they are quite distinct and easily recognisable. It is possible that these transitional forms are due to hybridisation; and further study by experimental sowings is needed to clear up the matter.

P. obovata is the most widely distributed of all the spruces, extending over the vast northerly region of eastern Europe and Asia, where the climate is severe in winter and continental in character. It occurs in northern Scandinavia, Lapland, Finland, northern and eastern Russia, throughout Siberia to the Sea of Ochotsk and Kamtschatka,² and in Manchuria. It extends far to the northward, reaching lat. 67° in the Kola peninsula, lat. 68° in the Ural range, attaining its most northerly point in Siberia on the Yenisei at lat. 69° 5', and crossing the Stanovoi mountains at lat. 64°, where it comes in contact with *P. ajanensis*. According to Komarov³ it is abundant throughout the wooded parts of Manchuria, where it grows along the banks of rivers, either forming pure woods or scattered amidst other trees. Its eastern and southern limits in Asia are imperfectly known, but it forms great forests in the mountains of Dahuria and in the Altai and Sayan ranges. Seebohm⁴ describes it as extending on the Yenisei "nearly as far north as the larch, where it is a very important tree for commercial purposes. Its wood is white, of very small specific gravity, extremely elastic; and it is said not to lose its elasticity by age. It makes the best masts for ships, and is for oars the best substitute for ash. Snow-shoes are generally made of this wood. The quality is good down to the roots, and it makes the best knees for shipbuilding."

In European Russia its southern limit is the northern edge of the Orenburg steppe; and it forms vast forests in the governments of Perm, Vologda, Ekaterinburg, Ufa, Viatka, and Kama, that are either pure or mixed with larch, *Pinus Cembra*, *Abies sibirica*, and birch. It appears to be the spruce prevalent in Finland and in the Baltic provinces; but in western Russia is mixed with *P. excelsa*, the limits between the two species being undefined, owing to the occurrence of transitional forms. Similarly in Scandinavia⁵ it is the common spruce in the north, while in the south *P. excelsa* appears to be the prevalent form. Its occurrence as a sporadic tree in the mountains of central Europe, under the form described as *P. alpestris*,

¹ Cf. Teplouchoff, *loc. cit.* Korshinsky, in *Tentamen Fl. Ross. Orient.* 493 (1898), admits that cones like those of *P. excelsa* are never seen in eastern Russia. At the junction of the rivers Kama and Viatka the woods are said to be composed of both species. Cf. Kihlman, *Pfl. Stud. Russ. Lapland*, 143 (1890), on the variation of the spruce in Finland, Lapland, and northern Scandinavia. Dammer, in *Gard. Chron.* iv. 480 (1888), may also be consulted, as well as the numerous authorities quoted by Schröter, *op. cit.* 240 (1898).

² It is a doubtful native of the Kurile Isles, according to Miyabe in *Mem. Boston Soc. Nat. Hist.* iv. 261 (1894).

³ *Flora Manshuriae*, i. 197 (1901).

⁴ *Siberia in Asia*, 233 (1882).

⁵ Cf. under *P. excelsa*, pp. 1347, 1348.

is peculiar; but may be explained as a remnant of the pre-glacial forests.¹ In habit, *P. obovata* is usually more columnar than *P. excelsa*; but little reliance can be placed on this character as a mark of distinction.

This species had not been introduced into England in Loudon's² time; and it is very doubtful if it occurs in cultivation in this country, except at Bayfordbury, where seedlings were raised in 1908 from seed brought from Siberia by Mr. C. F. H. Leslie. According to Kent,³ "the Siberian spruce soon perishes under the stimulus of the high temperature of this country." Small trees in botanic gardens reputed to be this species appear to me to belong to the transitional form between *P. excelsa* and *P. obovata*, which has less pubescence on the branchlets. Plants raised from Finnish seed, procured from Rafn, are much slower in growth at Colesborne than common spruce.

In Germany, according to Mayr,⁴ it is slower in growth than the native spruce, and is not more hardy. It appears⁵ also to be equally slow in growth in the Arnold Arboretum, U.S.A. (A. H.)

PICEA ORIENTALIS, CAUCASIAN SPRUCE

Picea orientalis, Carrière, *Conif.* 244 (1855); Boissier, *Fl. Orient.* v. 700 (1884); Masters, in *Gard. Chron.* xxv. 333, fig. 62 (1886), and iii. 754, fig. 101 (1888); Kent, Veitch's *Man. Conif.* 443 (1900); Clinton-Baker, *Illust. Conif.* ii. 44 (1909).

Pinus orientalis, Linnæus, *Sp. Pl.* 1421 (1763); Lambert,⁶ *Genus Pinus*, i. t. 39, fig. a (1803).

Abies orientalis, Poiret, in Lamarck, *Dict.* vi. 518 (1804); Loudon, *Arb. et Fruit. Brit.* iv. 2318 (1838).

A tree, attaining in the Caucasus 180 ft. in height and 12 ft. in girth. Bark brown, fissuring irregularly on old trees into thin scales. Young branchlets pale brown, slender, densely covered with a short pubescence, retained in the second and third years. Buds conical, acute, about $\frac{1}{5}$ in. long, brown; terminal buds girt at the base with a few keeled acuminate scales. Leaves, on lateral branches arranged as in *P. excelsa*, very short, $\frac{1}{2}$ to $\frac{2}{5}$ in. long, dark green, shining, bevelled and obtuse at the apex, quadrangular in section, with one to four lines of stomata on each of the four surfaces.

Staminate flowers, cylindrical, $\frac{1}{2}$ in. long, carmine red in colour; anther connective suborbicular, minutely denticulate.

Cones, 3 to 4 in. long, $\frac{3}{4}$ to 1 in. in diameter when closed, cylindrical but tapering to a narrow apex, violet coloured⁷ when growing, brown when ripe; scales

¹ Christ, *Flore de la Suisse*, 197 (1883), compares the distribution of this spruce with *Pinus sylvestris*, var. *engadinensis*, the pine on the Engadine, which he considers to be identical with *Pinus lapponica*, Mayr, the form of the common pine that occurs in northern Scandinavia and Lapland. Cf. *ante*, vol. iii. 573.

² Cf. Loudon, *Trees and Shrubs*, 1030 (1842).

⁴ *Fremdländ. Wald- u. Parkbäume*, 333 (1906).

³ Veitch's *Man. Conif.* 442 (1900).

⁵ Sargent, in *Garden and Forest*, x. 481 (1897).

⁶ The cones figured by Lambert in this edition, t. 29, fig. b, were from China, and are possibly those of *P. ajanensis*. Lambert, in his second edition, t. 39 (1832), gives a new and coloured drawing of leaves and cones, collected by Sir Gore Ouseley near Tiflis, repeating also the figures of the cones from China.

⁷ The scales of young cones are green, with a narrow carmine-coloured margin.

obovate with a cuneate claw, $\frac{1}{2}$ to $\frac{3}{8}$ in. wide, rounded entire and slightly bevelled in the upper margin; bract $\frac{1}{4}$ in. long, with a narrow claw and a rectangular lamina, truncate at the apex. Seed dark coloured, $\frac{1}{8}$ in. long, with the wing $\frac{1}{2}$ in. long; wing broadest about the middle, upper margin rounded.

This species is readily distinguished by its very short blunt leaves, and pale brown pubescent branchlets.

DISTRIBUTION

The oriental spruce is a native of Asia Minor and the Caucasus. It is widely spread in most of the mountain ranges of Asia Minor, being recorded for Troas, Mysia, Galatia, and Phrygia, where it generally occurs between 3000 and 7000 feet elevation. It is also met with in the valleys of the Antitaurus. It is, however, much more common, forming large forests, in the mountains between Trebizond and Erzerum, where it was discovered by Tournefort¹ at the beginning of the eighteenth century. In the Caucasus it is generally associated with *Abies Nordmanniana*, and occurs in Georgia between 2500 and 7500 feet. In the Lesser Caucasus its eastern limit is the meridian of Tiflis, being totally absent to the eastward and in the province of Talysch. As a rule it ascends higher than *Abies Nordmanniana*, occasionally forming the timber line at 7500 feet. The largest tree recorded by Radde,² measured, when felled, 184 ft. in height, with a diameter of stem of 4 ft. 1 in., and a cubic content of 925 ft.; it was 390 years old.

CULTIVATION

The species, according to Beissner,³ was introduced into Europe in 1837, but Loudon, writing in 1838, speaks of it as not in cultivation; and it appears⁴ to have come into this country in 1839. It has been in cultivation in the United States⁵ since about 1850, where it has proved hardy as far north as eastern Massachusetts, and is one of the most beautiful of all the exotic conifers that have been planted in the neighbourhood of Boston. (A. H.)

REMARKABLE TREES

None of the spruces seems more generally successful in cultivation than this; and though it does not grow so fast as the common or the Sitka spruce, it is a really good ornamental tree, hardy in all parts of Great Britain, and ripening seed in most places. We have measured many specimens of from 60 to 70 ft. high and a few taller, among which the following may be mentioned:—

At Dogmersfield Park, Hants, the seat of Sir H. Mildmay, a fine tree with many cones, 78 ft. by 7 ft. 8 in. in 1907. At Strathfieldsaye a handsome specimen 76 ft. by 7 ft. 8 in. At Highnam a tree about 67 ft. by 7 ft. in 1905. At Penrhyn a tree recorded⁶ as 58 ft. high in 1891, which was, when measured by me in 1906, 75 ft. by 5 ft. 10 in.

¹ *Voyage au Levant*, 288 (1717).

² *Kaukasuslindern*, 223 (1899).

³ *Nadelholzkunde*, 374 (1891).

⁴ Lawson, *Pinet. Brit.* ii. 163 (1865). Loudon, in *Trees and Shrubs*, 1029 (1842) says: "Of late many plants have been raised in Knight's exotic nursery, from seeds received from Mingrelia and the neighbourhood of Tiflis."

⁵ Sargent, *Silva N. Amer.* xii. 22, note (1898), and in *Garden and Forest*, 1895, p. 55.

⁶ *Journ. R. Hort. Soc.* xiv. 485 (1892).

In Canon Ellacombe's garden at Bitton there is a dwarf bush of considerable age, which when covered with young cones is very ornamental. From it I have raised seedlings which grow very slowly.

In Scotland the finest tree we know of is at Durris, which in 1904 was 61 ft. by 6 ft. 3 in.

In Ireland Henry measured at Fota one which in 1903 was about 67 ft. by 6 ft. (H. J. E.)

PICEA SCHRENKIANA, SCHRENK'S SPRUCE

Picea Schrenkiana, Fischer and Meyer, in *Bull. Acad. Sci. St. Petersb.* x. 253 (1842); Regel, in *Gartenflora*, xxvi. 69 (1877), and xxix. 49 (1880); Fedtschenko, in *Bull. Herb. Boissier*, vii. 189 (1899); Kent, Veitch's *Man. Conif.* 451 (1900); Clinton-Baker, *Illust. Conif.* ii. 48 (1909).

Picea tianschanica, Ruprecht, in *Mém. Acad. Sci. St. Petersb.* xiv. No. 3, p. 72 (1870).

Picea obovata, Ledebour, var. *Schrenkiana*, Masters, in *Journ. Linn. Soc. (Bot.)* xviii. 506 (1881).

Pinus Schrenkiana, Antoine, *Conif.* 97 (1840-1847).

Pinus obovata, Antoine, var. *Schrenkiana*, Parlature, in De Candolle, *Prod.* xvi. 2, p. 415 (1868).

Pinus orientalis, Linnæus, var. *longifolia*, Ledebour, *Fl. Ross.* iii. 671 (1847).

Abies Schrenkiana, Lindley and Gordon, in *Journ. Hort. Soc. Lond.* v. 212 (1850).

A large tree, attaining in Turkestan the dimensions of *P. obovata*. Young branchlets ashy grey, stout, glabrous. Buds dome-shaped or sub-globose, $\frac{1}{3}$ in. in length, rounded at the apex, light brown, with scarious scales; terminal bud girt with a ring of acuminate keeled pubescent ciliate scales and closely surrounded at the base by the uppermost leaves of the branchlet.

Leaves in an imperfect radial arrangement, dense and pointing forwards on the upper side of the branchlet, spreading with a few leaves pointing forwards and not truly pectinate on the lower side of the branchlet; $\frac{3}{4}$ to $1\frac{1}{4}$ in. long, straight or curved, rigid, gradually tapering at the distal end to a long fine sharp-pointed apex¹; obscurely quadrangular in section, with three to four lines of stomata on each of the four sides.

Cones, 3 to 4 in. long, cylindrical, narrowing towards the obtuse apex, shining dark brown when ripe; scales numerous, closely imbricated, longer than broad, about $\frac{1}{2}$ in. wide, obovate-cuneate, with the upper exposed part thin and glabrous, concealed part thicker and minutely pubescent; upper margin rounded, entire, undulate; bract $\frac{1}{5}$ in. long, ovate. Seed, light brown, $\frac{1}{8}$ in. long; seed with wing $\frac{1}{2}$ in. long; wing narrow, widest near the rounded apex.

This species was discovered in 1840 by Schrenk, and is widely distributed in Central Asia, occurring mainly in the Alatau mountains and in the Thianshan² range in Turkestan, where, according to Fedtschenko, it forms vast forests, now rapidly disappearing, as far south as lat. 41°, at 4000 to 8000 ft. altitude towards the north, and at 8000 to 10,000 ft. towards the south. It does not appear to

¹ In wild specimens from old trees, the leaves end in a short acute callous tip.

² Both Regel and Komarov agree that the spruce in the Thianshan range, considered by Ruprecht to be a distinct species (*P. tianschanica*), is identical with *P. Schrenkiana* in the Alatau range.

occur in the mountains uniting the Thianshan range with the Pamirs; and its western limit is probably the Alexandrovoski mountains in Russian Turkestan. Its eastern limit is not as yet clearly known;¹ but Przewalski found extensive woods of it, not only in the Thianshan range, but also in the upper course of the Yellow River in Mongolia, near Lake Kokonor, and in the adjoining Nan-Shan range.²

Mr. M. P. Price informs us that its most northerly point appears to be in the Barluk mountains, lat. 46°, where there are a few scattered forests in the higher valleys. He observed this tree at 9200 feet altitude in the pass between the valley of the river Baratala and the plateau of Lake Sairam. It bears the greatest extremes of heat and cold in these regions. Most of the trees, which he saw, scarcely exceeded 50 to 70 ft. in height and 7 to 8 ft. in girth. On a section 2 ft. 10 in. in diameter from the base of a tree, which had grown in the vicinity of Lake Issik Kul and was preserved in the museum at Vernoe, he counted 296 annual rings. The wood is used for building houses in Russian Turkestan; but is of little economic importance on account of the inaccessibility of the forests.

In the eastern part of the Thianshan range, where the climate is very severe, and the thermometer sinks at least 7° F. below freezing every night during summer, *P. Schrenkiana*, nevertheless, forms open woods at about 8000 ft. elevation, which are remarkable for the peculiar narrow columnar form of the trees. This is well shown by two photographs, taken by Baron von Dungern, which are reproduced in *Mitt. Deut. Dend. Ges.* 1910, pp. 227, 229. He explains the cypress-like habit as due to the fact that the shoots of the lateral branches are almost invariably frozen, soon after their production in early summer; whilst those of the leading branches, which are later in the season in emerging from the bud, escape destruction by the severe frosts.

This species was distributed by the St. Petersburg Botanic Garden after its re-discovery in 1877 by Regel in Turkestan. It has never become common in cultivation. There are two trees at Kew, 8 and 10 ft. high, obtained from Messrs. Veitch in 1882; and smaller specimens at Bayfordbury and in other private collections. It appears to be hardy, though slow in growth, and is very distinct in appearance, most of the branches being rigid and ascending. (A. H.)

¹ The spruce collected in Kansu, in north-western China, by Futterer and Holderer, identified with *P. Schrenkiana* by Diels, *Flora von Central-China*, 217 (1901); and another, collected by Bretschneider, near Peking, similarly identified by Masters, in *Journ. Linn. Soc. (Bot.)* xxvi. 554 (1902), appear to be identical with *Picea Mastersii*, Mayr, *Fremdländ. Wald- u. Parkbäume*, 328, figs. 105-107 (1906).

² Cf. Köppen, *Holzgewächse Europ. Russlands*, ii. 538 (1889). Regel, in *Act. Hort. Petrop.* vi. 485 (1880), states that it grows not only in the high mountains, but also along the rivers Baratala, Kash, and Yuldus.

PICEA SMITHIANA, WESTERN HIMALAYAN OR MORINDA SPRUCE

Picea Smithiana, Boissier, *Fl. Orient.* v. 700 (1884); Kent, Veitch's *Man. Conif.* 454 (1900).

Picea Morinda, Link, in *Linnaea*, xv. 522 (1841); Masters, in *Gard. Chron.* xxiv. 393, fig. 85 (1885);

Hooker, *Flora Br. India*, v. 653 (1888) (in part); Gamble, *Indian Timbers*, 716 (1902);

Brandis, *Indian Trees*, 692 (1906); Clinton-Baker, *Illust. Conif.* ii. 40 (1909).

Picea Khutrow, Carrière, *Conif.* 258 (1855).

Pinus Smithiana, Wallich, *Pl. Asiat. Rar.* iii. 24, t. 246 (1832).

Pinus Khutrow, Royle, *Illust. Him. Plants*, 353, t. 84 (1839).

Abies Smithiana, Lindley, in *Penny Cycl.* i. 31 (1833); Loudon, *Arb. et Frut. Brit.* iv. 2317 (1838).

Abies Khutrow, Loudon, *Trees and Shrubs*, 1032 (1842).

Abies Morinda, Nelson (Senilis), *Pinaceae*, 49 (1866).

A tree, attaining in the Himalayas over 200 ft. in height and 20 ft. in girth. Bark greyish brown, divided by shallow fissures into small rounded or quadrangular scales. Young branchlets grey, shining, glabrous. Buds about $\frac{1}{2}$ in. long, spindle-shaped or ovoid, acute at the apex, brownish, resinous; scales numerous, densely imbricated, rounded at the apex; terminal bud girth at the base with a ring of acuminate keeled scales. Lateral branches always pendulous, with the leaves radially arranged and directed outwards and towards the apex of the branchlet at an acute angle. Leaves long and slender, about $1\frac{1}{2}$ in. long and $\frac{1}{2}\frac{1}{5}$ in. broad, incurved, tapering towards the apex, which ends in a slender cartilaginous point; obscurely 4-angled, with about two lines of stomata on each of the four sides.

Staminate flowers, about 1 in. long and $\frac{1}{2}$ in. in diameter, cylindrical, obtuse, light yellow; anther connective orbicular, crenate.

Cones, 4 to 6 in. long, $1\frac{1}{2}$ to 2 in. in diameter, cylindrical, narrowed towards the base, obtuse at the apex; bright green and smooth when growing; shining brown when mature; scales about an inch wide, broadly obovate from a cuneate base, smooth, convex, rounded and entire in margin; bract obsolete. Seed dark brown, $\frac{1}{4}$ in. long, with the wing $\frac{3}{4}$ in. long; wing spatulate, broadest near the truncate denticulate apex.

P. Smithiana occurs throughout the western Himalayas, between 7000 and 11,000 ft. elevation, being common from Garhwal to Kashmir, and also occurring in Gilgit, Chitral, and Kafiristan. It extends westwards to Afghanistan, where Aitchison found it in the Kuram and Hariab district, between 8000 and 11,000 ft., occasionally extending as high as 12,000 ft., where it struggles for existence with *Pinus excelsa*. According to Gamble, it is a very fine tree in the Himalayas, often attaining a greater height than the deodar, but probably never equalling the latter in girth. Large trees measured near Mundali in Jaunsar were 175 to 215 ft. in length and 19 to 23 ft. in girth.¹ It forms mixed forests with *Abies Pindrow*, which cover mainly the northern and western slopes of the mountains, usually between 7500 and 8500 ft. In these forests the spruce is more common on the drier ridges, the silver fir growing in the moister ravines. *P. Smithiana* also forms mixed forests

¹ I am informed by Sir G. Watt that a tree, recorded by Sir E. Buck, near Nagkunda, measured no less than 250 ft. high. Cf. Frontispiece of Vol. V.—H. J. E.

with the deodar. Grown in dense forest the stems are often free from branches to a great height, crowned by a conical pyramid of foliage with pendulous branches. In this condition, it produces seed at intervals of three or four years, and in small quantity. The rank undergrowth consists of *Strobilanthes*, small bamboos, raspberries, balsams, and other plants, which render natural reproduction of seedlings rare and difficult. Clear cutting and artificial regeneration have been found to be the most successful modes of treating these forests. This spruce is attacked in the Himalayas by the aphid, *Chermes abietis*, which is common on the European spruce, and produces cone-like excrescences on the twigs. A fungus, *Peridermium incarcerans*, Cooke, often occurs as curious tassel-like orange bunches on the branchlets. The leaves are attacked by another fungus, *Aecidium Thomsoni*.¹ (A. H.)

CULTIVATION

P. Smithiana was introduced into cultivation in 1818 by Dr. Govan of Cupar, who gave the seed to the Earl of Hopetoun, from which the first trees were raised at Hopetoun House, near Edinburgh. It is a thriving tree in many parts of the British Isles; and though the young shoots are liable to be nipped by frost, this does not seem to do the tree permanent injury. It does not, however, seem to succeed on limestone soil.

The tallest specimen² I have seen in England is at Melbury, where, in 1906, I measured one 85 to 90 ft. high and 8 ft. 10 in. in girth. (Plate 345.)

At Cardew a tree was reported³ in 1891 as 80 ft. high, but when I measured it in 1905 it was 86 ft. by 7 ft. 9 in. At Pencarrow Mr. Bartlett measured a perfect specimen planted by Sir W. Molesworth about 1850, which in 1907 was 57 ft. by 6 ft. 7 in. At Bicton in 1902 I measured one 65 ft. by 6 ft. 9 in. At Redleaf, Kent, in 1907 a tree 75 ft. by 9 ft. had many cones on the lower branches, which rested on the ground. At Walcot there is a fine tree 60 ft. by $5\frac{1}{2}$ ft.

At Barton, Bury St. Edmunds, there are two fine trees, one of which was 84 ft. high by 7 ft. 1 in. in girth in 1904, the other 77 ft. by an inch less in girth. These trees were raised from seeds sent by Lady Napier, to whom they had been given by Wallich, and the seedlings were planted out in 1843. The trees were not injured in the least by the severe winter of 1860-1861, and commenced to bear cones for some years before 1869, having a very abundant crop in that year.⁴ A tree at Hardwicke House, Suffolk, planted later than those at Barton, was measured by Sir Hugh Beevor in 1904 as 73 ft. by 7 ft.

In Wales the largest I have seen, a tree at Margam Park, was 81 ft. by $6\frac{1}{2}$ ft. in 1907.

In Scotland there are many good specimens, of which those at Hopetoun are the oldest, having been raised from seed sent to the Earl of Hopetoun by

¹ Described and figured by Berkeley in *Gard. Chron.* 1852, p. 627.

² The *Picea Smithiana* reported in *Gard. Chron.* 1869, p. 713, to be growing at Shelsley Walsh in the Teme Valley in Worcestershire, is *P. excelsa*. Cf. p. 1341.

³ *Journ. R. Hort. Soc.* xiv. 488 (1892).

⁴ Bunbury, *Arboretum Notes*, 134.

Dr. Govan in 1818. When I saw them in 1904 the best of these was about 70 ft. by 8½ ft. Fowler¹ states that the two trees at Hopetoun House were planted in their present position in 1824, one being a seedling, the other a grafted plant worked on the common spruce, four feet above the ground. In 1871 the graft had outgrown the stock all round for 2 to 3 inches. The seedling tree in that year was 60 ft. high by 7 ft. in girth at four feet from the ground, the grafted tree being scarcely so tall. Mr. T. Hay, gardener at Hopetoun, remeasured these trees in January 1911, and informed me that the grafted tree is still in fair condition, and measures 70 ft. high. Its girth below the graft is 6 ft. 2 in., and above it 7 ft. 2 in. The seedling tree is more healthy and measures 75 ft. by 8 ft. 8 in. at 4 ft. from the ground.

At Smeaton Hepburn, a tree, planted in 1840, was measured by Henry in 1905 as 67 ft. by 6 ft. 5 in.

In Ireland this species thrives remarkably well, and there are many fine specimens. At Woodstock, Kilkenny, in 1909 I measured a tree 72 ft. by 8½ ft. At Mount Shannon near Limerick, a tree measured, in 1905, 69 ft. by 8½ ft. in girth. At Fota, Queenstown, there is a fine tree, which was, in 1903, 63 ft. by 8 ft. At Glenstal, Co. Limerick, in the same year, a tree was 11½ ft. in girth with an estimated height of 70 ft. At Bessborough in Co. Kilkenny, a tree, which was figured in the *Gardeners' Chronicle*, May 21, 1904, is, we are informed by Viscount Duncannon, 60 ft. high by 6 ft. 9 in. in girth. Another at Emo Park, Portarlinton, was 60 ft. by 8 ft. in 1907; and one at Coollatin was 59 ft. by 4 ft. 8 in. in 1906.

In the United States,² the tree is too tender for the climate of Boston, and does not do well even at Washington. There are no large trees of this species in the United States.

TIMBER

According to Gamble, the rate of growth in India is fairly fast, averaging about 11 rings per inch of radius, or 125 years to a girth of 6 ft. The wood is similar to that of the European spruce, and affords excellent planking for floors, walls, and ceilings. It is used for shingles, for packing cases, for building huts, for water-troughs, etc. In some places it is utilised for making tea boxes. It averages in weight 30 lbs. to 32 lbs. per cubic ft. The bark was formerly used extensively by the shepherds for roofing their huts, but this practice has been stopped in the Government forests. On account of the expense of transport, it is never likely to be exported.

(H. J. E.)

¹ In *Gard. Chron.* 1872, p. 76.

² *Garden and Forest*, 1893, p. 14, and 1897, p. 482.

PICEA GLEHNII

Picea Glehnii, Masters, in *Gard. Chron.* xiii. 300, fig. 54 (1880), and in *Journ. Linn. Soc. (Bot.)*, xviii. 512, fig. 13 (1881); Mayr, *Abiet. Jap. Reiches*, 56, 102, t. 4, fig. 11 (1890), and *Fremdländ. Wald- u. Parkbäume*, 327 (1906); Kent, Veitch's *Man. Conif.* 437 (1900); Shirasawa, *Icon. Ess. Forest. Japon.* ii. t. 3, figs. 19-42 (1907); Clinton-Baker, *Illust. Conif.* ii. 39 (1909).

Abies Glehnii, Schmidt, in *Mém. Acad. Imp. Sc. St. Pétersb.* xii. 176, t. 4 (1868).

A tree, attaining in Yezo over 100 ft. in height. Bark different from any of the other spruces, reddish in colour, and fissuring into broad thin loose plates. Young branchlets slender, reddish, with dense short pubescence in the furrows between the pulvini, not spreading over the surface of the latter. Buds ovoid, brown, ⅛ in. long, composed of a few glabrous scales; terminal buds girt with a ring of scales ending in long subulate points. Leaves arranged on the branchlets as in *P. excelsa*, ⅓ to ½ in. long, slender, ending in a short cartilaginous point; rhombic in section, with about two stomatic lines on each of the two upper sides, and a single line on each of the lower sides.

Cones, about 2 in. long by 1 in. in diameter when closed; violet, with a red edge to the scales when growing, shining brown when ripe; cylindrical, with an obtuse narrowed apex; scales, when ripe, spreading from the axis at a right angle, suborbicular, with a cuneate claw, about ½ in. wide, with the thin upper margin entire, slightly erose, or faintly denticulate; bract spatulate, ⅓ in. long, denticulate at the apex. Seed blackish, ⅓ in. long, with wing ⅔ in. long; wing broadest about the middle, rounded at the apex, outer margin denticulate.

This species is readily distinguishable from the other short-leaved spruces by the reddish branchlets, with the pubescence confined to the furrows. It resembles *P. orientalis* in the colour of the foliage, but is very distinct in the terminal buds, which have a ring of subulate scales, similar to *P. nigra* and *P. rubra*.

DISTRIBUTION

*P. Glehnii*¹ was discovered in Saghalien in 1861 by Glehn, the comrade of F. Schmidt on the expedition sent out by the Russian Geographical Society to Eastern Asia. It was subsequently found in Yezo by Maries in 1877.

In Saghalien, this species is confined to the southern half of the island, where it grows on the plains and in the valleys, never attaining, according to Schmidt, a great size, being seldom over a foot in girth. According to Mayr, it is probably absent from the Kurile Isles,² as it was not noticed by him on Shikotan; according to Komarov,³ it does not occur in Russian Manchuria.

(A. H.)

¹ The Formosan spruce, identified with *P. Glehnii* by Matsumura in *Tokyo Bot. Mag.* xv. 141 (1901), is quite distinct, and has been named *P. morrisonicola*, Hayata, in *Journ. Coll. Sci. Tokyo*, xxv. 220 (1908).

² Miyabe does not include it in his *Flora of the Kuriles*.

³ *Flora Manchuria*, i. 200 (1901).

P. Glehnii attains its maximum development in Yezo, where, according to Mayr, it is much commoner in the west of the island than in the east. In western Yezo it forms mixed forests in company with *P. ajanensis*, chiefly on the cooler parts of the mountains, the trees reaching on an average nearly 120 feet in height. Mayr mentions a peculiar forest of this species, which occurs on the volcanic Iwo-san (1500 feet elevation) east of Lake Kucharro. In the eastern part of the island, it forms pure forests in the river valleys in swampy situations, which are often several hundreds of acres in extent; but the trees are of no great size, averaging only 80 ft. in height. This species is known to the Japanese as *Shinko matsu* or *Aka-eso*.

According to Miyabe, it is rare near Sapporo and only found at high elevations mixed with *P. ajanensis*. Near Lake Shikotsu at 1500 feet elevation, I found it much less abundant than *P. ajanensis*, and could not procure any fruiting specimens. A self-sown seedling which I brought from here is growing very slowly at Colborne and is now only 1 foot high.

I could not learn whether the wood of the tree is distinguished from that of the common Yezo spruce. Some very broad clean pieces which I saw in the saw-mill at Sunagawa had a close grain and a shiny satiny surface when planed, making it suitable for interior work where strength is not required.

CULTIVATION

According to Beissner¹ seeds of this species arrived in Germany before 1891, from which young plants were raised. It is scarcely known in cultivation in England. There are young plants at Kew, about 2 ft. high, which are thriving; and small specimens at Bayfordbury and Brickendon Grange, Herts, and in the Cambridge Botanic Garden. It is too soon as yet to form any opinion as to the suitability of this species to our climate; but I do not expect that it will attain any size.

(H. J. E.)

PICEA POLITA

Picea polita, Carrière, *Conif.* 256 (1855); Masters in *Gard. Chron.* xiii. 233, fig. 44 (1880), and *Journ. Linn. Soc. (Bot.)* xviii. 507, pl. 19 (1881); Mayr, *Abiet. Jap. Reiches*, 46, t. 3, f. 7 (1890), and *Fremdländ. Wald- u. Parkbäume*, 335 (1906); Kent, Veitch's *Man. Conif.* 446 (1900); Shirasawa, *Icon. Ess. Forest. Japon.* ii. t. 2, figs. 18-29 (1907); Clinton-Baker, *Illust. Conif.* ii. 45 (1909).

Picea Torano, Koehne, *Deutsche Dendrologie*, 22 (1893).

Abies Torano,² Siebold, in *Verhand. Batav. Genoot. Konst. Wet.* xii. 12 (1830).

Abies polita, Siebold et Zuccarini, *Flor. Jap.* ii. 20, t. 111 (1842).

Pinus polita, Antoine, *Conif.* 95 (1840-1847).

A tree, occasionally attaining in Japan 120 ft. in height, but usually considerably smaller. Bark fissuring into small scales, exposing the yellowish brown cortex

¹ *Nadelholzkunde*, 377 (1891).

² This specific name is uncertain, as it was unaccompanied by any description, and cannot be adopted.

beneath. Buds ovoid, acute at the apex, up to $\frac{5}{8}$ in. long, shining reddish brown; scales closely imbricated, ovate, rounded at the apex. Young branchlets stout, glabrous, shining, pale yellow. Leaves on lateral branchlets in an imperfect radial arrangement, all directed outwards with their tips curving upwards; about $\frac{3}{4}$ to $\frac{7}{8}$ in. long, $\frac{1}{16}$ in. wide, very rigid, stout, curved, ending in a sharp spine-like point; compressed rhomboidal in section, with 4 to 6 lines of stomata on each of the four surfaces.

Cones, about 3 to 4 in. long, $1\frac{1}{2}$ in. in diameter when closed, yellowish green when growing, shining chestnut brown when mature; ovoid-cylindrical, obtuse at the apex; scales obovate, with a cuneate base, about $\frac{1}{10}$ in. wide; upper margin rounded, with a few irregular denticulations; bract oblong, $\frac{1}{4}$ in. long, slightly narrowed at the denticulate apex. Seed mottled grey, about $\frac{1}{8}$ in. long, with wing $\frac{7}{8}$ in. long; wing broadest near the truncate denticulate apex.

The very rigid sickle-shaped leaves, ending in prickly spines, and arranged radially on the branchlets, are unlike those of any other spruce.

P. polita is confined to the main island of Japan, having nearly the same distribution as *P. hondoensis* and *P. bicolor*, extending from about lat. $35\frac{1}{2}^{\circ}$ to lat. 38° , and not reaching the extreme north of the island. It is found in warmer situations than the other two spruces, and, unlike them, never forms pure woods. It always occurs as isolated trees or in small groups, scattered through the broad-leaved forest. It is the tallest of the three, the largest specimens seen by Mayr being nearly 120 ft. high; and is a much rarer tree, of no economic importance in Japan, where it is known as *hari-momi*.

This species was introduced into cultivation by J. Gould Veitch in 1861, and is perfectly hardy; but it has nowhere attained considerable dimensions. Kent states that the best specimens occur in Devon and Cornwall; but the largest which we have seen is one at Highnam, Gloucester, 30 ft. by 2 ft. in 1910. There is also a healthy specimen at Bayfordbury, planted in 1879, which has borne cones; and another at Hatfield, very thriving. A tree at the Heatherside Nursery, Farnborough, about 20 ft. high, bore cones in 1909. There are two good young trees at Castle Kennedy. A fine specimen at Castlewellan, planted in 1884, was about 25 ft. high in 1907.

According to Mayr this species, with *P. bicolor* and *P. pungens*, are the latest to grow in Germany, not opening their buds until June. It is much injured by squirrels, and will probably be of no economic value, either on the Continent or in England.

(A. H.)

PICEA BICOLOR

Picea bicolor, Mayr, *Abiet. Jap. Reich.* 49, t. 3, fig. 8 (1890), and *Fremdländ. Wald- u. Parkbäume*, 323 (1906); Shirasawa, *Icon. Ess. Forest. Japon.* i, text 19, t. 4, figs. 1-14 (1900).

Picea Alcockiana, Carrière, *Conif.* 343 (1867); Masters, in *Gard. Chron.* xiii. 212, figs. 41, 43 (1880), and in *Journ. Linn. Soc. (Bot.)* xviii. 508, figs. 7-9 (1881); Hennings, in *Gartenflora*, xxxviii. 216, fig. 40 (1889); Kent, *Veitch's Man. Conif.* 429 (1900); Henry, in *Trees of Great Britain*, i. 89, 90 (1906).

Picea japonica,¹ Regel, *Index Sem. Hort. Petrop.* 33 (1865).

Picea acicularis, Beissner, *Nadelholzkunde*, 380 (1891).

Abies bicolor, Maximowicz, in *Mél. Biol.* vi. 24 (1866).

Abies acicularis, Maximowicz, in *Index Sem. Hort. Petrop.* 74 (1868).

Abies Alcockiana, Gordon, *Pinetum*, 4 (1875) (not Lindley).

Pinus Alcoquiana, Parlatore, in De Candolle, *Prod.* xvi. 2, p. 417 (1868).

A tree, attaining in Japan 80 ft. in height. Bark greyish brown, fissuring into small scales. Young branchlets yellowish, glabrous on the lateral branches, but pubescent in the furrows between the pulvini on strong leading shoots; older branchlets shining reddish brown. Buds, about $\frac{1}{8}$ in. long, conic, rounded at the apex, without resin, and with few scales, scarious in margin. Leaves, on lateral branches arranged as in *P. excelsa*, about $\frac{3}{4}$ in. long, rigid, curved, ending in a short cartilaginous point, rhombic in section, with two conspicuous white stomatic bands on the upper two sides, each of 5 or 6 lines, and two bands of about 2 lines each on the two lower green sides.

Cones, averaging $3\frac{1}{2}$ in. long and 1 in. in diameter when closed; bluish red with green margins to the scales when growing, brownish when mature; ovoid-cylindrical: scales obovate with a cuneate base, about $\frac{3}{8}$ in. broad, thin and faintly denticulate in the upper rounded margin; bract $\frac{1}{8}$ in. long, spatulate, with a slightly expanded denticulate lamina. Seed, $\frac{1}{8}$ to $\frac{1}{4}$ in. long, brown; seed with wing $\frac{3}{8}$ in. long; wing widest about the middle, rounded and faintly denticulate at the apex.

This species, as its name implies, differs from the other quadrangular-leaved spruces, in the conspicuous white broad stomatic bands on the upper surface of the leaf, contrasting with the green lower surface, and in this respect it simulates the flat-leaved spruces, and has been confused² with *P. hondoensis* and *P. ajanensis*. The leaves of the latter are flat and not rhombic in section, and are devoid of the faint stomatic lines on their lower surface, which are readily seen in *P. bicolor*.

HISTORY

This species was discovered in 1860 on Fujiyama by J. G. Veitch, who collected cones of it, unfortunately mixed with twigs of *P. hondoensis*. Lindley, in 1861, described a mixture of the two species, and his name, *Abies Alcoquiana*, Veitch,³

¹ A name without any description. It is identified in *Index Sem. Hort. Petrop.* 3 (1866) with *Abies bicolor*, Maxim. Seeds were sent from Japan in 1865 by Tschonoski.

² Cf. Vol. I. p. 90.

³ Ex Lindley, in *Gard. Chron.* 1861, p. 23. Lindley's description comprises the leaves of *P. hondoensis* and the cones of *P. bicolor*. The type specimen, in which both these are mixed in one packet, is in the herbarium at Cambridge.

cannot stand. Maximowicz gave a correct description of the species under the name *Abies bicolor* in 1866.

As explained in our article¹ on *P. hondoensis*, seeds of both species were early distributed as *P. Alcockiana*; and in gardens most trees named *P. Alcockiana* are in reality *P. hondoensis*.

This species was introduced into the St. Petersburg Botanic Garden by seeds sent from Japan in 1868 by Tschonoski under the name *Abies acicularis*,² Maximowicz.

DISTRIBUTION

This species occurs only in the main island of Japan, where, like *P. hondoensis* and *P. polita*, it is confined to the central ranges between lat. $35\frac{1}{2}^{\circ}$ and lat. 38° . It forms part of the coniferous forest, which covers these mountains at varying altitudes from south to north, usually above the zone of broad-leaved trees; but occasionally scattered trees are met with in the upper limits of this zone. Mayr never saw any trees over 80 ft. in height, though he thinks that it occasionally attains greater dimensions.

This species is rare in collections, the largest we have seen being at Kew, where there are two trees, 25 and 30 ft. high, one of which bore cones in 1900. There are also specimens at Westonbirt, Pencarrow, Murthly, Castle Kennedy, and Glasnevin. Mr. H. Clinton Baker collected cones from the tree at Pencarrow in August 1908; and I saw at Castlewellan in 1907 a tree about 20 ft. high bearing cones.

The tree at Blackford Park, Edinburgh, mentioned by Kent, was planted about 1882-1884, and measured 20 ft. by 1 ft. 7 in. in 1906. The gardener, Mr. Small, states that it is late in starting into growth in the spring, and in consequence escapes late frosts.

Probably the finest tree in cultivation is growing in Mr. Hunnewell's pinetum at Wellesley, Mass., U.S.A. It bears cones freely, some of which I gathered in 1906, when the tree measured about 36 ft. high by 3 ft. in girth.³ (A. H.)

¹ Vol. I. p. 90.

² Young plants with slender sharp-pointed needles were distributed under this name.

³ Cf. Sargent, *Pinetum at Wellesley*, 1905, p. 11.

PICEA MAXIMOWICZII

Picea Maximowiczii, Regel, in *Index Sem. Hort. Petrop.* 33 (1865); Carrière, *Conif.* 347 (1867); Masters, in *Gard. Chron.* xiii. 363 (1880), and *Journ. Linn. Soc. (Bot.)* xviii. 507 (1881); Mayr, *Abiet. Jap. Reiches*, 98 (1890).

Picea obovata, Ledebour, var. *japonica*, Beissner, *Nadelholzkunde*, 370 (1891).

Picea Tschonoskii, Mayr,¹ *Fremdländ. Wald- u. Parkbäume*, 339 (1906).

Abies obovata, Loudon, var. *japonica*, Maximowicz, in *Index Sem. Hort. Petrop.* 1 and 3 (1866); Franchet, *Enum. Pl. Jap.* i. 466 (1875).

Abies Maximowiczii, Neumann, *Cat.* 1865, ex Parlatores, in De Candolle, *Prod.* xvi. 2, p. 431 (1868); Veitch, *Man. Conif.* 80 (1881).

A small tree. Young branchlets reddish brown, glabrous, with the apices of the pulvini all directed outwards and forwards. Buds about $\frac{1}{2}$ in. long, ovoid, acute, with glabrous rounded resinous scales. Leaves on lateral branches radially spreading on all sides at nearly a right angle to the branchlet, but with their tips pointing slightly forwards; $\frac{3}{8}$ to $\frac{1}{2}$ in. long, rigid, tapering near the apex which is tipped with a short blunt point; green, quadrangular in section, with three to five stomatic lines on each surface; resin-canals two, lateral, close to the epidermis.

Cones, $1\frac{3}{4}$ to 2 in. long, 1 in. in diameter when open, shining brown when ripe, cylindrical, but tapering at both ends: scales numerous, obovate with a cuneate claw, $\frac{1}{2}$ in. wide; rounded, entire, and bevelled in the upper margin: glabrous in the exposed part, elsewhere covered with a minute reddish pubescence: bract about $\frac{1}{8}$ in. long, oblong, with a rounded faintly denticulate apex. Seeds, not extending to the upper and lateral margins of the scale, $\frac{1}{8}$ in. long, dark brown mottled with lighter streaks; seed with wing $\frac{1}{2}$ in. long; wing widest near the upper rounded denticulate margin.

This species is readily distinguishable by its short leaves radially arranged, and its resinous buds. At Kew it produces new shoots a month earlier than *P. bicolor*.

This spruce is a native of Japan, where it was collected in 1864 on Mt. Fujiyama by Tschonoski,² a young Japanese collector in the employment of Maximowicz. One of the original specimens from this locality is preserved at Kew, where there is also an imperfect specimen,³ collected in the same year in the province of Senano by Tschonoski, which was recognised by Maximowicz to be the same species.⁴ It appears to be very rare, and has not since been found by Japanese botanists. Maximowicz considered it to be a variety of *P. obovata*, from which it is clearly distinct; but it is rather related to *P. bicolor*, though differing much in foliage and in cones.

¹ Mayr erroneously considered that the tree cultivated as *P. Maximowiczii* was different from Tschonoski's Fujiyama specimen. He identified the latter with *P. bicolor*, and proposed a new name, *P. Tschonoskii*, for the former.

² Maximowicz, in *Rhamn. As. Or.* 17 (1866), gave an account of Tschonoski, who was a Japanese and not a Russian as some authors have supposed. He gathered about 800 species of Japanese plants, and sent seeds of many kinds to St. Petersburg.

³ Consisting of a cone and a single leaf. The cones on the Grignon tree, about 2 in. long, are intermediate in size between those of the Fujiyama tree (which are $1\frac{3}{4}$ in. long) and those of the Senano specimen (about $2\frac{1}{2}$ in. long).

⁴ The Senano specimen is labelled *Abies obovata*, Loudon, var. *japonica*, Maximowicz; and the Fujiyama specimen is named *Picea Maximowiczii*, Regel.

Seeds sent to St. Petersburg by Tschonoski in 1865 were distributed by Regel to various botanic gardens on the Continent. The best specimen that I have seen is a tree with ascending branches at the Agricultural School of Grignon near Paris, which is about 30 ft. in height by 19 in. in girth; but M. Hickel¹ tells me that there are still finer trees elsewhere in France.

A smaller tree in the Arnold Arboretum, U.S.A., also bears cones, smaller in size than those on the tree at Grignon. Another in Mr. Hunnewell's pinetum at Wellesley, Mass., was 11 ft. high in 1905. There is also a small specimen² in the spruce collection at Kew, a bush about 4 ft. high; and two trees at Handcross Park, Sussex, the taller of which was 32 ft. by 2 ft. 5 in. in 1911. These were planted about thirty years ago, and have not as yet borne cones. (A. H.)

PICEA NIGRA, BLACK SPRUCE

Picea nigra, Link, *Handb.* ii. 478 (1831); Kent, Veitch's *Man. Conif.* 438 (1900); Clinton-Baker, *Illust. Conif.* ii. 41 (1909).

Picea Mariana, Britton, Sterns, and Poggenburg, *Cat. Pl. N. York*, 71 (1888); Sargent, *Silva N. Amer.* xii. 28, t. 596 (1898), and *Trees N. Amer.* 39 (1905).

Picea brevifolia,³ Peck, *Spruces of the Adirondacks*, 13 (1897), and in *Bull. Torrey Bot. Club*, xxvii. 409 (1900).

Abies Mariana, Miller, *Dict.* ed. 8, No. 5 (1768).

Abies nigra, Du Roi, *Harbk. Baumz.* ii. 182 (1800); Loudon, *Arb. et. Frut. Brit.* iv. 2312 (1838).

Abies denticulata, Michaux, *Fl. Bor. Amer.* ii. 206 (1803).

Pinus Mariana, Du Roi, *Obs. Bot.* 38 (1771).

Pinus nigra, Solander, in Aiton, *Hort. Kew.* iii. 370 (1789).

A tree, attaining in America 100 ft. in height and 9 ft. in girth, but usually much smaller. Bark brownish, fissuring into irregular thin appressed scales. Buds small, ovoid, acute; the terminal buds surrounded at the base by ciliate pubescent scales with conspicuous long subulate points. Young branchlets brownish, with dense short erect glandular pubescence, retained on the dark-coloured branchlets of the second year. Leaves, arranged on lateral branches as in the European spruce, about $\frac{1}{2}$ in. long, bluish or glaucous green, slightly incurved, ending in a short cartilaginous point, quadrangular in section, with four lines of stomata on each of the two sides turned towards the branchlets, and with one to two lines on each of the other sides.

Cones persistent on the branches for several years, ovoid, acute at the apex, $\frac{3}{4}$ to $1\frac{1}{2}$ in. long, dark purple when growing, dull brown when ripe; scales rigid, woody, pubescent, about $\frac{2}{8}$ in. wide, rounded or rarely pointed at the apex, denticulate

¹ M. Hickel informs me that the older trees in France, which were planted about 1868, were originally raised in Thibaut and Keteleer's nursery at Sceaux, from seed given them by Carrière, which he received from Regel. Of late years this spruce has been propagated by grafting.

² This is perhaps the same shrub as that from which a specimen in the Kew Arboretum herbarium was taken in 1882, labelled "low bush, 1 to 2 ft. (rounded). Pinetum, Aug. 3, 1882. J. D. Hooker." The low stature of the shrub at Kew indicates probably an alpine origin for the seed from which it was raised.

³ This is the ordinary stunted form of *P. nigra*, growing on swamps and exposed mountain summits, and is not distinguishable even as a variety by Sargent, or by Britton and Shafer, *N. Amer. Trees*, 57 (1908); Rehder, in Bailey, *Cyc. Am. Hort.* iii. 1334, fig. 1794 (1901), and in *Rhodora*, ix. 109 (1907), has distinguished it as var. *brevifolia*.

in margin. Seeds dark brown, about $\frac{1}{8}$ in. long, with pale brown wings broadest above the middle and very oblique at the apex.

Dwarf and fastigate forms,¹ and varieties in which the foliage is variegated with white or golden yellow in colour are mentioned by Beissner.

Var. *Doumetii*, Carrière, *Conif.* 242 (1855). This variety was first noticed about 1835 in the garden of the Château de Baleine² near Moulins in France. It is a small tree or large shrub, with short numerous branches, forming a dense conical pyramid of foliage. The leaves are very crowded, thin and sharp-pointed. As seen at Kew this variety is very distinct in appearance.

There are remarkable black spruces³ in the Wilhelmshöhe and Karslane parks at Cassel in Germany, which are pyramidal in habit and bluish in foliage. Self-layering occurs, and numerous colonies of young plants are produced round the parent trees.

DISTRIBUTION

The black spruce is widely spread throughout the Dominion of Canada, occurring as far north as Labrador on the Atlantic coast, and reaching lat. 65° in the valley of the Mackenzie River, whence, crossing the Rocky Mountains, it spreads in the interior of Alaska to the valley of the White River.⁴ Farther south, it is restricted to the eastern side of the Rocky Mountains, extending throughout Alberta, Assiniboia, northern Saskatchewan, and northern Manitoba (where it attains its largest size) to central Wisconsin and Michigan. It is common in Newfoundland and all the eastern provinces of Canada, except southern Ontario; and spreads in the north-eastern United States to Pennsylvania, reaching its most southerly point in the Alleghanies in southern Virginia.

Towards the northerly part of its range it is abundant, and grows on well-drained alluvial soils and on the stony slopes of barren hills; while towards the south it is almost entirely restricted to bogs and swamps. Mr. H. E. Ayres in *Garden and Forest*, vii. 504, fig. 80 (1894), describes and figures it under these conditions in Minnesota, as the "Muskeag" spruce, this being the name by which the sphagnum bogs so common in North America are known. He states that in these swamps the trees grow slowly to a height of 60 ft. with very drooping branches, the trunks never exceeding about 10 in. in diameter. The cones are densely crowded at the summit of the tree, and are sometimes produced on trees only 3 ft. high.

(A. H.)

CULTIVATION

The black spruce was introduced⁵ into England by Bishop Compton about 1700; but Sir W. Watson, who gave a list of the principal trees which he found in the Fulham Palace gardens in 1751, does not include it.

¹ For *Picea nigra*, var. *virgata*, Rehder, see under *P. rubra*, p. 1378.

² When I visited this place in 1909, I found that the original specimen, a tree about 30 ft. high, was dead; but two plants grown from its layers are now about 15 ft. high, with pointed tops; while others, which were raised from cuttings, form dense dwarf bushes.—(H. J. E.)

³ See *Gard. Chron.* xi. 81, *Suppl. Illust.* (1892). The black spruce appears to layer frequently; and Loudon figures an instance which was noticed in 1828 at Braco Castle, Perthshire.

⁴ Cf. Sargent, *Silva N. Amer.* xiv. 106 (1902).

⁵ Aiton, *Hort. Kew.* iii. 371 (1789).

It is common in cultivation and usually sold in nurseries under the name of blue spruce, but it never attains large dimensions and is of no economic importance. It has been recommended for planting in boggy and marshy situations, but is always much surpassed in growth by *Picea sitchensis*, and seems to be a short-lived tree in this country.

One of the best specimens we know of is the one figured in Plate 346, which grows on the north edge of a plantation of common spruce at Lyde, near Colesborne, on my property. This tree has been favoured by a moist clay soil, a sheltered position and a cold damp climate; and has attained at about fifty-five years old a height of 56 ft. with a girth of 2 ft. 10 in. As the figure (Plate 346) shows, it has become self-layered under the shade of a hedge, which was cut away to show it; and one of the lower branches has already attained half the height of the parent stem. Though it has not increased much in the last ten years, this tree is in good health, but several others, planted at the same time on dry land, are not half the size and dead or dying. As usual in England it bears cones in abundance near the top of the tree. I have seen a tree at Woburn about 60 ft. by 4 $\frac{1}{2}$ ft.; and there is one at Merton which was about 40 ft. by 5 ft. 10 in. in 1905.

In the west of Scotland it grows well, but so far as we have seen never attains a large size; the tallest recorded¹ in Scotland in 1891 was 46 ft. by 3 ft. 5 in. at Mount Stuart. Of the numerous trees planted in two groups in 1832 at Keillour, Perthshire, at the lower end of a peat-bog, Henry only found a few surviving in 1904, none exceeding 40 ft. in height. At Dawyck, a tree was 37 ft. by 2 $\frac{1}{2}$ ft. in 1911.

In Ireland the best we have seen was measured by Henry at Fota in 1903, when it was 60 ft. by 4 ft. 10 in. (H. J. E.)

PICEA RUBRA, RED SPRUCE

Picea rubra, Link, in *Linnaea*, xv. 521 (1841) (not Dietrich²); Gorrie, in *Trans. Bot. Soc. Edin.* x. 353 (1870); Kent, Veitch's *Man. Conif.* 450 (1900); Sargent, in *Bot. Gaz.* xlv. 226 (1907); Clinton-Baker, *Illust. Conif.* ii. 47 (1909).

Picea nigra, Link, var. *rubra*, Engelmann, in *Gard. Chron.* xi. 334 (1879).

Picea rubens, Sargent, *Silva N. Amer.* xii. 33, t. 597 (1898), and *Trees N. Amer.* 41 (1905).

Pinus rubra, Lambert, *Genus Pinus*, i. 43 (1803) (not Miller³).

Picea acutissima, Jack, in *Garden and Forest*, x. 63 (1897).

Abies rubra, Poiret, in Lamarck, *Dict.* vi. 520 (1804); Loudon, *Arb. et Frut. Brit.* iv. 2316 (1838).

A tree, attaining in America 100 ft. in height and 9 ft. in girth. Bark, branchlets, and buds, similar to *P. nigra*. Leaves yellowish or dark green, not glaucous, about $\frac{5}{8}$ in. long, incurved, acute or rounded at the apex, quadrangular in section, marked on each of the two upper sides by about four stomatic lines, and on each of the two lower sides by two to three stomatic lines.

¹ *Journ. Roy. Hort. Soc.* xiv. 506 (1892).

² *Picea rubra*, Dietrich, *Fl. Berol.* ii. 795 (1824) is the common European spruce, *Picea excelsa*.

³ *Pinus rubra*, Miller, *Gard. Dict.* No. 3 (1795) is the common European pine, *Pinus sylvestris*.

Cones, ovoid-oblong, $1\frac{1}{4}$ to 2 in. long, green or purplish green when growing, shining reddish brown when mature, usually falling in the second summer: scales $\frac{2}{5}$ in. broad, rounded entire or denticulate at the thin upper margin: bract inconspicuous, oblanceolate, about $\frac{1}{8}$ in. long. Seeds mottled dark brown, about $\frac{1}{8}$ in. long, with wings broadest near the rounded apex, the total length of seed and wing being about $\frac{2}{5}$ in.

VARIETIES

1. *Picea australis*, Small, *Flora S.E. United States*, 30 (1903), is probably a variety¹ of the red spruce, which differs in bearing small cones that are said to fall directly after shedding their seed. Large trees of this kind, attaining 130 ft. in height, are reported to occur on the summits and rocky slopes of mountains in Virginia and North Carolina.

2. A solitary red spruce,² with snake-like branches, similar in habit to *P. excelsa*, var. *virgata*, was discovered in 1892, near Williamstown, in north-western Massachusetts. From it young plants were raised by grafts in the Arnold Arboretum.

DISTRIBUTION

The red spruce has a much more southerly distribution than the black spruce,³ and does not extend farther north than Prince Edward Island and Nova Scotia. It is widely spread in New England,⁴ through Maine, New Hampshire, Vermont, and northern Massachusetts; but is not known in Rhode Island and Connecticut. In New York, especially in the Adirondacks, it forms extensive forests; and extends through the Alleghany Mountains southward through Pennsylvania and West Virginia to the high peaks of North Carolina. Pinchot⁵ has given a complete account of this species, which provides the only merchantable spruce timber in the United States; and states that it is remarkable for its tolerance of dense shade and its capacity for recovering after years of suppression. In the Adirondacks, it ascends to 4500 ft., and is often seen on steep southern slopes; but elsewhere is mixed with balsam fir, hemlock, white pine, birch, maples, and beech. (A. H.)

CULTIVATION

The red spruce was first accurately described and figured by Lambert from a tree growing in England, which was said to have been brought from Newfoundland. According to Aiton,⁶ it was cultivated near London by Miller before 1755; but it is doubtful if this tree was distinguished from the black spruce at that date.

P. rubra is rare in collections, the only large trees which we have seen being

¹ Cf. Britton and Shafer, *North American Trees*, 58 (1908).

² Figured in *Garden and Forest*, viii. 45, fig. 7 (1895). This is identical with *Picea nigra*, Link, var. *virgata*, Rehder, in Bailey, *Cycl. Am. Hort.* iii. 1334 (1901), corrected to *P. rubra forma virgata*, Rehder, in *Rhodora*, ix. 110 (1907). Cf. *Mitt. Dent. Ges.* 1907, p. 116.

³ Keiler, *Our Native Trees*, 470 (1907) says: "Black spruce is a tree of the far north, existing but precariously south of the northern boundary of the United States; while red spruce is an Appalachian tree, attaining its greatest dimensions in northern New Hampshire and Pennsylvania."

⁴ Dame and Brooks, *Trees of New England*, 14 (1902).

⁵ *The Adirondack Spruce*, pp. 1-157 (1898).

⁶ *Hort. Kew.* v. 319 (1813).

one at Stanage Park, Herefordshire, which measured in 1911, 72 ft. by 5 ft. 9 in.; and another at Merton, Norfolk, 63 ft. high and 4 ft. 7 in. in girth in 1909.

The large trees reputed¹ to be of this species at Dropmore are undoubtedly *P. excelsa*.

The only place I know where this tree has been planted in quantity is on the drive of the Rhinefield enclosure in the New Forest, where there are a number of red and white spruce along the south end of the main avenue. The largest of the former was on the north side of the first cross ride on the west and measured 40 ft. by 4 ft. in 1906; most of the trees had old and new cones, low down on the ends of the branches, from which I have raised seedlings. The largest of the white spruce at the corner of the second cross ride on the west was 56 ft. by 5 ft. 4 in., and I found cones on only one of the trees.

Some small trees sent from America grow very slowly at Colesborne.

In 1870 Gorrie² found a few trees of this species, about 12 to 18 ft. in height, and bearing cones, which were growing on the railway bank near Tynehead in Midlothian at 800 ft. elevation. They had been raised about fifteen years previously from seed obtained in Newfoundland. Some of the seedlings which had been planted two or three miles off in a dry heavy soil had dwindled and died. Dr. A. W. Borthwick visited this place in 1906, and sent me specimens from these trees, from the cones of which I have raised seedlings. The trees are now about 35 ft. in height, growing mixed with common spruce, but not so large as white spruce at the same place. Gorrie also reported in the same year trees about 15 to 20 ft. high growing in Dunmore Park, near Stirling. We have not been able to discover whether these are living.

At Avondale, in Ireland, there is an experimental plot, covering about two acres, which was planted in 1907 with red spruce, mixed with a small proportion of white and black spruce. The red spruce in this plot is extremely thriving, being about 6 ft. high in January 1912, and exceeding in vigour a plot of European spruce beside it.

In France the species seems to grow remarkably well at Les Barres, according to Pardé, who figures³ a group of three trees about 45 ft. by 4 ft. There are others even larger planted in 1832 which have produced several natural seedlings. Beissner says that there are fine specimens in the Karls-aue at Cassel, at Herrenhausen in Hanover, and at Worlitz. (H. J. E.)

In 1908 I visited in the Hertogenwald in Belgium, a plantation of red spruce consisting of five acres in two separate plots at an elevation of 1250 ft. The soil here is a loamy clay, on which the European spruce thrives remarkably well. The plots had been accurately measured in 1907, when the trees were fifty-five years old with the following results:—

Number of trees per acre, 950.

Total volume in the round per acre, 3265 cubic ft.

Annual increment, about 60 cubic ft. per acre.

¹ Kent, Veitch's *Man. Conif.* 451, note (1900).

² In *Trans. Bot. Soc. Edin.* x. 353 (1870).

³ *Arb. Nat. des Barres*, 102, pl. 46 (1906).

The two best trees were, in 1908, 50 ft. high and 10 in. in diameter at five feet from the ground. The plantation had not been properly thinned at an early period.

The European spruce in the same district, at a higher elevation, about 1800 ft., averaged at forty-five years old 445 trees per acre, with an annual increment of 136 cubic ft. per acre; and the best trees were 60 ft. high by 12½ in. in diameter.

The red spruce had a redder and more scaly bark than the common spruce; and was more densely clothed with foliage, the improvement of the soil due to the decay of the fallen leaves being well marked. The trees bear cones about every two years; and I noticed several seedlings in the open ground adjoining the plantation. One of the trees had a sucker from its roots about 3 ft. high. (A. H.)

PICEA ALBA, WHITE SPRUCE

Picea alba,¹ Link, *Handb.* ii. 478 (1831), and in *Linnaea*, xv. 519 (1841); Kent, Veitch's *Man. Conif.* 427 (1900); Clinton-Baker, *Illust. Conif.* ii. 34 (1909).

Picea canadensis, Britton, Sterns, and Poggenburg, *Cat. Pl. N. York*, 71 (1888); Sargent, *Silva N. Amer.* xii. 37, t. 598 (1898), and *Trees N. Amer.* 42 (1905).

Picea laxa, Sargent, in *Garden and Forest*, ii. 496 (1888); Jack, in *Garden and Forest*, x. 63 (1897).

Abies canadensis, Miller, *Dict.* 8th ed. No. 4 (1768).

Abies alba, Michaux, *Fl. Bor. Amer.* ii. 207 (1803) (not Miller); Loudon, *Arb. et Frut. Brit.* iv. 2310 (1838).

Abies curvifolia, Salisbury, in *Trans. Linn. Soc.* viii. 315 (1807).

Abies laxa, Koch, *Dendrologie*, ii. 2. p. 243 (1873).

Pinus canadensis, Du Roi, *Obst. Bot.* 38 (1771) (not Linnæus).

Pinus laxa, Ehrhart, *Beiträge*, iii. 24 (1788).

Pinus alba, Solander, in Aiton, *Hort. Kew.* iii. 371 (1789); Lambert, *Genus Pinus*, i. 39, t. 26 (1803).

A tree, attaining in America 70 to 100 ft. in height and 6 to 8 ft. in girth. Bark ¼ to ½ in. thick, with thin greyish plate-like scales. Young branchlets slender, glabrous, glaucous; becoming greyish or pale brown in the second year. Buds, ¼ in. long, ovoid, rounded or obtuse at the apex; with glabrous scales, non-ciliate, rounded and bifid at the tip, and usually loosely imbricated. Leaves on lateral branches arranged as in the common spruce, usually with a disagreeable odour² when bruised, bluish,

¹ The oldest specific name (*canadensis* of Miller) for this species is not available, as it was previously used by Linnæus for the eastern hemlock, his *Pinus canadensis* being *Tsuga canadensis*. Moreover, Jack, in *Garden and Forest*, x. 63 (1897), gives some reasons for supposing that Miller indicated the red spruce by his name *Abies canadensis*; and on this account Jack proposes the name *Picea canadensis* for the red spruce, and *Picea laxa* for the white spruce. The latter name is based on Ehrhart's *Pinus laxa*, which is earlier than Solander's *Pinus alba*. Voss, in *Mitt. Deut. Dend. Ges.* 1907, p. 93, proposes *Picea glauca* for the white spruce, based on *Pinus glauca*, Moench, which is earlier than any name except Miller's, but was applied to the glaucous variety. In the midst of the confusion, in which the nomenclature of the American black, white, and red spruces is involved, it is most convenient to adopt for them the names *Picea nigra*, *Picea alba*, and *Picea rubra*, which were first used in combination by Link, and which have been in common use for a great number of years. Moreover, these names are unambiguous, as they have always been applied in each case to the same species.

² Hence the name cat or skunk spruce often given to the tree in America. Usually the odour is only perceived when the leaves are bruised, but in certain states of the air it can be detected at some distance from the tree. Cf. *Garden and Forest*, x. 63 (1897).

about ½ in. long, incurved, ending in a rounded or acute (not acuminate) cartilaginous tip; quadrangular in section, with three to four rows of stomata on each side.

Cones, deciduous in the autumn or winter of the first year after the escape of the seeds, sessile or shortly stalked; slender, cylindrical but tapering at both ends, about 2 in. long and ½ in. in diameter, green when growing, shining pale brown when ripe: scales few, loosely imbricated, thin and flexible, so that the cone can be easily crushed by the hand, orbicular or oval, ⅓ in. broad, rounded or truncate at the entire anterior margin: bract about ⅓ in. long, oblong with a slightly enlarged ovate denticulate lamina. Seed, ⅓ in. long, brown, partly embraced by the inflexed margins of the base of the narrow pale wing, which is broadest near the rounded denticulate apex; seed with wing, ⅔ in. long.

The three American species are often confused, though they have been clearly recognised by botanists in Europe since Lambert's time. In America the younger Michaux and Asa Gray united *P. rubra* with *P. nigra*; but all modern American botanists and foresters keep the three species distinct. The best account of their history is given by Dr. G. Lawson of Halifax, Nova Scotia, in *Proc. Canad. Institute*, 1887, pp. 169-179. Formerly the white spruce was considered to be a native of the Rocky Mountains, but the tree inhabiting Alberta, British Columbia, and Montana is now considered to be distinct, and has been named *P. albertiana*.

P. alba is readily distinguished by its bluish disagreeably smelling foliage and glabrous branchlets, and cannot be confused with *P. nigra* and *P. rubra*, which have pubescent branchlets and peculiar buds with long subulate scales. The cones of the white spruce are easily crushed by the hand on account of their thin flexible scales, and are very different in shape from those of the other two species, which have firm rigid scales.¹

VARIETIES

1. Var. *arctica*, Kurz, in *Bot. Jahrb.* xix. 425 (1895).

Abies arctica, Murray, in *Journ. Bot.* v. 253, t. 69 (1867).

Pinus alba, var. *arctica*, Parlatore, in De Candolle, *Prod.* xvi. 2, p. 414 (1868).

Towards the northern limit of its area the white spruce has thicker leaves and smaller cones, with more concave scales and bracts slightly different in shape. This form was first collected by Seemann in north-western Alaska. According to Sargent² the branchlets of the white spruce in the interior of Alaska are sometimes slightly pubescent, and in all probability this variety is a connecting link between *P. alba* and *P. albertiana*.

A few peculiar forms have arisen in cultivation:—

2. Var. *nana*, Loudon. A round compact bush, rarely exceeding 6 ft. in height.
3. Beissner mentions fastigiata, pendulous, and variegated forms, which we have not seen in England.

¹ Trelease, in *Bot. Gaz.* xxix. 196 (1900) describes remarkable burrs, almost globose in shape and covered with smooth bark, which are occasionally seen on the trunk and branches of the white spruce in the United States.

² *Silva N. Amer.* xii. 38, note (1898).

4. Var. *cærulea*, Carrière, *Conif.* 320 (1867).*Pinus glauca*, Moench, *Bäume Weiss.* 73 (1785).*Abies rubra cærulea*, Loudon, *Arb. et Frut. Brit.* iv. 2316 (1838).*Abies cærulea*, Forbes, *Pin. Woburn.* 99 (1839).*Picea cærulea*, Link, in *Linnaea*, xv. 522 (1841).*Pinus rubra violacea*, Endlicher, *Syn. Conif.* 114 (1847).*Picea canadensis glauca*, Sudworth, in *U.S. Forestry Bulletin*, No. 14, p. 37 (1897).

A small tree of dense pyramidal habit, with very glaucous leaves closely pressed against the branchlets. This variety, which according to Carrière frequently arises in the seed-bed, appears to have been known since 1785, and is unquestionably a form of *P. alba*, though it has been by various authorities ascribed to *P. rubra*.

(A. H.)

DISTRIBUTION

The white spruce is a native of eastern Canada and the northern part of the United States, extending southward to the Black Hills of Dakota, the northern parts of Minnesota, Wisconsin, and Michigan, New York, Vermont, northern New Hampshire, and the coast of Maine as far south as Casco Bay. It is recorded¹ for a few stations in Massachusetts, its most southerly limit.

Its westerly distribution in the Dominion of Canada is uncertain; but according to Dr. Lawson, the white spruce is essentially a maritime species, growing along the Atlantic and northern coasts of Canada, and extending by way of the St. Lawrence to the great lakes, as far as Lake Winnipeg. It is common in Newfoundland, Nova Scotia, and New Brunswick, and on the streams which flow from the north into the St. Lawrence, ranging westward through Ontario to the treeless plains of Manitoba, where it occupies sandhills and the dry slopes of river banks. In Labrador it is widely but not generally distributed, growing in the south in well-watered valleys and ascending rocky hills to elevations of 2000 ft. West of Hudson Bay it grows to a large size on river terraces to the borders of the barren lands; and its stems choke the mouths of every arctic American river, strewing the shores with driftwood and testifying to its abundance on their shifting banks.²

CULTIVATION

The white spruce was first described by Miller in 1731, and is said by Loudon to have been introduced into England by Bishop Compton in 1700.

Though the name is often found in nursery catalogues and it has no doubt been planted in many places, yet it is nowhere in England so far as we have seen of any special value, either as a timber or an ornamental tree. In some parts of Denmark, however, it has been largely planted as a shelter tree on poor sandy land, in alternate rows with *Pinus montana*, as it is found to grow on poorer soil and to bear salt sea

¹ Dame and Brooks, *Trees of New England*, 17 (1902).² E. T. Seaton, *Arctic Prairies*, 329 (1912), measured a tree near Fort McKay 118 ft. high. A log here, 84 ft. long, was 22 in. in diameter at the butt and 15 in. at the small end. At tree limit on the eastern shore of Artillery Lake, a tree, 8 ft. high and 1 ft. in diameter at the butt, showed 300 annual rings.

wind better than common spruce. From what I saw, however, during our visit to Denmark in 1908,¹ it is not likely to become a timber tree of any value here.

In a paper on the "Reclamation of Moors in Belgium,"² Mr. A. P. Grenfell says that it forms an excellent mixture with common spruce on poor soils, and in exposed situations in that country, and that it is more windfirm than common spruce.

The white spruce is extremely hardy, and will thrive in exposed situations on high hills, where the common spruce succumbs to the continued action of cold winds in spring. Annand³ gives an instance of its success on poor peaty soil at a high elevation in the north of Scotland, and recommends it for planting as a wind-break. He tells us that at Carragill in Cumberland, where it has been planted in perhaps the most exposed situation in England, it continues to grow as a low tree between 1600 and 2000 feet, where there is practically no soil, and above the zone in which the common spruce can exist. He considers it specially valuable on wet soils; and says that it has been planted for shelter to a considerable extent in the Moorfoot hills in Midlothian, and in hilly districts in Peeblesshire, Aberdeenshire, and Caithness. At Durris,⁴ however, *P. sitchensis* far surpasses it in growth in such conditions, and appears to be equally hardy. In the Hertogenwald in Belgium *P. alba* has been planted with some success in the wettest parts of the peat mosses at high altitudes.

At Weston Hall, Staffordshire, on good alluvial soil, a plantation was made of the common spruce in 1868, amongst which are scattered a few *P. alba*. The best of the white spruce was 45 ft. by 2 ft. 9 in. in 1909, while the European spruce averaged 60 ft. by 5 ft. 3 in.

The tallest white spruce in England is probably one at Woburn, which measured in 1909 72 ft. by 4 ft. 6 in. There are two fine trees at Powis Castle, the best of which measured 56 ft. by 5 ft. 3 in. in 1906. At Eastnor, a white spruce measures 46 ft. by 2 ft. 10 in.

In the Keillour pinetum, Perthshire, which was planted in 1832, the best *P. alba* measured 52 ft. by 5½ ft. in 1905. In this poor boggy soil, the West American conifers much surpass both *P. alba* and *P. nigra* in growth, the growth of *P. sitchensis* and *Abies grandis* being astonishing.⁵ Kent mentions a tree, 45 ft. high, growing on light loam at Dolphinton, Lanarkshire.

At Fota, a white spruce was 45 ft. by 5 ft. in 1907.

TIMBER OF THE BLACK, RED, AND WHITE SPRUCES

In the United States, only the red and white spruce yield merchantable timber, the black spruce never attaining large enough dimensions. In Canada the red spruce is never mentioned by foresters or lumbermen, and only the white and black spruces are said to produce lumber. According to Dr. Lawson, the black spruce is

¹ *Quarterly Journal of Forestry*, iii. 75 (1909).² In *Trans. Roy. Scot. Arb. Soc.* xvi. 473 (1901).³ Cf. Crozier's account in *Trans. Roy. Scot. Arb. Soc.* xxiii. 7-16, plate 1 (1910), and in our Vol. I. p. 95.⁴ Cf. our account of the pinetum at Keillour, in Vol. I. p. 96. Complete details of the original planting operations in 1832 at Keillour are given in *Proc. Hort. Soc.* iii. 297 (1863).⁵ *Ibid.* ii. 273 (1908).

famed amongst the Canadian lumbermen as a tree yielding sound, strong, and lasting timber; while red spruce produces softer wood, less durable "under exposure to the open air, as is known from experience; every year the red spruce poles have to be replaced more frequently than the black in fences."¹

Langelier² states that the black spruce is the prevailing coniferous tree in northern Quebec, where the forests are estimated to be capable of supplying 400,000,000 cords of pulp wood. White spruce is less abundant in this region, but attains a larger size, and is utilised for lumber, only the tops being converted into pulp wood. In the southern section of the Abitibi territory white spruce attains splendid dimensions over an area of 15,000,000 acres, and Mr. H. O'Sullivan has seen trees over 100 ft. in height and 20 in. in diameter. Dr. Bell is quoted as saying that "white spruce is perhaps the most valuable tree of the district. It grows to a great size everywhere along the rivers and lakes, where it often girths upwards of 6 ft. The timber is sound; as a rule the trunks run to a great height, and in every respect the white spruce ranks among the very best timber for the manufacture of first-class saw-logs."

J. M. Macoun, in *Forest Wealth of Canada*, says that the wood of the three species is not separated commercially, and that they are used for the same purposes. The black spruce is perhaps the best suited for masts or spars. Of the white spruce he says that the wood is tougher, stronger, and more elastic than that of pine, and is very largely used as lumber, and for railway ties, fence-posts, piles, and telegraph poles.

The wood of these Canadian spruces now supplies the greater part of the material used for pulp-making, which has recently become one of the great industries of Canada. According to a paper on *Pulp Wood in Canada*, by George Johnson, which was printed for the Minister of Agriculture at Ottawa in 1904, no less than 15,000,000 to 20,000,000 dollars are now invested in this manufacture; and as it is estimated that no less than 450,000,000 acres of land in Canada are covered more or less densely with spruce which reproduces itself very rapidly when cut, there is no risk of the supply failing. Great Britain and the United States are said to consume about 900,000 tons of pulp wood annually, the product of about 90,000 acres.

The black spruce is considered better than the white for this purpose and grows mostly on the hills and rocky ground, whilst white spruce loves valleys, where there is more soil.

To show the rapid increase in the value of these timber lands it is stated that in 1892 spruce limits were sold in the province of Quebec as low as eight dollars per square mile, whereas in 1899 similar limits realised 150 dollars per mile, and the price has risen higher lately.

English papermakers are said to have found out that Canadian spruce pulp makes a stronger and better newspaper than Scandinavian pulp; and the immense water-power of the Dominion makes both the transport of the logs and the manufacture cheaper than in most parts of Europe.

(H. J. E.)

¹ *Proc. Canad. Inst.* 1887, p. 169.

² *Report 6th Meeting Canada Forestry Association*, 1905, p. 65.

PICEA ALBERTIANA, ALBERTA WHITE SPRUCE

Picea albertiana, Stewardson Brown, in *Torrey*, vii. 126 (1907); Rehder, in *Mitt. Deut. Dend. Ges.*, 1907, p. 69; Britton and Shafer, *N. Amer. Trees*, 58 (1908).

Picea columbiana, Rydberg, in *Mem. New York Bot. Garden*, i. 11 (1900) (not Lemmon¹); M. E. Jones, in *Montana Botany Notes*, 10 (1910).

Picea alba, Mayr, *Fremdländ. Wald- u. Parkbäume*, 319 (in part), fig. 101 (1906) (not Link).

A tree, attaining in western North America 160 feet in height. Bark thin, greyish white, scaling off in small quadrangular plates, furrowed at the base of old trunks. Young branchlets greyish or light yellow; yellow or orange in the second year; glabrous or more usually with a minute pubescence on the pegs (from which the leaves arise), which is occasionally scattered over the rest of the surface of the pulvini. Buds about $\frac{1}{3}$ in. long, ovoid, slightly resinous, with scarious scales rounded and entire in margin; terminal buds girt at the base with acuminate ciliate keeled scales. Leaves bluish green, in an imperfect radial arrangement on the lateral branches, but more crowded on the upper side of the branchlets; $\frac{1}{2}$ to 1 in. long, soft or rigid, curved, ending in a short point, quadrangular in section, with three to five stomatic lines on each side.

Cones, 1 to 2 $\frac{1}{4}$ in. long, cylindrical, obtuse at the apex, sessile, about 1 in. wide when open, shining light brown when ripe: scales numerous, thin, and flexible, fan-shaped, wide, and rounded anteriorly, cuneate on the sides, flatter than those of *P. alba*; upper margin thin, undulate, or faintly denticulate; light brown and glabrous on the exposed part, minutely pubescent and reddish brown on the concealed part: bract $\frac{1}{5}$ in. long, with an oblong claw, slightly expanded into a denticulate lamina, which is either emarginate or rounded at the apex. Seed $\frac{1}{8}$ in. long, mottled dark brown; seed with wing $\frac{1}{2}$ in. long; wing contracted just above the seed, widest in the upper two-thirds, ending in an oblique denticulate apex.

This species is very variable in the amount of pubescence on the branchlets, which is occasionally absent both in specimens from Montana² and from Alberta. The cones are also variable in size, and in the faint denticulation of the margin of the scale. It is most closely allied to *P. alba*, of which it may be considered the Rocky Mountain form. In *P. alba* the branchlets are always perfectly glabrous, with less prominent pulvini; and the leaves are differently arranged in the two species. The buds of *P. alba* are non-resinous, with scales emarginate or two-lobed, and not entire as in *P. albertiana*. The cones of *P. alba* are less rigid, being easily crushed by the hand, and have very fragile scales, entire in margin, more concave internally from side to side, and more reddish brown in colour than those of *P. albertiana*. The seeds are similar in the two species, but those of *P. alba* have shorter wings.

¹ *P. columbiana*, Lemmon, is imperfectly described, and is referred by Sargent and by Britton to *P. engelmanni*. Lemmon's description may have partly included *P. albertiana*; but the latter name, being quite certain, must stand for the species now treated here. Cf. p. 1388.

² Three trees growing together in a clump at 3300 ft. altitude, near Belton in Montana, which I examined in 1906, were precisely alike in size, bark, and habit. One had perfectly glabrous branchlets, silvery leaves, and large cones. Another had very pubescent branchlets, green leaves, and small cones. The third was intermediate.

This species, the exact distribution of which has not yet been clearly defined, ranges from Wyoming¹ and western Montana northward to Alberta and British Columbia. It occurs in the Rocky Mountains at lower elevations than *P. Engelmanni*, extending from 3000 to 5000 ft. The type specimen was collected at Bankhead, Alberta, by Stewardson Brown; and I have received from Macoun specimens from the neighbourhood of Banff, in the same province. Rehder states that this spruce near Banff occasionally attains 160 ft. in height, and forms extensive forests, in one of which he took a fine photograph, which shows well the habit of the tree, and is reproduced by Mayr² in his article on the white spruce. *P. albertiana* is the white spruce referred to by Sargent³ as a native of "the Rocky Mountains of Alberta, British Columbia, and northern Montana, where it lines the banks of streams and lakes up to 5000 ft. elevation, attaining a large size, and sending up tall spire-like heads of dark foliage."

In Montana this spruce is not found on the east side of the continental divide, but is common in the Flathead⁴ region, where it forms a low tree in marshy situations; but on moist alluvial soil, in mixture with the Douglas fir, western larch, and *Thuja plicata*, it attains large dimensions. It usually occurs in small groups in these mixed forests, occupying the moister ground, and bearing considerable shade. The largest tree which I measured, growing near Nyack on the Northern Pacific railway, was 150 ft. by 10 ft. A tree 114 ft. by 4 ft. 9 in. showed, when cut down, 114 annual rings; another, 15 in. in diameter, showed 160 rings, the bark being only $\frac{1}{4}$ in. thick.

It is possible that the trees referred to *P. Engelmanni*, in Idaho, Washington, and Oregon, may wholly or in part belong to *P. albertiana*; and a further study of the spruces in western America is desirable, as the variability in *P. albertiana* points possibly to hybridisation with Engelmann's spruce.

This spruce is the finest species in North America, except *P. sitchensis*, and is worth a trial as an ornamental tree. It was introduced into England by Elwes, who received seeds from Mr. J. M. Macoun of Ottawa in 1906, which have produced plants, the largest of which in 1912 were about 18 in. high, and which have been distributed to several places in England and Scotland. According to Rehder, it was sent by Baron von Fürstenberg to Germany in 1907. (A. H.)

¹ Britton and Shafer, *N. Amer. Trees*, 58 (1908), give Wyoming as a habitat; but I have seen no specimens.

² *Fremdländ. Wald- u. Parkbäume*, fig. 101 (1906). This photograph is also reproduced in Möller's *Deut. Gärtn. Zeit.* 1905, p. 117.

³ *Silva N. Amer.* xii. 39 (1898).

⁴ The spruce described as *P. Engelmanni* by Whitford, in *Bot. Gaz.* xxxix. 196 (1905).

PICEA ENGELMANNI, ENGELMANN'S SPRUCE

Picea Engelmanni, Engelmann, in *Trans. St. Louis Acad.* ii. 212 (1863), and in *Gard. Chron.* 1863, p. 1035; Sargent, *Silva N. Amer.* xii. 43, t. 599 (1898), and *Trees N. Amer.* 43 (1905); Kent, Veitch's *Man. Conif.* 431 (1900); Britton, *N. Amer. Trees*, 59 (1908); Clinton-Baker, *Illust. Conif.* ii. 37 (1909).

Picea columbiana, Lemmon, in *Garden and Forest*, x. 183 (1897).

Picea pseudopungens, Dieck,¹ *Verkaufs-Verzeichniss Zöschchen*, 28 (1904).

Abies Engelmanni, Parry, in *Trans. St. Louis Acad.* ii. 122 (1863).

Abies commutata, Murray, in *Gard. Chron.* iii. 106 (1875).

Pinus commutata, Parlatore, in De Candolle, *Prod.* xvi. 2, p. 417 (1868).

A tree with disagreeably smelling foliage, attaining in America 150 ft. in height and 15 ft. in girth, though usually considerably smaller. Bark reddish, exuding resin, with thin loose scales. Young branchlets greyish yellow, with a sparse minute erect glandular pubescence. Buds conical, about $\frac{1}{2}$ in. long, obtuse at the apex; the terminal bud closely surrounded at the base by the uppermost leaves; scales scarious, rounded, without resin.

Leaves, arranged on lateral branches as in *P. excelsa*, $\frac{3}{8}$ to 1 in. long, soft and flexible, tapering towards the apex, which ends in a sharp point; bluish green in colour, with a cat-like odour when bruised; quadrangular in section, with four to five stomatic lines on each side.

Cones horizontal at first, ultimately pendulous, sessile, green tinged with scarlet when growing, light brown when ripe, cylindrical but narrowed at both ends; very variable in size, $1\frac{1}{2}$ to 3 in. long: scales numerous, thin and flexible, rhombic or ovate, minutely pubescent in the lower half, longer than broad, $\frac{2}{3}$ in. wide, with their upper margin truncate or rounded and lacerate: bract $\frac{1}{4}$ in. long, with an oblong claw, and an oval expanded denticulate lamina. Seed about $\frac{1}{10}$ in. long, dark brown; seed with wing $\frac{3}{10}$ in. long; wing broadest near the rounded oblique faintly denticulate apex.

This species resembles *P. alba* in the peculiar odour of the leaves, but is readily distinguishable by the very sparse minute pubescence on the branchlets.

VARIETIES

1. Forms with glaucous or silvery foliage appear in the seed-bed, and are known as var. *glauc*a and var. *argentea*. The tree, however, usually cultivated under the name *P. Engelmanni glauca* is a form of *P. pungens*, agreeing with the latter species in having glabrous branchlets and peculiar buds with reflexed scales.

2. Var. *microphylla*, Hesse. A dwarf form with short leaves, mentioned by Beissner, *Nadelholzkunde*, 345 (1891).

3. Var. *Fendleri*, Henry (var. *nova*).

At Kew one of the tallest spruce trees has long been labelled *P. Engelmanni*, but differs remarkably from that species in habit. Young branchlets pendulous,

¹ Dieck, *Neuh. Offert. Zöschchen*, 1892, p. 38, mentions *Abies Engelmanni*, var. *pseudopungens*, as a supposed new variety, raised from seed collected by Purpus north of Lytton in British Columbia.

brownish yellow, densely covered with minute erect glandular pubescence, retained for several years. Leaves disagreeable in odour when bruised, radially spreading from the branches equally on all sides, long and slender, about $1\frac{1}{8}$ in. long, bluish in tint, sharp pointed, quadrangular in section, with four stomatic lines on each of the inner two sides, and two lines on each of the outer two sides. This tree has never borne either flowers or cones.

In the pendulous branches and the radial arrangement of the leaves it resembles *P. Smithiana*; but differs entirely from this species in branchlets and buds. The tree at Kew, the history of which cannot be ascertained, now measures 40 ft. high by 3 ft. in girth.

It is probably identical with a specimen, preserved in the Kew Herbarium, which was gathered by Fendler in 1847 in New Mexico. This specimen, which bears no cones, has similar branchlets and buds, and leaves similar in length and stomatic lines, but somewhat stouter. Engelmann has marked this specimen in pencil: "vigorous long-leaved form, young tree"; but in all probability it is a distinct species. Until the tree at Kew bears cones, the identification must remain doubtful. The seed was perhaps sent home by Roetzl, who collected in this region.

DISTRIBUTION

Engelmann's spruce is an alpine tree, widely distributed in western North America, extending in the Rocky Mountains from Alberta¹ to southern New Mexico and Arizona, and westwards to the Selkirk and Cascade Mountains of British Columbia, Washington, and Oregon. Towards the south it occurs at 8000 to 11,500 feet elevation, while farther north it descends to 5000 feet. It attains its largest size and forms a great part of the forests on the high mountains of southern Alberta, and is a common tree in Montana and Idaho. Westward, on the Cascades and Blue Mountains of Washington and Oregon, it is smaller in size, and is usually scattered amongst other trees; and on account of its slightly different habit, was distinguished by Lemmon as *P. columbiana*²; but both Sargent and Britton are unable to separate this even as a distinct variety. It is common on the Yellowstone plateau in Wyoming, and forms extensive forests in Colorado, Utah, eastern Nevada, and the San Francisco peaks of northern Arizona, reaching its most southerly point on the summit of the Mogollon Mountains in New Mexico.

(A. H.)

This tree is a conspicuous feature in the alpine forest of Alberta, where I often camped under its shelter in 1895. It grows from the foothills of the Rocky Mountains up to nearly timber line, which is here about 7000 feet. It seems to be a very slow-growing tree, for Wilcox³ counted 400 rings on an old stump near Lake Louise, which was less than 3 ft. in diameter.

¹ A good photograph of a forest of this tree at Laggan is reproduced by Mayr, *Fremdländ. Wald- u. Parkbäume*, 325, fig. 103 (1906).

² The tree in Montana ascribed to this species by M. E. Jones, *Montana Botany Notes*, 10 (1910), is *P. albertiana*.

³ *The Rockies of Canada*, 62 (1900).

Mr. F. R. S. Balfour, who saw it in the same region, writes to me as follows:—"This alpine spruce covers immense tracts in the Rockies at high altitudes. The finest I have seen are near Lake Louise, where it grows to a height of 140 ft., mixed with *Abies lasiocarpa*. Indeed the two are singularly alike and difficult to distinguish, except for the red drooping cones of the *Picea*, and the small black erect ones of the *Abies*. The barks of these trees are very similar, of a grayish red broken into large loose scales. The leaves when crushed have a rather unpleasant smell. Wherever I have seen this tree, it has an arrowy appearance from the shortness of its branches. This is doubtless due to the weight of frozen snow which covers them in winter, and prevents lateral growth. The tree often fruits profusely when quite young and small, the leader then becoming bent with the weight of cones surrounding it. These are about two inches long and of a warm crimson when fully grown. The branches are produced in very regular whorls; and when young the bark is smooth and silvery before it becomes scaly."

This spruce was first distinguished by Dr. C. C. Parry, who found it in 1862 on Pike's Peak in Colorado, and sent seeds in the following year to the Botanic Garden of Harvard University, where the tree was first cultivated. It is said to have been introduced¹ into England in 1864; but the tree seems quite uncommon in this country. We have found no trees which are probably so old as this, except one at Highnam, which was bearing cones in 1909 and measured 38 ft. by 3 ft. 2 in. The bark of this separates into regular small scales. A thriving tree at Hatfield, Herts, which was planted in 1893, measured 21 ft. by 1 ft. in 1908. There are smaller trees in the same county at Bayfordbury, High Leigh, and Brickendon Grange.

(H. J. E.)

PICEA PUNGENS, COLORADO SPRUCE

Picea pungens, Engelmann, in *Gard. Chron.* xi. 334 (1879) and xvii. 145 (1882); Masters, in *Gard. Chron.* xx. 725, fig. 130 (1883), and x. 547, figs. 73, 74 (1891); Kent, Veitch's *Man. Conif.* 448 (1900); Britton and Shafer, *N. Amer. Trees*, 60 (1908); Clinton-Baker, *Illust. Conif.* ii. 46 (1909).

Picea Parryana, Sargent, *Silva N. Amer.* xii. 47, t. 600 (1898), and *Trees N. Amer.* 44 (1905).

Picea Menziesii, Engelmann, in *Trans. St. Louis Acad.* ii. 214 (1863) (not Carrière); Sargent, in *Bot. Gaz.* xlv. 227 (1907).

Abies Menziesii, Engelmann, in *Amer. Journ. Science*, xxxiv. 330 (1862) (not Lindley), and in *Gard. Chron.* vii. 790 (1877); André, in *Gard. Chron.* vii. 562 (1877).

Abies Menziesii Parryana, André, in *Illust. Hort.* xxiii. 198 (1876), and xxiv. 53, 119 (1877).

A tree, attaining in America 150 ft. in height and 9 ft. in girth, usually considerably smaller. Bark reddish grey, fissuring on young stems into small oblong plates, on old trunks deeply divided into broad rounded scaly ridges. Young branchlets, stout, rigid, glaucous at first, gradually becoming orange brown. Buds $\frac{1}{4}$ to $\frac{5}{8}$ in. long, ovoid, rounded at the apex, with the tips of the upper scales rounded

¹ Veitch, *Man. Conif.* 69 (1881).

and scarious and usually reflexed; terminal buds girt with a ring of keeled acuminate scales. Leaves on lateral branches in an imperfect radial arrangement, more crowded on the upper than on the lower side of the branchlet, all spreading forwards as well as outwards; $\frac{3}{4}$ to $1\frac{1}{4}$ in. long, stout, rigid, incurved, tapering towards the hard sharp-pointed apex; varying greatly in colour on different trees, bright green, bluish or silvery white; quadrangular in section, with four to seven stomatic lines on each side.

Cones sessile, usually persistent till the second winter, about 2 to 4 in. long, 1 to $1\frac{1}{2}$ in. in diameter, cylindrical but slightly narrowed at both ends; green tinged with red when growing, pale shining brown when mature: scales numerous, like those of *P. Engelmanni*, thin, tough and flexible, rhomboidal, narrowing towards the truncate denticulate apex, longer than broad, about $\frac{1}{2}$ in. wide: bract about $\frac{1}{8}$ in. long, with a denticulate ovate lamina. Seed blackish, $\frac{1}{8}$ in. long; seed with wing $\frac{2}{3}$ in. long; wing broadest near the truncate lacerate apex.

This species is readily distinguished by its radially arranged, rigid, sharp-pointed leaves, by its glabrous branchlets, and by the loose reflexed tips of the bud-scales.

VARIETIES

Seedlings differ very much in the colour of the foliage, which varies from almost a pure green to a silvery white. Trees with very blue glaucous foliage are distinguished as var. *glauca*, Regel,¹ and are much more ornamental than the green form, var. *viridis*, Regel,¹ which is less common in cultivation. Var. *argentea*, Waterer,² is a form with silvery foliage, which has longer and more slender needles than usual; and on this account it is often erroneously known in gardens as *Picea Engelmanni glauca*,³ from which species it is readily distinguished by its glabrous branchlets and peculiar buds with reflexed scales.

Var. *Kosteriana*⁴ (var. *glauca pendula*⁵). This is a form with very pendulous branches and fine bluish foliage, which originated in Messrs. Koster's nursery at Boskoop in Holland.

Another variety, said to be vigorous in growth, and characterised by shining leaves, silvery white in colour and broader and longer than in the type, originated in the nursery of Herr Weise at Kamenz in Saxony, who sent it out as var. *König Albert von Sachsen*.⁶

Beissner describes two prostrate forms, var. *prostrata*⁷ and var. *tabuliformis*.⁸ According to Rehder,⁹ a dwarf compact form originated about 1890 in the Arnold Arboretum, U.S.A.

¹ *Russ. Dendr.* i. 37 (1883).

² *Ex Masters*, in *Journ. Roy. Hort. Soc.* xiv. 223 (1892).

³ This is *Abies Engelmanni glauca*, Veitch, *Man. Conif.* 69 (1881). Cf. Kent, Veitch's *Man. Conif.* 432 (1900).

⁴ Masters, in *Kew Hand-List Conif.* 85 (1903).

⁵ Beissner, *Nadelholzkunde*, 348 (1901). Bean, in *Kew. Bull.* 1908, p. 390, calls it var. *Kosteri pendula*.

⁶ Ledien, in *Gartenflora*, xl. 69, fig. 22 (1891).

⁷ *Mitt. Deut. Dend. Ges.* 1906, p. 141.

⁸ *Ibid.* 1909, p. 268.

⁹ In Bailey, *Cycl. Am. Hort.* 1334 (1901).

DISTRIBUTION AND CULTIVATION

P. pungens is very restricted in its area of distribution, and is nowhere abundant, growing usually as isolated trees or in small groves on the banks and terraces of streams at 6500 to 10,000 ft. elevation. It is met with in Colorado, eastern Utah, New Mexico,¹ and in Wyoming, extending in the latter state as far north as the Wind River mountains.

This species was discovered² in 1862 on Pike's Peak in Colorado by Dr. C. C. Parry, who sent seeds in the following year to the Botanic Garden of Harvard University. One of the earliest plants³ raised had attained in 1883 16 ft. in height in Prof. Sargent's garden at Brookline, Massachusetts. Waterer⁴ in 1877 took cuttings from this tree, which were propagated in his nursery at Knap Hill; and, doubtless, from these are derived most of the older specimens growing in England. Seeds⁵ were again collected in Colorado by Roehl, from which some of the trees on the Continent may have originated.

It has been largely planted on account of its beautiful foliage; but has nowhere, so far as we know, attained large dimensions, and seems only suitable as an ornament in gardens. It has lately been attacked by a fungus.⁶

There are good specimens, about 30 ft. high, of both the green and glaucous varieties at Highnam, which were bearing cones in March 1910. A glaucous tree at Aldenham also bore cones in 1909. Mr. A. B. Jackson in 1911 reported two good trees, 35 and 33 ft. high, at Yattendon Court, Berks.

According to Schwappach,⁶ this tree may prove valuable for planting in northern Germany, where it not only supports the cold of winter without injury, but is hardier⁷ against late frosts than any other conifer. It grows well on moist soils, and thrives even on wet soils, which are unsuitable for *P. excelsa* or even for *P. sitchensis*; and on account of the sharp-pointed needles, it is not attacked by deer or squirrels. It has been tried at nineteen stations, the total area of the experimental plots being fifteen acres. It grows slowly at first, averaging in the fifth year 12 to 20 in. high, and in the tenth year $2\frac{1}{2}$ ft. to 4 ft. 8 in.

According to Sargent, it has been much planted in the United States as an ornamental tree, on account of its handsome pyramidal habit; but trees with bluish foliage lose in a few years much of their colour, and the older trees, 30 to 40 ft. in height, are losing their lower branches, so that their pyramidal habit is spoiled.

(A. H.)

¹ Britton and Shafer, *N. Amer. Trees*, 60 (1908), give New Mexico as a habitat for this species; but I have seen no specimens.

² According to Sargent in *Gard. Monthly*, quoted in *Woods and Forests*, 1885, p. 53, trees of this species were transplanted from Colorado to Iowa in 1860, and proved very hardy.

³ *Gard. Chron.* xx. 725, fig. 130 (1883).

⁴ *Gard. Chron.* vii. 48 and 562 (1877).

⁵ Borthwick, in *Trans. Bot. Soc. Edin.* xxiii. 232 (1906), and *Notes R. Bot. Gard. Edin.* 1909, p. 260, plate 50, states that this fungus, which he names *Cucurbitaria piceae*, attacks the buds, and produces large black conical swellings, in which numerous fructifications of the fungus occur. The bud is either immediately destroyed, or it may produce a twisted cankered shoot which frequently dies off at an early period.

⁶ *Anbauversuche mit Fremdländ. Holzarten*, 49 (1901).

⁷ This is also the case in my experimental ground at Colesborne, where late frosts have severely injured all the other spruces.—H. J. E.

PICEA SPINULOSA, SIKKIM SPRUCE

- Picea spinulosa*, Henry, in *Gard. Chron.* xxxix. 219 (1906); Beissner, in *Mitt. Deut. Dend. Ges.* 1906, p. 83; Clinton-Baker, *Illust. Conif.* ii. 50 (1909).
Picea morindoides, Rehder, in Sargent, *Trees and Shrubs*, i. 95, t. 48 (1903); Henry, in *Gard. Chron.* xxxix. 132, 219 (1906), and in *Trees of Great Britain*, i. 77 (1906); Masters, in *Gard. Chron.* xxxix. 218, fig. 84, and 274, fig. 113 (1906), and xli. 388 (1907); Brandis, *Indian Trees*, 720, 721 (1906); Stapf, in *Bot. Mag.* t. 8169 (1907).
Picea Alcockiana, Carrière, var. *morindoides*, Mottet, *Conif. et Taxac.* 273 (1902).
Abies spinulosa, Griffith, *Journals*, 259 (1847), and *Itin. Notes*, 145 (1848).
Abies Morinda, Lindley, in *Gard. Chron.* 1855, p. 334 (not *Picea Morinda*, Link).
Abies Smithiana, Hooker, *Himalayan Journals*, ii. 32 (1854) (not Lindley).
Pinus spinulosa, Griffith, *Icon. Pl. Asiat.* t. 363 (1854).

A tree, attaining in the eastern Himalayas over 200 ft. in height. Bark rough and scaling off in small quadrangular plates. Young branchlets slender, glabrous, yellowish grey. Buds, about $\frac{1}{4}$ in. long, ovoid, obtuse at the apex, brown, scarcely resinous, with glabrous obtuse scales. Leaves, in an imperfect radial arrangement, covering in closely imbricated ranks the upper side of the branchlets, those on the lateral sides directed outwards and forwards, those on the under side pointing downwards and forwards; $\frac{3}{4}$ to $1\frac{1}{4}$ in. long, $\frac{1}{20}$ in. broad, slender, acute at the apex, which is tipped with a sharp point; flattened, but keeled on both surfaces, so that the section is rhomboid-elliptic; ventral surface green without stomatic lines and directed towards the light; dorsal surface with two stomatic bands, each of 4 to 6 lines; resin canals, two (occasionally absent), dorsal, near the edges and close to the hypoderm.

Staminate flowers pink, $\frac{3}{4}$ in. long; connective with an orbicular denticulate appendix. Cones, about $2\frac{1}{2}$ in. to 3 in. long on cultivated trees, up to 4 in. long on wild trees, 1 to $1\frac{1}{2}$ in. in diameter, cylindrical, obtuse at the apex, green with a purple border to the scales when growing, shining brown when mature: scales thin and flexible, suborbicular with a cuneate base, about $\frac{1}{2}$ to $\frac{5}{8}$ in. wide, bevelled in the upper margin, which is rounded,¹ entire, undulate, or slightly denticulate: bract ovate, acute, $\frac{1}{8}$ in. long. Seed, $\frac{1}{8}$ in. long, greyish brown; seed with wing $\frac{1}{2}$ in. long; wing broadest above the middle, rounded and denticulate at the apex.

This species is distinguishable from the other flat-leaved spruces with glabrous branchlets,—by the leaves somewhat radially arranged, distinctly keeled on both surfaces, slender, and ending in a sharp point. The leaves of *P. sitchensis*, which are similar in appearance, are arranged on the lateral branches as in the common spruce.

This species appears to be the only spruce occurring in the eastern Himalayas, where it has been found in Sikkim and Bhutan, at 8000 to 10,000 ft. altitude. There are no specimens of *P. Smithiana* from this region in the Calcutta and Kew herbaria.²

¹ In some wild specimens the scales are truncate in the upper margin.

² The specimens in the Calcutta Herbarium, which were sent on loan to Kew in 1910, comprise the following:—

“Sikkim, chief forest tree in Rinchingung; King, 1875.”

“Sikkim, Lachen; King's collector in 1885.”

“Sikkim, Lachung; Gammie, 1892.” Referred to as *P. Morinda* in *Rec. Bot. Survey India*, i. No. ii. pp. 11, 19.

“Chumbi; Gamble, 1880.”

“Chumbi; King's collector, 1884.”

There are no specimens from Bhutan, either in the Kew or Calcutta herbarium.

It was discovered by Griffith, who found it growing on the slopes of the Rodoola Pass and in the Tung-chiew valley in northern Bhutan (about $91\frac{1}{2}^{\circ}$ long. and almost 150 miles east of the Sikkim frontier). He described it as a tree usually of moderate size, but occasionally attaining 80 ft. in height, and growing in groups between 8500 and 10,000 ft. elevation. It resembled at a distance a larch in habit, with the lower branches deflexed and the upper branches spreading. He named it *Abies spinulosa*, and there is no doubt possible as to its identity. He refers to the pulvini from which the leaves arise, showing that it was a spruce and not a silver fir. His statement¹ that “the lower surface of the leaf is glaucous, but that probably this was the true upper surface turned downwards” is characteristic of the section *Omorica*, to which *P. spinulosa* belongs.

Sir Joseph Hooker found this spruce again in 1849 in the Lachen valley, at 9000 ft. altitude, in Sikkim; and Elwes saw it in the same place on 1st October 1870; but neither Hooker nor Elwes noticed it elsewhere in Sikkim. Hooker identified it with Griffith's *Abies spinulosa*; but, unfortunately, afterwards combined it with *Picea Smithiana*.²

It was again found at 9000 to 10,000 ft. altitude, in 1887, in the drier climate of the Chumbi valley (on the north-eastern frontier of Sikkim) by a native in the employment of the late Sir J. Ware Edgar, then Deputy Commissioner of Darjeeling. It has lately been rediscovered in this locality by Mr. E. H. C. Walsh, who accompanied the military expedition to Lhasa. There are also specimens in the Kew Herbarium collected at Yatung ($27^{\circ} 51' N. lat., 88^{\circ} 35' E. long.$) by Mr. H. E. Hobson.

Sir George King, who considered the Chumbi valley specimens to be a new species, which, however, he left undescribed, sent seeds in 1877 or 1878 to various botanical establishments in Europe; and a tree probably raised from this seed is now growing in the arboretum of M. Allard, at Angers in France. It was found here by Mr. Rehder, who described it as a new species of unknown origin, under the name *P. morindoides*. It bore cones which I gathered in 1906, and was then about 20 ft. high. M. Allard obtained it about 1891 from Van Houtte.

(A. H.)

Though I saw this tree in the Lachen valley of Sikkim during my first journey to the Tibetan frontier in 1870, I did not take special notice of it at the time, and certainly saw no such wonderful trees as are described by Mr. J. Claude White in his recently published book.³ These grow in the Sebu valley, a tributary of the Lachung, and must be among the tallest trees in India. Mr. White says: “One fallen giant, a spruce that I measured, was 220 ft. from the roots to where it had broken off short, and there it measured 6 ft. in girth. What had become of the top I do not know, but it was a magnificent specimen.”

¹ Griffith's MS. description at Kew, which is mutilated in the printed *Itin. Notes*, reads: “Ramulis fere omnibus deflexis, verrucis e quibus folia oriuntur exasperatis; folia undique patentia, linearea, mucrone spinulosa terminale, pungentia; pagina inferior glauca, superior an resupinata. Conis terminalibus, pendentibus, oblongis, fere cylindraceis, castaneo brunneis; squamis latiformis, obtusissimis, laevibus.”

² *Flora Brit. India*, v. 653 (1888) under *P. Morinda*. Hooker gives on a drawing at Kew the height of the tree as 80 ft., and the locality, Lachen, 8000 to 10,000 ft. altitude.

³ *Sikkim and Bhutan*, 79 (1909).

To confirm this, I may say that I have since heard from Mr. A. D. Hickley, who visited and re-measured the same tree. He informs me that it grew at a place called Chu-par-rab-dong on the left bank of the river just opposite Yakchi, at an elevation of about 10,000 ft. Five lengths of the fallen stem were missing, having been probably used by the natives; but without counting these he made the length 207 ft., and the girth as follows:—at the base, 12 ft. 7 in.; at 50 ft., 13 ft.; at 100 ft., 12 ft.; at 139 ft. (the place where the tree was first broken in its fall), 9 ft. 4½ in. The thinnest piece, without the bark, was 5 ft. 2 in. in girth. In the same valley not far away Mr. Hickley measured another spruce, also with the top broken, 197 ft. long; and there were many like it still standing. A silver fir (*Abies Webbiana*) in this valley girthed 15½ ft. at four feet from the ground; and a larch (*Larix Griffithii*) growing between two spruces, of which he sends me a photograph, was well over 125 ft., and very much taller than any previously recorded. The photograph, unfortunately, is not good enough for reproduction in this work, and I have vainly endeavoured to obtain a better one.

This species was first detected by Henry in cultivation in this country at Castlewellan, where there are three or four trees, which were raised by the late Earl Annesley from seed sent by the Calcutta Botanic Garden in 1890. The largest tree¹ was 22 ft. high and 18 in. in girth in 1906, and produced cones for the first time in 1907. It is a handsome tree (Plate 347), remarkably distinct in appearance, and perfectly hardy. Specimens have been sent from Castlewellan to the Botanic Gardens at Kew, Glasnevin, and Cambridge.

There are three trees at Leonardslee, Horsham, which produced cones in 1906 and 1907. Sir Edmund G. Loder informs me that these were planted by a former owner, and that their origin is unknown. The largest in 1910 measured 31 ft. 9 in. by 2 ft. 5 in. From the seed of these trees seedlings have been raised each year since 1908. Mr. H. Clinton-Baker found a tree about 25 ft. high at Menabilly, in August 1908, which was bearing cones. Seedlings were raised from their seed at Bayfordbury. In Mr. J. M. Robb's garden at Chiltley Place, Liphook, Hants, there is a tree with two stems about 26 ft. high, which was bearing young and old cones in June 1912. This is supposed to have been planted about twenty-five years ago; but has been crowded by other trees. A smaller specimen with a single stem, about twenty years old, is more thriving. I found another tree at Melbury, about 15 ft. high, which was bearing cones in September 1909. It is said to have been planted about ten years ago. (H. J. E.)

¹ Figured in *Gard. Chron.* xxxix. 274, fig. 113 (1906).

JUNIPERUS

Juniperus, Linnæus, *Gen. Pl.* 311 (1737); Endlicher, *Syn. Conif.* 7 (1847); Parlato, in De Candolle, *Prod.* xvi. 2, p. 475 (1868); Bentham et Hooker, *Gen. Pl.* iii. 427 (1880); Masters, in *Journ. Linn. Soc. (Bot.)* xxx. 12 (1893); Hickel, in *Bull. Soc. Dend. France*, 1911, p. 31. *Sabina*, Haller, in Ruppert, *Fl. Jen.* 336 (1745); Garcke, *Fl. Deutschl.* 387 (1849); Antoine, *Cup. Gatt.* 35 (1857).
Thuicarpus,¹ Trautvetter, *Pl. Imag. Flor. Ross.* 11, t. 6 (1844).
Arceuthos, Antoine and Kotschy, in *Oestr. Bot. Wochenbl.* 1854, p. 249.

EVERGREEN shrubs or trees, belonging to the division Cupressineæ of the order Coniferae. Bark usually thin, and scaling in longitudinal strips. Leaves on young plants always spreading and acicular; on adult plants acicular, or appressed and scale-like, different in the sections of the genus, where they are described.

Flowers monœcious or diœcious. Staminate flowers composed of numerous stamens on a central axis, with ovate or peltate scale-like connectives, each bearing two to six globose pollen-sacs. Pistillate flowers, surrounded at the base by minute scale-like bracts, which persist unchanged under the fruit; composed of three to eight opposite or ternate pointed scales, bearing either at their base or alternate with them one to two ovules. Fruit a succulent berry-like indehiscent strobile, composed of three to eight fleshy scales united together, covered by a membranous epidermis; ripening in the first, second, or rarely in the third year. Seeds, variable in number (one to twelve) and in shape; usually free, but in one species coalesced. Cotyledons two, or four to six.

The genus comprises about thirty-five species distributed over the northern hemisphere from the Arctic Circle to Mexico and the West Indies, Azores and Canary Islands, Northern Africa, Abyssinia, and the mountains of East Tropical Africa,² Himalayas, China, and Formosa.

The genus is divided into three sections:—

I. Leaves always acicular, spreading in whorls of threes, jointed at the base. Buds distinct, and with scale-like leaves. Flowers axillary, diœcious.

§ I. OXYCEDRUS, Endlicher, *Syn. Conif.* 9 (1847).

Leaves always spreading, never appressed, linear, rigid, usually sharp-pointed, convex and green beneath, whitened above with one or two stomatic bands, entire in margin, without glands, not decurrent on the branchlets, which are glabrous and triangular in section.

Flowers solitary in the axils of the leaves. Staminate flowers, surrounded at

¹ Founded on a cultivated specimen of *J. communis*, L., var. *oblonga*, with abnormal fruit.

² Here extending south of the equator into the southern hemisphere.

the base by a few scales; stamens in ternate whorls, with oval connectives. Pistillate branchlets, composed of five to eleven ternate whorls of scales, with usually only the apical whorl fertile, each of its scales alternating with one of the three ovules, the tips of which protrude at the apex of the branchlet. Fruit, composed of three or six scales, marked at the apex by three radiating lines or furrows. Seeds, normally three, free and radially disposed in the centre of the berry, with depressions for large resin-glands.

A. *Leaves with one white stomatic band above.*

1. *Juniperus communis*, Linnæus. Europe, North Africa, Extratropical Asia, Canada, and the United States. See p. 1400.

Leaves, $\frac{2}{5}$ to $\frac{3}{5}$ in. long, slightly concave above, no trace of a green midrib being present except in rare cases near the base. In var. *nana*, leaves shorter, $\frac{1}{6}$ to $\frac{1}{3}$ in. long.

2. *Juniperus rigida*, Siebold and Zuccarini. Japan, Korea, Manchuria. See p. 1408.

Leaves $\frac{1}{2}$ to $\frac{3}{4}$ in. long, very slender, deeply concave above with the margins inflexed, forming a narrow median groove.

B. *Leaves with two white stomatic bands above.*

* *Shrubs, with leaves spreading horizontally outwards; branchlets usually not pendulous.*

3. *Juniperus Oxycedrus*, Linnæus. Mediterranean Region, Caucasus, Persia, Madeira. See p. 1409.

Leaves $\frac{1}{2}$ to $\frac{3}{4}$ in. long, gradually tapering from the middle to the sharp-pointed acuminate apex; upper surface with a conspicuous midrib, about half the width of the white bands, which are equal in width to the marginal green bands.

4. *Juniperus macrocarpa*, Sibthorp and Smith. Mediterranean Region. See p. 1412.

Leaves $\frac{3}{4}$ to 1 in. long, tapering from the base to the sharp-pointed acuminate apex; upper surface with a conspicuous midrib, less than half the width of the white bands, which are broader than the marginal green bands.

5. *Juniperus brevifolia*, Antoine. Azores. See p. 1413.

Leaves, oval-linear, very short, $\frac{1}{4}$ to $\frac{1}{3}$ in. long, with a rounded or acute and not acuminate apex; upper surface with a conspicuous midrib, and white bands broader than the green bands.

** *Trees, with leaves directed forwards towards the apices of the pendulous branchlets.*

6. *Juniperus Cedrus*, Webb and Berthelot. Canary Islands. See p. 1414.

Leaves, $\frac{1}{2}$ to $\frac{3}{4}$ in. long, with a conspicuous midrib above, about half the width of the white bands, which are equal in width to the marginal green bands.

7. *Juniperus formosana*, Hayata. China, Formosa. See p. 1415.

Leaves, $\frac{1}{2}$ to $\frac{3}{4}$ in. long; upper surface with a midrib much narrower than the white bands, which are broader than the marginal green bands.

§ 2. *CARYOCEDRUS*, Endlicher, *Syn. Conif.* 8 (147).

Leaves as in § *Oxycedrus*, but decurrent on the branchlets, which show between the whorls three raised pulvini, separated by grooves.

Staminate flowers, three to six in a head, on a scaly stalk arising in the axil of a leaf; stamens nine to twelve in each flower. Fruit, much larger than in the other sections, composed of six or nine ternate scales. Seeds consolidated into a thick globose three-celled bony mass. This section includes only one species.

8. *Juniperus drupacea*, Labillardière. Greece, Asia Minor, Syria. See p. 1417.

Leaves $\frac{1}{2}$ to $\frac{7}{8}$ in. long, widely spreading, very rigid, sharp-pointed; upper surface with a broad green midrib, deeply furrowed near the base, and two white bands, which are much broader than the marginal green bands.

11. Leaves (a) all scale-like and appressed, or (b) all acicular, or (c) often mixed; never jointed at the base, always adnate to the branchlet. No distinct leaf-buds. Flowers monœcious or diœcious, terminal on short axillary branchlets.

§ 3. *SABINA*, Spach, in *Ann. Sci. Nat.* xvi. 291 (1841).

Branchlets in most species like those of a *Cupressus*, terete or tetragonal in section, densely clothed with closely appressed imbricated scale-like leaves, which are usually in four ranks in decussately opposite pairs, or rarely ternate in six ranks, oval or triangular, adnate in the basal half, more or less free at the apex, glandular or marked with a depression on the back, entire or denticulate in margin.

In young plants of all the species, on occasional branches of adult trees of most species, and on all the branches of two species, acicular foliage occurs:—leaves linear-lanceolate, sharp-pointed, nearly appressed or more or less spreading, in whorls of threes or in opposite pairs, whitened on the ventral surface.

Staminate flowers with usually the stamens in opposite pairs, rarely ternate. Pistillate flowers, with usually opposite or rarely ternate scales, each of which bears one or two ovules. Fruit, with usually opposite or rarely ternate scales. Seeds, one to twelve, generally ovoid, with a broad base marked by a large hilum.

A. *Leaves on adult plants always acicular.*

9. *Juniperus recurva*, Buchanan-Hamilton. Himalayas. See p. 1419.

A tree with curved and pendulous branchlets. Leaves in threes, loosely appressed, $\frac{1}{8}$ to $\frac{1}{4}$ in. long, sharp-pointed, greyish green on the dorsal surface, which is channelled in the middle line near the base.

10. *Juniperus squamata*, Buchanan-Hamilton. Afghanistan, Himalayas, China, Japan, Formosa. See p. 1420.

A prostrate shrub. Leaves in threes, appressed or spreading, broader and shorter than in *J. recurva*, green on the dorsal surface, which is channelled from the base to near the apex.

J. procumbens, Siebold, is similar, but has larger leaves, which like the branchlets are glaucous in tint. See p. 1422.

B. Leaves on adult plants scale-like, except on occasional branches.

* Leaves denticulate¹ in margin.

(a) Acicular leaves usually in whorls of threes.

11. *Juniperus Wallichiana*, J. D. Hooker. Himalayas. See p. 1423.

Ultimate branchlets, tetragonal, $\frac{1}{25}$ in. in diameter; leaves closely appressed, narrowly ovate, acute, with a conspicuous linear furrow on the back from base to apex. Acicular foliage usually present, similarly furrowed on the back. Fruit blue, ovoid, with one very large seed.

12. *Juniperus phœnicea*, Linnæus. Mediterranean Region, Crimea, Canary and Madeira Islands. See p. 1424.

Ultimate branchlets, terete, $\frac{1}{25}$ in. in diameter; leaves closely appressed, ovate-rhombic, blunt, with an inconspicuous oval depression on the back. Acicular foliage rare on adult trees. Fruit, yellow or reddish brown, with fibrous yellow flesh, and three to nine seeds.

13. *Juniperus flaccida*, Schlechtendal. Texas, Mexico. See p. 1426.

A tree with long pendulous branches. Leaves ovate-lanceolate, slightly spreading, $\frac{1}{2}$ in. long, sharp-pointed, with a linear sunken gland, exuding resin. Acicular foliage usually present, similarly glandular, mostly ternate, rarely in pairs. Fruit reddish brown, minutely tuberculate, with six to twelve seeds.

14. *Juniperus pachyphlœa*, Torrey. Arizona, Texas, New Mexico, Mexico. See p. 1429.

Tree with thick bark, divided into small square scaly plates, unique in the genus. Ultimate branchlets, tetragonal, $\frac{1}{25}$ in. in diameter; leaves appressed, ovate-rhombic, with a depressed oval gland, often exuding resin. Acicular leaves often present. Fruit reddish brown, tuberculate on the surface, with four seeds.

(b) Acicular leaves in opposite pairs.

15. *Juniperus thurifera*, Linnæus. France, Spain, Portugal, Sardinia, Morocco, Algeria. See p. 1427.

Ultimate branchlets, $\frac{1}{10}$ in. in diameter; leaves ovate, appressed but free at their acute or acuminate tips, with a conspicuous glandular depression on the back. Acicular foliage often present. Fruit blue, with two to four seeds.

** Leaves entire in margin.

(a) Acicular leaves usually in whorls of threes.

16. *Juniperus chinensis*, Linnæus. China, Japan. See p. 1430.

Ultimate branchlets, $\frac{1}{25}$ in. in diameter, marked with white crosses, due to the pale margins of the leaves, which are appressed, rhombic, obtuse, with an inconspicuous dorsal gland. Acicular foliage usually present, either ternate or in pairs. Fruit brown, covered with a white mealy bloom, subglobose, but widest and depressed at the summit, with usually two or three seeds.

17. *Juniperus bermudiana*, Linnæus. Bermuda. See p. 1434.

Ultimate branchlets, tetragonal, $\frac{1}{10}$ in. in diameter; leaves closely appressed, ovate, obtuse at the incurved apex, with a conspicuous dorsal furrow. Acicular leaves usually present, furrowed on the back. Fruit dark blue, covered with a glaucous bloom, with two or three seeds.

¹ The denticulations on the leaves are very minute, and can only be seen with a considerable magnifying power.

(b) Acicular leaves in opposite pairs.

18. *Juniperus virginiana*, Linnæus. North America. See p. 1435.

A tree. Ultimate branchlets very slender, $\frac{1}{30}$ in. in diameter; leaves appressed, ovate, acute or acuminate, with often a small oval depression on the back. Acicular foliage usually present. Fruit bluish, very small, $\frac{1}{4}$ in. in diameter, with one or two seeds.

19. *Juniperus Sabina*, Linnæus. Europe, Caucasus, North America. See p. 1443.

A shrub, distinguishable by the strong disagreeable odour of the foliage, when bruised. Ultimate branchlets very slender, $\frac{1}{30}$ in. in diameter; leaves appressed, ovate, acute or acuminate, with a conspicuous depressed dorsal resin-gland. Acicular foliage often present. Fruit bluish, very small, $\frac{1}{5}$ in. in diameter, with usually two seeds.

20. *Juniperus excelsa*, Bieberstein. Balkan States, Crimea, Syria, Asia Minor, Caucasus. See p. 1446.

A tree. Ultimate branchlets very slender, $\frac{1}{30}$ in. in diameter; leaves appressed, ovate-rhombic, acute or obtuse, marked on the back with a depressed gland. Acicular foliage rarely present. Fruit dark purplish brown, $\frac{1}{3}$ to $\frac{1}{2}$ in. in diameter, with about six seeds.

The following species, of which I have seen no living adult specimens in cultivation, may be briefly mentioned, on account of their economic importance.

- I. *Juniperus procera*, Hochstetter, ex Endlicher, *Syn. Conif.* 26 (1847).

A tree, widely spread throughout Abyssinia, Somaliland, and the highlands of equatorial Africa. In botanical characters it closely resembles *J. excelsa*. Hutchins¹ gives a good account of this species in British East Africa, where it is called cedar and is a timber tree of great value, occasionally attaining an enormous size. He figures a very old tree dividing into two stems, the largest of which is 110 ft. high and 12 ft. in diameter. The wood is now imported into Hamburg in considerable quantity (about 2500 tons in 1911 from German East Africa), and is used for the same purposes as *J. virginiana*, selling in London at about 4s. per cubic foot. *J. procera* is occasionally seen in the juvenile stage in conservatories in botanic gardens; but is not hardy in the open air in Britain. Koch² mentions a reputed tree of this species, growing in 1873, in Simon-Louis's nursery at Metz, which we cannot now identify.

- II. *Juniperus occidentalis*, W. J. Hooker, *Fl. Bor. Amer.* ii. 166 (1839).

A tree, attaining 60 ft. in height, and 9 ft. in girth, readily distinguishable by the stout ultimate branchlets, covered with closely appressed scale-like leaves, arranged in six ranks, in whorls of threes, denticulate in margin, and conspicuously glandular on the back. Fruit subglobose, $\frac{1}{3}$ in. long, bluish with a glaucous bloom, with resinous juicy flesh, containing two or three seeds.

This species occurs on mountain slopes and high prairies in western North America from Washington and Idaho to the Sierras of California.

I have seen no specimens of this species in the living state in England; and

¹ Report of the Forests of British East Africa, 20, 145 (1909), and Scot. Geog. Mag. 1909, p. 351.

² Dendrologie, ii. pt. ii. 132 (1873).

it is doubtful if it has ever been introduced, as Carrière states¹ that all the reputed plants of *J. occidentalis* which he saw were very doubtful; and Kent² does not appear to have recognised this species. (A. H.)

JUNIPERUS COMMUNIS, COMMON JUNIPER

Juniperus communis, Linnæus, *Sp. Pl.* 1040 (1753); Loudon, *Arb. et Frut. Brit.* iv. 2489 (1838); Parlatore, in De Candolle, *Prod.* xvi. 2, p. 479 (1868); Bentley and Trimen, *Medicinal Plants*, iv. t. 255 (1880); Boissier, *Flora Orientalis*, v. 707 (1881); Willkomm, *Forstliche Flora*, 261 (1887); J. D. Hooker, *Fl. Brit. India*, v. 646 (1888); Köppen, *Geog. Verbreit. Holzgewächse Russlands*, ii. 396 (1889); Jack, in *Bot. Gaz.* xviii. 369, pl. 33 (1893); Sargent, *Silva N. Amer.* x. 75, t. 516 (1896), and *Trees N. Amer.* 86 (1905); Mathieu, *Flore Forestière*, 514 (1897); Ascherson and Graebner, *Syn. Mitteleurop. Flora*, i. 243 (1898); Franchet, in *Journ. de Bot.* 1899, p. 264; Kent, *Veitch's Man. Conif.* 170 (1900); Brandis, *Indian Trees*, 694 (1906); Kirchner and Schröter, *Lebensgesch. Blütenpfl. Mitteleuropas*, i. 287 (1906).

A shrub or low tree, occasionally, however, attaining 40 ft. or more in height. Bark reddish brown, at first smooth, ultimately peeling in thin papery shreds. Young branchlets slender, triquetrous, with three projecting narrow ridges between the whorls of leaves. Buds about $\frac{1}{8}$ in. long, with a few loose ovate acuminate green scales. Leaves all acicular, persistent for three years, sessile, spreading, variable in length, averaging $\frac{2}{8}$ to $\frac{3}{8}$ in. long, linear-subulate, gradually tapering from near the jointed and swollen base to the slender spine-like apex; upper surface concave, with usually a single continuous broad white longitudinal stomatic band, no green midrib being present, except occasionally near the base, in which case the stomatic band is divided into two parts for a short distance; lower surface bluntly keeled, with usually a slight furrow in the middle line; resin-canal solitary, situated in the substance of the leaf below the central fibro-vascular bundle.

Flowers dioecious, rarely monœcious, formed in autumn in the axils of the lower whorls of leaves on the current year's shoot, opening in the following spring. Staminate flowers solitary, cylindrical, $\frac{1}{8}$ in. long, yellow; stamens in five or six whorls, three in each whorl, with ovate acute connectives, each of which bears three or four pollen-sacs. Pistillate flowers solitary, green, $\frac{1}{12}$ in. long; scales in six or seven whorls, three in each whorl; the upper three scales minute at the time of flowering, and alternating with three fleshy tubular ovules; the lower scales larger, ovate-acuminate, empty.

Fruit³ ripening in the second or third year,⁴ small and green in the first year; when mature, bluish or almost black, covered with a slight bloom, globose or slightly longer than broad, $\frac{1}{3}$ in. in diameter, on a short scaly stalk; smooth, marked at the summit by three very short radiating lines, below which are three shallow depressions overhung by three minute mucros, indicating the three scales of which

¹ *Conif.* 40 (1867).

² *Veitch's Man. Conif.* 178 (1900).

³ Occasionally the three scales, of which the fruit is composed, do not unite at the summit of the fruit, but gape, showing the seeds inside. This abnormality, var. *thiocarpus*, Ascherson and Graebner, *op. cit.* 245, was described as a distinct genus, *Thuiocarpus juniperinus*, by Trautvetter, *Imag. Pl. Ross.* 11, t. 6 (1844).

Another abnormality, var. *coronata*, Sanio, in *Deut. Bot. Monatsschr.* i. 51 (1883), is occasionally met with, when the points of the scales unite together and form a projection at the summit of the fruit.

⁴ Cf. Jack, in *Bot. Gaz.* xviii. 369-375, plate 33 (1893), who states that in America this species does not ripen its fruit till the autumn of the third year after blossoming.

the fruit is composed. Seeds usually three, rarely two, immersed in a soft resinous mealy sweet pulp; light-brown, elongated-ovoid, triquetrous, narrowed at the summit, which is compressed into a thin transverse ridge; broad at the base, above which on the sides are a few large depressions for resin-glands. Seedling, with two cotyledons, the primary leaves and those of the second year being arranged in whorls of fours.

VARIETIES

The common juniper in the wild state displays a considerable amount of variation in the length and breadth of the leaves, and in the size and shape of the fruit; and numerous varieties based on these characters have been named by Ascherson and Graebner and other botanists, most of which need not be even mentioned here. The most remarkable varieties are the following:—

1. Var. *nana*, Loudon, *op. cit.* 2489 (1838); Ascherson and Graebner, *op. cit.* 246 (1898); Kirchner and Schröter, *op. cit.* 303 (1906).

Var. γ , Linnæus, *Sp. Pl.* 1040 (1753).

Var. *saxatilis*, Pallas, *Fl. Ross.* ii. 12, t. 54 (1788).

Var. *montana*, Solander, in Aiton, *Hort. Kew.* iii. 414 (1789).

Var. *alpina*, Gaudin, *Fl. Helv.* vi. 301 (1830).

Var. *depressa*, Pursh, *Fl. Amer. Sept.* ii. 646 (1814).

Var. *sibirica*, Rydberg, in *Contrib. U.S. Nat. Herb.* iii. 533 (1896).

Juniperus sibirica, Burgsdorf, *Anleit.* ii. No. 272 (1787), and ii. 127 (1790).

Juniperus nana, Willdenow, *Berl. Baumz.* 159 (1796), and *Sp. Pl.* iv. 854 (1805).

Juniperus alpina, J. E. Gray, *Nat. Arr. Brit. Pl.* ii. 226 (1821).

Juniperus depressa, Rafinesque, *Medic. Pl.* ii. 13 (1830).

Juniperus canadensis, Loddiges, *Cat.* 1836, p. 47; Loudon, *op. cit.* 2490 (1838).

Juniperus pygmaea, Koch, in *Linnæa*, xxii. 302 (1849).

A low prostrate spreading shrub, seldom more than a foot in height. Branchlets stouter than in the type. Leaves shorter, less spreading, $\frac{1}{8}$ to $\frac{1}{3}$ in. long, $\frac{1}{4}$ to $\frac{1}{2}$ in. broad, linear-subulate, gradually tapering to the spine-like apex; upper surface very concave, with a continuous white stomatic band; lower surface convex, bluntly keeled. Fruit blue, glaucous, globose, $\frac{1}{8}$ in. in diameter; seeds one, two, or three, smaller than in the type.

This, which is the alpine and arctic variety¹ of *J. communis*, is considered by many botanists to be a distinct species; but Kirchner and Schröter adduce good reasons for supposing it to be only a form, due to climatic conditions. Connecting links² between the type and var. *nana* are found both in the Alps and in Lapland; and experimental sowings of the latter at Berlin and Zurich gave seedlings which resembled the common juniper in all respects. Similarly plants of common juniper from Fontainebleau, which were cultivated by Bonnier³ on Mont Blanc at 6800 feet, assumed the habit of var. *nana* in three years.

¹ *J. dealbata*, Douglas, *ex Gordon*, in *Gard. Chron.* 1842, p. 652, is *J. communis*, var. *nana*. Cf. p. 1436, note 2.

² These have been distinguished as var. *intermedia*, Sanio, in *Deut. Bot. Monatsschr.* i. 51 (1883); and as *J. intermedia*, Schur, in *Verh. Siebenb. Naturw.* v. ii. 169 (1850).

³ *Assoc. Franc. Avanc. Sci., Compt. Rend.* 1892, pt. ii. 521.

2. Var. *hemisphaerica*, Parlature, *Fl. Ital.* iv. 83 (1867).

Juniperus hemisphaerica, Presl, *Delic. Pragens.* 142 (1822).

Resembling var. *nana* in habit, but with longer leaves and larger fruits. It is said by Parlature to occur on Mount Etna, where it grows¹ on sterile soil between 5000 and 7000 ft. elevation; in the mountains of Calabria and Greece; and on the Djurdjura range in Algeria.

Var. *echiniformis*,² which was introduced into gardens by Rinz of Frankfort, is usually identified with var. *hemisphaerica*, but this is extremely doubtful. This cultivated variety, which is commonly known as the "hedgehog juniper," forms a globose bush, 1 to 2 ft. high, with densely crowded branches, branchlets, and leaves.

3. Var. *suecica*, Aiton, *Hort. Kew.* v. 414 (1813).

Var. β , Linnæus, *Sp. Pl.* 1070 (1753).

Var. *fastigiata*, Parlature, in De Candolle, *Prod.* xvi. 2, p. 479 (1868).

Juniperus suecica, Miller, *Gard. Dict.* ed. 8, No. 2 (1758).

Juniperus hibernica, Loddiges, *ex Loudon, op. cit.* 2489 (1838).

Fastigiata in habit, with ascending branches, short leaves, and oblong fruit. This is occasionally found wild in the forests of Scandinavia and of east Prussia, where it often is a tree, 30 ft. to 40 ft. in height, resembling in appearance the fastigiata Mediterranean cypress. So far as I can learn, it has not been noticed³ in the British Isles; but many wild Junipers have a narrow columnar habit.

In gardens the fastigiata juniper is often seen under the name of Irish juniper, perhaps so called because it has the habit of the Irish yew. It is a neat shrub until it becomes thin and shabby in foliage, and often attains 10 to 15 ft. in height. The best specimen which we have seen is one at Westonbirt, about 25 ft. high in 1910. Another at Abercairney was about 20 ft. high in 1911.

4. Var. *compressa*, Carrière, *Conif.* 22 (1855).

Fastigiata, with short branches, and densely crowded very short leaves, forming a small bush, rarely exceeding 3 ft. in height. This is said to be tender, and is possibly of southern origin, as it was identified by Koch⁴ with *J. hispanica*,⁵ which was introduced into cultivation by Booth of Hamburg.

5. Var. *oblonga*, Loudon, *Arb. et Frut. Brit.* iv. 2489 (1838).

Var. *caucasica*, Endlicher, *Syn. Conif.* 16 (1847).

Juniperus oblonga, Bieberstein, *Fl. Taur. Caucas.* ii. 426 (1808) and iii. 634 (1819).

Leaves $\frac{3}{4}$ in. long. Fruit small, $\frac{1}{8}$ in. in diameter, oblong; seeds solitary or two. This variety has been found growing wild in the Caucasus, and scarcely deserves mention, as individuals with the same characters are not uncommon elsewhere. According to Loudon, it was introduced from Paris into the Horticultural Society's Garden at Chiswick about 1826, and formed a bush 4 ft.

¹ Schouw, in *Ann. Sc. Nat.* iii. 243 (1845).

² *J. Oxycedrus echiniformis*, Knight, *Syn. Conif.* 11 (1850). Cf. also Koch, *Dendrologie*, ii. pt. ii. p. 115 (1873).

³ Mr. R. A. Phillips has never seen the fastigiata form growing wild in Ireland, and knows of no records of its existence.

⁴ *Dendrologie*, ii. pt. ii. p. 115 (1873).

⁵ *J. hispanica*, Booth, *ex Endlicher, Syn. Conif.* 15 (1847).

high after being planted twelve years.¹ It has not been recognised by us as now in cultivation.

6. Var. *variiegata aurea*, Carrière, *Conif.* 19 (1867).

Young shoots golden yellow, becoming green in the following year.

7. Var. *cracovia*, Knight, *Syn. Conif.* 11 (1850).

Juniperus cracovia, Loddiges, *ex Loudon, op. cit.* 2490 (1838).

This,² which was said to have been introduced from Poland, was described as a robust plant, with pendulous terminal branchlets. It appears to be very rare in England, the only specimen which we have seen being a tree at Bicton, about 25 ft. high, which has been much broken by the wind.

DISTRIBUTION

The common juniper is more widely distributed than any other tree or shrub in the northern hemisphere. In Europe it is common throughout the northern and central part of the continent, and occurs in the mountains of the countries bordering on the Mediterranean; while the alpine form is reported³ to exist on the Djurdjura range in Algeria. Eastwards *J. communis* spreads through Siberia to Kamtschatka and the Kurile Isles, and through Turkestan to the Thianshan range in Mongolia; but it is not found in Japan,⁴ where it is represented by *J. rigida*. It is also met with in Asia Minor, the Caucasus, Persia, Afghanistan, and the western Himalayas, as far east as Garhwal and Kumaon. In North America it extends from far north in Alaska and in Canada, southwards on the east to New Jersey, Pennsylvania, Michigan, and western Nebraska; in the Rocky Mountains, to New Mexico; and on the Pacific coast, to northern California; and, according to Sargent, only becomes a tree on the limestone hills of Illinois.

Kirchner and Schröter attempt to distinguish with great accuracy the limits of distribution of the common juniper and its var. *nana*; but the altitudes given show that the records of the two forms are much confused. In a general way, it may be stated that var. *nana* extends farther to the north in the plains of the holarctic region, and ascends higher in the mountains to the southward. It is said to occur at the following altitudes: in the Sierra Nevada, between 5400 and 9700 ft.; in the Alps, usually between 6000 and 8000 ft., attaining its highest point on Mt. Rosa at 11,900 feet; in the Caucasus, between 7600 and 9400 feet; in the western Himalayas, between 4300 and 12,000 feet.

J. communis, while widely distributed throughout Russia, is totally absent from the south, in the provinces where the "black earth" formation prevails; and is most common in the Baltic provinces, where in Courland, north-west Livland, Esthonia, and the islands of Oesel and Dagö, it covers large tracts of peaty sand. Kerner⁵

¹ Gordon, in *Gard. Chron.* 1842, p. 652, says that this variety is a robust spreading plant, 2 ft. or 3 ft. high, with leaves like the common juniper, but long and slender; fruit dark purple when ripe, and very small.

² Gordon, in *Gard. Chron.* 1842, p. 652, says that this variety is not different from *J. communis*.

³ Chabert, in *Bull. Soc. Bot. France*, xxxvi. 30 (1889), who also states that the common form, 6 to 8 ft. in height, occurs, but is very rare, in Kabylia.

⁴ Kawakami, in *Tokyo Bot. Mag.* 1900, p. 111, records it, however, for Rishiri Island, on the west coast of Yezo.

⁵ *Pflanzenleben der Donauland* (1863).

long ago described a remarkable juniper forest in Hungary, between the Danube and the Thies, north of the Bacser Canal, where on loose sand it forms extensive thickets of bushes, about 6 ft. in height. The juniper is also widely spread in certain regions as undergrowth in the pine forests, as in those of *P. sylvestris* in the Alps, of *P. austriaca* in Austria, Bosnia, and Servia, and of *P. Peuke* in Macedonia. It is very common on all kinds of heath land in northern Germany; and is elsewhere found on sunny rocky mountain slopes, as in the Jura, the Alps, etc. (A. H.)

The juniper in Norway attains a very much larger size than it ever does in this country, many remarkable trees being mentioned by Schübeler, *Virid. Norv.* i. pp. 357-369. The cypress-like form, var. *suecica*, is not uncommon in a wild state; and he gives excellent illustrations of it, and mentions a tree found by Prof. Sexe in the Hardanger Fjord which was 40 ft. high. He figures a tree leaning very much on one side, which has the habit of a stunted spruce, growing near Vossevangen, which was 38 ft. high. Even as far north as Saltdalen (lat. $67\frac{1}{2}^{\circ}$) it attains very large dimensions. Forstmeister Niewjaar told me that he had sent one from there to the Paris Exhibition in 1878 of great size, and knew of one still living which was eleven metres high and about one metre in girth. Schübeler figures a tree with a short thick stem 7 ft. 1 in. in girth, and a spread of branches 26 ft. in diameter, at Hohl, near Christiania, and another with a beautiful straight clean trunk dividing into three stems.

Such trees as those above mentioned are of great age; some of which the rings were counted were as follows:—

- (1) 130 years old; longest diameter, 17 in.; shortest diameter, $14\frac{1}{2}$ in. at the base.
- (2) 114 years old; longest diameter, $14\frac{1}{2}$ in.; shortest diameter, $11\frac{1}{2}$ in. at the top of the log.
- (3) 150 years old; 33 ft. long; 4 ft. 3 in. in girth at the base, 3 ft. 3 in. at 5 ft., 2 ft. 8 in. at 10 ft., 2 ft. 1 in. at 15 ft., 1 ft. 6 in. at the top, where there were 47 annual rings; the total height of this tree was 37 to 38 ft.
- (4) 216 years old; 14 in. in diameter.
- (5) 300 years old; $12\frac{1}{2}$ in. in diameter.

Schübeler, *Tillæg til Virid. Norv.* 102 (1891) states that Lensmand Lund of Stryn parish, in North Bergenhus district ($61^{\circ} 55'$ lat.) sent him a sketch of a juniper supposed to be the tallest and thickest in Norway. It grows at an elevation of 1200 to 1500 ft., and is 45 ft. high, with the trunk 6 ft. 3 in. in girth, and the crown $9\frac{1}{2}$ ft. in diameter. It is supposed to be 195 years old.

In the Swedish forestry journal, *Skogsvårdsfor. Tidskrift*, 1911, p. 132, fig. 1, a photograph is reproduced of a remarkable fastigiata juniper, growing in the parish of Tyrserum, south of Linköping in Sweden, which is 37 feet high.

Wittmack,¹ quoting from the *Tägl. Rundschau*, says that a juniper, one of the oldest trees in the world, grew in Kokenberg parish in Livland. It was so large that two men were unable to span it near the base. The stem when cut down was deposited in the Riga Museum, and is said to have shown 2000 annual rings.

¹ *Gartenflora*, xxxvi. 139 (1887). Willkomm, *Forstliche Flora*, 263 (1887) quotes the same account—except that the name of the parish is given as Ermas—from *Oesterr. Forstzeitung*, 1885, p. 137.

According to Koernicke and Roth¹ the juniper is the characteristic conifer of the Eifel Mountains at an elevation of 1000 to 2000 ft. Here it grows on all kinds of soil, but best on the heaths of grauwacke, where it often forms large groups and attains about 25 ft. in height. The plates show how variable is the form of the tree here, some being round bushes, and some narrow pyramids. Prof. T. Schube, of Breslau,² figures a tree in a forest meadow at Kuchelberg, about 23 ft. high, and 5 ft. 5 in. in girth at a foot above the ground, which he thinks is the finest wild juniper in Silesia.

CULTIVATION

Though it has now been to a great extent displaced by modern introductions, the juniper was a great favourite as a garden shrub in former times, and according to Evelyn³ may be formed into most beautiful and useful hedges. He says: "The discreet loosening of the Earth about the Roots also, makes it strangely to prevent your Expectations, by suddenly spreading into a bush fit for a thousand pretty Employments. My Brother having cut out of one only tree, an Arbour capable for three to sit in; it was at my last measuring seven foot square, and eleven in height, and would certainly have been of much greater altitude and farther spreading, were it not continually kept shorn. But what is most considerable, is the little time since it was planted, being yet hardly ten years, and then it was brought out of the Common a slender bush of about 2 ft. high." He adds: "I have raised them abundantly of their seeds (neither watering nor dunging the soil) which in two months will peep." My experience in raising the seeds of juniper, which agrees with that of Boucher, and also with Loudon's statement, is that the seeds lie for one year before germinating, even when freshly sown. They keep for some years in the berry without losing their vitality.

REMARKABLE TREES

Though the common juniper seldom in Scandinavia and never in Great Britain attains the size of a timber tree, yet it is so striking a feature in the vegetation of some English hillsides that it cannot be passed by in silence. One of the best instances of its growth is seen on a dry oolite hillside at Hilcot, about two miles from Colesborne, on my own property. (Plate 348.) How old these trees are and how they originated, it is impossible to say; and though the juniper is indigenous in the Cotswold hills, this is the only hillside I know of in the county where it is abundant, and as the trees have not perceptibly increased in size during the last fifty years, they must be of great age. The largest are 20 to 25 ft. high, but none have developed a single stem thicker than 6 to 9 in. in diameter, and though they produce berries freely, natural reproduction is entirely prevented by rabbits. In young plantations, however, protected by wire-netting, not far away, there are seedlings in the grass, which have grown from seeds dropped by birds. On many of the chalk-hills of the Chilterns, the South Downs, and in Surrey and Hants, scattered

¹ In Karsten and Schenck, *Vegetationsbilder*, v. tt. 5, 6 a and b (1908).

² *Mitt. Deut. Dend. Ges.* 1910, p. 47.

³ *Silva*, 136 (1679).

bushes of juniper mixed with yew, holly, and thorn appear, but rarely exceed 8 to 10 ft. in height, and natural reproduction is in my own experience seldom found. Mr. Dykes informs us that many junipers grow on Shackleford Heath, and on the south side of the Hog's Back near Puttenham.

In a valley called Juniper Valley, about three miles east from Godalming, formerly the property of Col. H. H. Godwin-Austen, the juniper attains a greater size than I have seen it anywhere else in a state of nature in Great Britain. Col. Godwin-Austen tells me that a map in his possession shows the land to have been a sheep walk in 1733. The soil is a deep sand on the lower greensand formation, at an elevation of 350 ft., and is overgrown with rank ling and bracken. The trees are mostly branched near the ground, and attain 15 to 30 ft. in height, some having a fastigiate habit like the Irish juniper. They are mostly damaged and broken by heavy snow; and I could find no young seedlings.

H. Speight, *Romantic Richmondshire*, 239 (1897), states that "Down to the beginning of the last century there were many hundred acres of juniper and briar in the townships of Reeth, Helalough, and Muker. The chips at one time were extensively used for fumigating, and during seasons of plague and sickness no house was found without them. The berries were used as a spice. The plant grows best on open elevated limestone country, and flourished amazingly in upper Swaledale. There are acres of it about Harkeside, above Marden Castle, and elsewhere. In Wensleydale it occurs but sparingly."

At Merton, Norfolk, there is a remarkable plantation of juniper which covers 14½ acres, and consists of numerous shrubs very variable in appearance, and averaging about 20 ft. high. The smallest are about 7 ft. high, while the majority range from 15 to 20 ft.; the tallest being 25 ft. This was planted about 1845. In a neighbouring plantation there is a fine specimen 35 ft. high.

The largest recorded juniper in England is one which grew at Farnham Castle, Surrey, and was said by Loudon to be of the Swedish variety, and 40 ft. high, but on a recent visit to Farnham I could find no trace of this tree. Loudon¹ figures a tree growing in a birch wood near Farningham which was 20 ft. high and 4 ft. in girth in 1838; but of this also I can find no trace.

At Langley Park, Norfolk, I measured a very fine bush about 20 ft. high, and 43 paces round the branches; and at Westonbirt there is the finest specimen I know of the fastigiate form, measuring 26 ft. high in 1909.

In Scotland the juniper is less common in a wild state than formerly, but in certain districts is still abundant. Mr. T. Cathie, forester at Aberuchill, Comrie, Perthshire, informs me that a tree no less than 40 ft. high was blown down near there in 1904, but that the tallest now living were only 17 ft. high.

The finest I have seen wild in Scotland are in the forest of Guisachan, near the house of the forester Donald Kennedy, who told me that thirty years ago some of the thickets of juniper were so dense that he could not pass through them. Now, however, many are broken down by the snow, and injured or killed by the stags cleaning their horns on them; and the tallest that I saw, on a grassy mound,

¹ *Arb. et Frut. Brit.* iv. 2492 (1838).

were not over 20 ft. high. A specimen log in the Forestry Museum, Cambridge, sent by the Earl of Portsmouth, shows a section about 7 in. in diameter at five feet from the ground, displaying 120 annual rings. Owing to decay, the rings at the base could not be counted. In Glen Urquhart there are large thickets of scrubby junipers, which in Gaelic are called *asten*, but I saw no tall ones in this locality. In Perthshire it is local and, according to Buchanan White,¹ commonest between Dunkeld and Ballinluig. It ascends to 2600 ft. in Breadalbane.

On Ford, a farm occupied by Mr. Wallace, near Capenoch, Dumfriesshire, there is a hillside facing south, on the Silurian formation, covered with junipers over an area of thirty to forty acres, which, as I was told by Mr. Hugh Gladstone who showed them to me, have been in their present condition as long as any one can remember. Prof. R. Wallace tells me that an old man, who died last year at a great age, said that he could remember them when they were quite small; and Mr. Paterson of Craigdarroch says that no class of stock would eat juniper, though Herdwick sheep are said to do so when they can get no other food. At Capenoch, though the ground is grazed by sheep and cattle, there are many young seedlings coming up among the heather. The largest bushes here were 15 to 18 ft., but the majority were 6 to 10 ft. high, and some had the fastigiate habit of the so-called Irish juniper. Except a few ash, holly, and rowan, I noticed no other trees but juniper on this hillside. Col. Kennedy of Milton Park Lodge, Dalry, Kirkcudbrightshire, says that juniper is very scarce in that district, and that in Inverness-shire, where it is common near Kingussie, grouse are very fond of taking shelter in it in hot weather.

The juniper is common as a wild plant in the west of Ireland, being recorded by Praeger² for Donegal, Sligo, Mayo, Galway, Tipperary, and Kerry, where it is confined to the mountains and lake shores. Mr. R. A. Phillips writes to us as follows:—"I doubt if var. *nana*³ is really a variety or only a prostrate state of *J. communis*. In east Galway, on the limestone at Gort, and on the shores of Loch Derg near Portumna, where the species is abundant, it is an upright bushy plant when growing in fairly deep soil or in sheltered hollows; but close by on exposed rocks or bare ground it is perfectly prostrate. I have always failed in these localities to distinguish any difference in the leaves or fruits of the two forms. On the non-calcareous mountains of west Galway, Cork, and Kerry, principally Old Red Sandstone, the juniper is usually prostrate, and here its leaves are broader and more imbricate, with sometimes oval fruit, than the plant of the limestone; but even this form is in some sheltered lowland spots an upright bush. So far as I have seen, the juniper will not live in shade, and never forms undergrowth. Near Gort, the prostrate form covers large areas; and near Portumna, the upright form occurs in small groves, but never in such quantity as to deserve the name of a wood. The largest specimens which I have seen were about 12 to 15 ft. high, girthing near the ground 18 to 24 in." The finest that I have seen in Ireland is in the grounds of

¹ Buchanan White, *Flora of Perthshire*, 282 (1898).

² In *Proc. Roy. Irish Acad.* vii. 288 (1901).

³ Mr. Phillips is inclined to think that in Ireland, typical *J. communis*, as regards leaves and fruit, is a *calcicole*; whereas var. *nana* is a *calcifuge*.

Woodstock, Kilkenny, where in 1909 I measured a tree with four stems each measuring 3 to 4 ft. in girth and about 30 ft. high.

TIMBER

The wood of the juniper is whitish brown, hard, and takes a very good polish, but owing to its being usually too small for any but local uses is not often seen. It is, however, so strong and durable that the stems are commonly used for railway and other fences in Norway and Sweden, and are exported to Denmark from Sweden for the same purpose.

The fence of the Dyrhave or Royal Deerpark, near Copenhagen, is made from straight juniper poles about 3 to 4 in. in diameter, fixed on oak posts and rails. When I saw this fence in 1887, I was informed by the late Mr. O. Benson of Copenhagen that it had been erected about 100 years. I was so much struck by its appearance and durability that in 1904 I imported, through the kind assistance of Mr. E. Nilson of the Swedish Royal Forest Service, 1000 juniper poles, 2 metres long, at a cost of £15 free on board, and have put them up to fence off a part of my own deerpark for planting. The fence is made with stout oak posts, 4 yards apart, and the poles are kept in place by three strands of strained galvanised wire without crossbars, strong wire netting being fixed on the lower half to keep rabbits out and deer from getting their heads between the poles. It forms a strong, cheap, and probably a very durable deer fence.

Though the berries of the juniper are not now valued in medicine as much as they were in Evelyn's time,¹ yet they are still used for flavouring gin,² which owes its diuretic quality to them. An essential oil is also distilled from them. The berries are largely collected in the south-east of France and in Hungary for the wholesale druggists.³

(H. J. E.)

JUNIPERUS RIGIDA

Juniperus rigida, Siebold and Zuccarini, *Fl. Jap.* ii. 56, t. 125 (1844); Franchet and Savatier, *Enum. Pl. Jap.* i. 471 (1875); Masters, in *Journ. Linn. Soc. (Bot.)* xviii. 496 (1881), and xxvi. 543 (1902); Kent, Veitch's *Man. Conif.* 188 (1900); Shirasawa, *Icon. Ess. Forest. Jap.* i. t. 12, figs. 1-13 (1899); Komarov, *Fl. Mansh.* i. 207 (1901).

A small tree, attaining in Japan 20 to 30 ft. in height, often a low spreading bush. Bark thin and scaly. Young branchlets triquetrous, with three projecting ridges, becoming terete and scaly in the fourth year. Leaves all acicular, persistent three or four years, spreading, in whorls of threes, linear-subulate, $\frac{1}{2}$ to $\frac{3}{4}$ in. long, about $\frac{1}{5}$ in. broad, tapering from the middle to the very sharp cartilaginous apex, swollen

¹ Evelyn, *Silva*, 130 (1670) says:—"The berries afford (besides a tolerable pepper) one of the most universal remedies in the world to our crazy forester. The berry swallowed only, instantly appeaseth the worst collique, and in decoction most sovereign against an inveterate cough. They are of rare effect being steeped in beer. The water is a most singular specific against the gravel in the reins."

² Bentley and Trimen, *Medicinal Plants*, t. 255 (1880), give a good account of the medicinal uses of juniper, and state that the gin ordinarily distilled in England is flavoured with oil of turpentine, whereas gin, made in Holland, is slightly flavoured with juniper berries, two pounds of berries being used to 100 gallons of gin.

³ Flückiger and Hanbury, *Pharmacographia*, 626 (1879).

and jointed at the base; upper surface deeply concave with the margins inflexed, the narrow median groove whitened with a stomatic band scarcely so wide as the green margins on each side of it; lower surface green, prominently keeled, without glands. Buds ovoid, minute, with sharp-pointed scales, which persist brown and withered at the ends of the branchlets of the second year; lateral buds about $\frac{1}{5}$ in. long.

Flowers dioecious. Fruit ripening in the second year, globose, $\frac{1}{3}$ in. long, with six bracts in two whorls at the base, on a very short stalk, scarcely $\frac{1}{2}$ in. long; smooth, purplish brown, composed of three scales, separated at the apex by three radiating lines, each scale glaucous and with a minute mucro near the top. Seeds usually three, rarely two, in each berry, triquetrous, with three sharply angled sides, converging to a narrow apex, and marked near the base with three or four deep pits containing resin.

This species is a native of Japan,¹ where, according to Sargent,² it is usually a small tree or spreading bush. It is common on the barren land near Gifu, and is generally distributed at low elevations in central Japan, but usually is only found growing on dry sterile gravelly soil. Elwes saw it on dry hillsides in Kiushu, where it did not exceed 15 to 20 feet in height, and had usually a fastigate habit. It is much cultivated by the Japanese, especially in temple gardens. *J. rigida* also occurs in Korea and in the provinces of South Ussuri and Kirin in Manchuria, where it often grows isolated in rocky situations; but it does not seem to occur in China.¹ It was introduced³ into England in 1861 by J. Gould Veitch, who found it in the Hakone Mountains. Maximowicz⁴ sent living plants in 1864 to the botanic garden at St. Petersburg, of a form, which he called var. *filiformis*; but this, if distinct and not a mere juvenile state, is unknown in England.

This species appears to be rather rare in gardens; but there are specimens at Kew, Tortworth, Casewick, Chipping Campden, Highnam, and other places in England, and at Hamwood and Glasnevin in Ireland. It nowhere attains more than 20 ft. in height, but it often produces fruit abundantly. (A. H.)

JUNIPERUS OXYCEDRUS

Juniperus Oxycedrus, Linnæus, *Sp. Pl.* 1038 (1753); Loudon, *Arb. et Frut. Brit.* iv. 2494 (1838); Parlatore, in De Candolle, *Prod.* xvi. 2, p. 477 (1868); Boissier, *Fl. Orient.* v. 707 (1881); Mathieu, *Fl. Forest.* 516 (1897); Ascherson and Graebner, *Syn. Mitteleurop. Fl.* i. 247 (1898); Kent, Veitch's *Man. Conif.* 179 (1900); Rikli, in Kirchner, Loew, and Schröter, *Lebenges. Blütenpfl. Mitteleurop.* i. 309 (1906).
Juniperus tenella, Antoine, *Cupress. Gattung.* 20, tt. 27, 29 (1857).
Juniperus Marschalliana, Steven, in *Bull. Soc. Nat. Mosc.* xxix. 244 (1856), and xxx. 397 (1857).
Juniperus heterocarpa, Timbal-Lagrave, ex Loret et Barrandon, *Fl. Montpellier.* ii. 610 (1876).
Juniperus Biebersteiniana, Koch, *Dendrologie*, ii. pt. ii. 112 (1873).

¹ The plant, collected by David in the Ourato Mountains in Mongolia, and referred to *J. rigida* by Franchet, *Pl. David.* i. 295 (1884), is considered by M. Hickel to be *J. communis*. Wilson's No. 370, collected in Hupeh, and referred to *J. rigida* by Masters, in *Journ. Bot.* xli. 268 (1903) is *J. formosana*. A plant, collected by Giralddi in Shensi, and referred to *J. rigida* by Beissner, in *Mitt. Deut. Dend. Ges.* 1897, p. 216, is also probably *J. formosana*.

² *Forest Flora of Japan*, 78 (1894).

³ *Hortus Veitchii*, 340 (1906).

⁴ Bretschneider, *Hist. Europ. Bot. Disc. China*, i. 610 (1898).

A shrub or small tree, occasionally attaining 30 ft. in height and 10 to 12 ft. in girth. Branchlets angled, becoming pale brown and scaly in the third year. Leaves all acicular, in alternate whorls of threes, spreading, linear, $\frac{1}{2}$ to $\frac{3}{4}$ in. long, $\frac{1}{8}$ to $\frac{1}{6}$ in. broad, gradually tapering from the middle to the acuminate cartilaginous point, swollen and jointed at the slightly narrowed sessile base, entire in margin; upper surface with a narrow elevated green midrib, on each side of which is a white stomatic furrow, bounded externally by a narrow green band; lower surface green, convex, with a projecting sharp keel.

Flowers dioecious. Staminate flowers solitary in the axil of a leaf, two or three in each whorl, sessile, ovoid, about $\frac{1}{5}$ in. long. Fruit ripening in the second year, solitary in the axils, on short stalks about $\frac{1}{8}$ in. long, globose, $\frac{3}{8}$ to $\frac{1}{2}$ in. in diameter; shining reddish brown when ripe, with or without a partial glaucous bloom; composed of three or six scales, each indicated by a minute mucro, the apex of the fruit having three radiating lines. Seeds normally three, radially disposed in the centre of the fleshy resinous pulp, reddish brown, triquetrous-oblong, with two sharp lateral edges; the upper edge usually thin, rounded, broad and emarginate, occasionally narrow and pointed; with two resin-glands at the base which occasionally mark the surface with depressions.

Both *J. Oxycedrus* and *J. communis* are frequently attacked¹ by the parasitic *Arceuthobium Oxycedri*, Bieberstein, a plant allied to the mistletoe, which is common in the Mediterranean region.

This species is very variable in the wild state, differences occurring in the size and shape of the fruit and of the leaves. It usually forms a compact shrub, with ascending or spreading branches and branchlets; but large trees occur on the Riviera, which bear long pendulous branches, and are similar in habit to *J. Cedrus*.

VARIETIES

The following varieties have been described:—

1. Var. *viridis*, Pospichal, *Fl. Oest. Küstenl.* i. 30 (1897). Fruit dull green when ripe. Has only been seen on the north bank of the Canal di Leme, near Rovigno in Istria.

2. Var. *umbilicata*, Rikli, *op. cit.* 315 (1906).

Juniperus macrocarpa, Tenore, *Syll. Fl. Neap.* 483 (1831) (not Sibthorp and Smith).

Juniperus umbilicata, Grenier et Godron, *Fl. de France*, iii. 158 (1855).

Fruit when young, glaucous and covered with a bluish bloom; when ripe, larger than in the type, chestnut brown, very variable in shape, often umbilicate at the base. This is considered by Rikli to be a variety of *J. Oxycedrus*; but by Ascherson and Graebner to be a variety of *J. macrocarpa*. It occurs in Italy, and is perhaps a hybrid between the two species.

¹ Prof. Ed. Henry in *Bull. Soc. Bot. France*, xvii. 260 (1900) mentions an instance in which a branch of *J. communis*, attacked by this parasite, developed scale-like leaves, similar to those normally borne by *J. phoenicea*. Cf. also *ibid.* 155 (1900), where an instance is recorded of *J. phoenicea* being also attacked by *Arceuthobium Oxycedri*.

3. Var. *brachyphylla*,¹ Loret, in Billot, *Annot. Fl. France et Allemagne*, 282 (1855).

Juniperus heterocarpa, Timbal, *ex Loret et Barrandon, Fl. Montpellier*, ii. 610 (1876).

Leaves short, almost obtuse at the apex. Fruit large, pinkish, glaucous. Found on limestone rocks at Saint Béat in Haute Garonne.

4. Var. *maderensis*, Menezes, in *Bull. Acad. Internat. Géog. Bot.* xvii. Nos. 227-228, p. xii (1908).

Leaves very slender, $\frac{1}{3}$ to $\frac{2}{5}$ in. long, $\frac{1}{30}$ in. broad, rounded or acute and not mucronate at the apex. Fruit similar to the type in shape and size, brown with a glaucous tinge.

This is very rare, growing wild in Madeira at elevations of over 1500 feet, on the Serra do Faial, and on rocky slopes near Curral das Freiras. Menezes says that it is cultivated in the villages of Monte Camacho and Santo Antonio da Serra. Dr. Michael Grabham, from whom I obtained specimens,² says that it is an elegant small tree with pendulous branches, 20 to 30 ft. in height, and with a stem 15 in. in diameter. It is very distinct in appearance from *J. Cedrus*; and appears to be closely allied to a form of *J. Oxycedrus*, occurring in Portugal, of which I received a fruiting branch from Mr. H. Clinton-Baker. The latter has short and rather broad leaves.

DISTRIBUTION

This species³ is widely distributed throughout the Mediterranean region, extending eastwards through Syria, western Asia Minor, the south coast of the Crimea, and the Caucasus to Armenia and the Elburz Mountains in northern Persia. It is very common in the shrub-covered waste called *maquis*, which is characteristic of much of the region where it is prevalent; and appears to be indifferent to the chemical nature of the soil, as it grows on limestone, sand, and other formations; but it thrives in warm arid soils, where larger trees do not succeed.

In Algeria and Tunis, it forms undergrowth in the forests of Aleppo pine and cedar, ascending to 5000 ft. on Teniet-el-Hââd. It is widely spread throughout Spain, extending to Traz os Montes in Portugal, and ascends in the woods of *Pinus sylvestris* on the Sierra Nevada to 6600 feet. It occurs throughout Italy, Sicily, and Sardinia, and is not uncommon in the mountains of Corsica. On the eastern coast of the Adriatic, it is the commonest shrub in Istria and Dalmatia, extending inland to Herzegovina, where in the Dinaric Alps it grows to 3000 ft. elevation, and ascends the Narenta valley to Stolac. Its most northerly point is in Servia, in the western branch of the Morava valley. On the Rhodope Mountains it ascends to 3600 feet; and southwards it is common in Albania, Macedonia, Greece, and the Ægean archipelago. (A. H.)

In France it is common in the departments bordering on the Mediterranean, as

¹ This variety is referred to *J. macrocarpa*, by Loret, in *Bull. Soc. Bot. France*, vi. 446 (1859).

² Through Dr. Herbert Watney.

³ The distribution of the species and of *J. macrocarpa* is difficult to separate, both occurring in the same regions, but apparently occupying different altitudes. See under *J. macrocarpa*, p. 1412.

around Montpellier and on the Riviera; but it has been found inland in Aveyron and Ardèche. It is usually seen as a shrub, but is capable of becoming a tree in favourable situations, one recorded by Mathieu near Corbières being 11 ft. in girth. When I was at Montpellier in 1909, M. Marc Bazille showed me the largest tree known to exist in France. This grows on the Ferme de la Rouvière, in the commune of Salinzelles (Gard), twenty miles east of Montpellier. It stands on dry rocky soil covered with scrub of *Quercus Ilex* and *Q. coccifera*, and though a very old tree, is in a good healthy condition. It measured about 35 ft. high, with a trunk 8 ft. long, and 13 ft. 4 in. in girth, dividing into six or eight large limbs which spread over a space 58 paces round. According to M. Pardé,¹ this species will not endure the severe winters of Paris, but it is cultivated at Les Barres.

It was cultivated as early as 1739 in the Physic Garden at Chelsea; but we have seen no specimens of considerable size in England. The largest which we have seen is a shrubby tree at Glasnevin in Ireland, evidently of great age and about 18 ft. high. (H. J. E.)

JUNIPERUS MACROCARPA

- Juniperus macrocarpa*, Sibthorp and Smith, *Fl. Græc. Prod.* ii. 263 (1813); Loudon, *Arb. et Frut. Brit.* iv. 2494 (1838); Boissier, *Fl. Orient.* v. 706 (1884); Kent, Veitch's *Man. Conif.* 181 (1900); Parlato, in De Candolle, *Prod.* xvi. 2, p. 476 (1868).
Juniperus Oxycedrus, Linnæus, sub-species *macrocarpa*, Ascherson and Graebner, *Syn. Fl. Mitteleurop.* i. 248 (1898); Rikli, in Kirchner, Lœw, and Schröter, *Lebenges. Blütenpfl. Mitteleurop.* i. 315 (1906).
Juniperus Biasoletti, Link, in *Atti V. Riun. Sc. Ital. Napoli*, 878 (1845).
Juniperus attica, Orphanides, in Heldreich, *Nutzpfl. Griechen.* 13 (1862).
Juniperus Lobelii, Gussone, *Syn. Fl. Sicul.* ii. 635 (1844).
Juniperus sphaerocarpa, Antoine, *Cupress. Gattung.* 11, t. 10 (1857).

This species is closely allied to *J. Oxycedrus*, with which it has been united as a sub-species by Rikli and by Ascherson and Graebner. It differs in the longer and broader leaves, $\frac{3}{4}$ to 1 in. long, about $\frac{1}{2}$ in. broad, which gradually taper from the base to the acuminate sharp-pointed cartilaginous apex. Fruit larger than in *J. Oxycedrus*, glaucous blue, turning purplish brown after ripening, about $\frac{1}{2}$ in. broad, and $\frac{5}{8}$ in. long, on a short stalk less than $\frac{1}{8}$ in. long; seeds similar to, but larger than in *J. Oxycedrus*. The fruits are either globose; or more commonly pyriform in shape, gradually tapering to the base, constituting var. *ellipsoidea*, Neilrich, *Veget. Croat.* 52 (1868), and identical with *J. Lobelii*, Gussone.

This species has a similar distribution to that of *J. Oxycedrus*, extending throughout the Mediterranean region from Spain to Syria, and also occurring in Bulgaria. It does not appear to be a native of southern France. It grows on low hills, and in sandy tracts close to the sea-coast; whereas, as a rule, *J. Oxycedrus* occupies more inland and higher elevated regions.²

¹ *Arb. Nat. des Barres*, 49 (1906). It is commonly known in France as *genévrier cade* or *cadier*, and yields an oil, called *huile de cade*, which is much used in veterinary practice. Cf. Legre, in *Bull. Soc. Bot. France*, xlviii. 129 (1901).

² This distribution of the two species is confirmed for Greece by Halacsy, *Consp. Fl. Græca*, iii. 455 (1904), and for Algeria, by *Rev. Hort. de l'Algérie*, iv. 176 (1900).

J. macrocarpa was introduced about 1838 by Strangways from Italy; but does not appear to have succeeded in our climate. Rikli says that even on the coast of Istria it is often much injured in severe winters. (A. H.)

JUNIPERUS BREVIFOLIA

- Juniperus brevifolia*, Antoine, *Cupress. Gattung.* 16, tt. 20-22 (1857); Parlato, in De Candolle *Prod.* xvi. 2, p. 478 (1868); H. C. Watson, in *London Journ. Bot.* ii. 7, 9, 398, 401, 408 (1843) and iii. 606 (1844), and in Godman, *Nat. Hist. Azores*, 224 (1870); Trelease, in *Missouri Bot. Gard. 8th Ann. Rep.* 169 (1897); Kent, Veitch's *Man. Conif.* 180 (1900).
Juniperus Oxycedrus, Linnæus, var. *brevifolia*, Hochstetter, in Seubert, *Fl. Azorica*, 26 (1844).
Juniperus rufescens, Link, var. *brevifolia*, Endlicher, *Syn. Conif.* 11 (1847).

A shrub or small tree in the Azores, with a stem often 3 to 4 ft. in girth. Branchlets numerous, short, densely clothed with foliage. Leaves all acicular, in alternate whorls of threes, very short and broad, $\frac{1}{4}$ to $\frac{1}{3}$ in. long, about $\frac{1}{2}$ in. wide, oval-linear, jointed and swollen at the slightly narrowed base, widest about the middle, whence they taper to a rounded or acute (non-acuminate) apex; upper surface with a narrow green midrib not extending to the apex, on each side of which is a broad white stomatic furrow, bounded by an external green band; lower surface green, with a prominent midrib; margin entire.

Flowers diœcious. Fruit sub-globose, $\frac{1}{3}$ in. in diameter, on scaly stalks about $\frac{1}{16}$ in. long, dark reddish brown when mature; scales three, separated at the apex by three radiating prominent lines, and each marked by a minute mucro. Seeds three, embedded in a scanty pulp, ovoid, triquetrous, broadest at the base, gradually tapering to an acute apex, light brown; outer surface convex with two or three longitudinal furrows, not separated from the inner surface by a winged thin margin, as in *J. Oxycedrus*.

This species is remarkably distinct in the very short glaucous leaves; and its seeds differ from those of the allied species.

This species is limited to the Azores, where it occurs on the islands of Corvo, Flores, Fayal, San Miguel, and Pico, ascending to 5000 ft., and rarely descending below 1000 ft. It is locally known as *cedro*, and is usually a compact shrub or small tree, becoming a prostrate bush with interlacing branches on exposed hill summits. Formerly it appears to have been a tree of considerable size, as large logs have been found deeply buried under the secondary volcanic debris in the Grotto do Enferno of the large crater known as Caldeira des Sette Cidades. A slab of this was presented to the Kew Museum by Dr. Goeze, which was reported to have been excavated from a depth of 100 metres.¹

So far as we know this beautiful species has not been introduced² into cultivation in England. (A. H.)

¹ Cf. Goeze in *Card. Chron.* 1867, p. 929, and Masters in *Journ. R. Hort. Soc.* xvii. 3 (1894), who identified this wood with *Cupressus lusitanica*. The slab at Kew is undoubtedly the wood of this species of juniper. Cf. our Vol. V. 1179, note 1.

² Gordon, *Pinetum*, 131 (1880), says it is tender in England; but he gives no particulars as to its introduction.

JUNIPERUS CEDRUS

Juniperus Cedrus, Webb and Berthelot, *Hist. Nat. Isles Canar.* iii., *Phytog. Canar.* ii. 277, t. 217 (1840); Antoine, *Cupress. Gattung.* 14, tt. 16-19 (1857); Parlato, in De Candolle, *Prod.* xvi. 2, p. 478 (1868); Kent, *Veitch's Man. Conif.* 180 (1900).

Juniperus Oxycedrus grandifolius, Buch, *Phys. Besch. Can. Inseln*, 109, 159 (1825).

Juniperus canariensis, Knight, *Syn. Conif.* 13 (1850).

Juniperus Webbii, Carrière, *Conif.* 13 (1855).

A tree, attaining a large size in the Canary Islands, with wide-spreading branches and long pendulous branchlets. This is an insular form of *J. Oxycedrus*, differing mainly from the Mediterranean tree in habit and not in technical characters. Leaves directed towards the apex of the branchlet, and not widely spreading, resembling in this respect *J. formosana*, thinner in texture than in *J. Oxycedrus*, and becoming acute or rounded at the apex in adult trees; glaucous and not bright green on the lower surface, the glaucous tint being present on the narrow midrib and the borders external to the white stomatic bands of the upper surface. Fruit similar to that of *J. Oxycedrus*, with two or three seeds, which are often acute and not broad and emarginate at the apex, the resin-pits being usually more developed than in the Mediterranean species.

Copious specimens received from Dr. Perez show that this tree is scarcely separable as a distinct species from *J. Oxycedrus*; and trees of the latter, with pendulous branchlets, which occur on the Riviera, are very similar to, if not identical with *J. Cedrus*.

J. Cedrus is a native of the Canary Islands, where it has been nearly exterminated by the inhabitants, who value its timber highly. It still exists on Teneriffe, Grand Canary, and Palma, but is extinct on Gomera.¹ Dr. Perez writes that it was common on Teneriffe at the end of the eighteenth century,² as Humboldt mentions it as occurring all the way up from Orotava to the *cañadas*, growing with *Pinus canariensis*; but only a few stunted specimens now survive, which grow on inaccessible rocks about the *cañadas*, from 7000 to 9000 ft. altitude. Schenck,³ who gives the latest published account, quotes Fritsch,⁴ who mentions a noble juniper, which formerly grew on the south-west side of the Peak at 8000 ft. elevation. This tree was 18 ft. in girth and nearly 100 ft. high.

It also occurs in the crater of Tirijana on Grand Canary, but seems to be most abundant now on Palma,⁵ where it grows on the inaccessible inner walls of the crater, and outside it to the north-east on isolated rocks at 7000 ft. elevation. Dr. Burchard⁶

¹ Dr. Christ, in Engler, *Bot. Jahrb.* vi. 487, 500 (1885).

² Buch, *Phys. Besch. Canar. Inseln*, 109 (1825), mentions a few trees which were then growing at 9000 ft. altitude amidst the lava at the foot of the last cone of the Peak.

³ *Wiss. Ergeb. Deut. Exped. 'Valdivia'*, ii. pt. 1, p. 375, figs. 63, 64 (1907).

⁴ *Reisebilder*, 6 (1879).

⁵ Bornmüller, in Engler, *Bot. Jahrb.* xxxiii. 398 (1904), states that he found trees also on the south side of the crater, in the Barranco de las Angustias at 1300 and 2700 ft. elevation; and at Cumbrecita at 4700 ft.

⁶ In *Mitt. Deut. Dend. Ges.* 1911, p. 296, fig.

says that these trees have trunks almost completely bare of bark, and over a metre in diameter; and reproduces the photograph of a fine old female tree, which he took in June 1910. Schenck¹ also figures a very old tree, with a short bole, a few snaggy branches, and very little foliage. (A. H.)

It is doubtful if this plant was introduced until recently, as it was not mentioned by Loudon² in 1838, and was included by Knight and Perry in 1850 amongst the kinds of juniper of which little was known. Kent says that it is not hardy in England; and the only plant now living at Kew is one in the Temperate House, about 7 ft. high, raised from seed sent by Sir Daniel Morris in 1893. Sir John Ross-Bladensburg, K.C.B., however, informs me that a plant in his garden at Rostrevor survived without protection the winter of 1909-1910, which was exceptionally severe in the north of Ireland. As it grew well during the following summer, he looks upon it as hardy; in December 1911 it was 6 ft. high with a good leader, and slightly pendulous branches. A small plant at Glasnevin bore last winter 12° of frost without injury.

J. Cedrus is readily propagated by cuttings at Kew; but there seems to be a great difficulty in raising it from seed.³ Beissner,⁴ however, has raised young plants from seed which I saw in his collection at Bonn in 1908. (H. J. E.)

JUNIPERUS FORMOSANA

Juniperus formosana, Hayata, in *Journ. Coll. Sci. Tokyo*, xxv. art. 19, p. 209, pl. 38 (1908).

Juniperus oblonga pendula,⁵ Knight and Perry, *Syn. Conif.* 11 (1850); Carrière, *Conif.* 20 (1867).

Juniperus taxifolia, Masters, in *Journ. Roy. Hort. Soc.* xiv. 215 (1892), and *Journ. Linn. Soc. (Bot.)* xxvi. 543 (1902) (in part); and in *Journ. Bot.* xli. 268 (1903) (not Hooker and Arnott); Kent, *Veitch's Man. Conif.* 191 (1900).

A tree, attaining in China 40 ft. in height. Branchlets triquetrous, with three narrow ridges, yellowish green in the first year, reddish brown in the second year. Leaves all acicular, spreading, in whorls of threes, linear-subulate, about $\frac{1}{2}$ in. long and $\frac{1}{20}$ to $\frac{1}{12}$ in. broad, jointed and swollen at the base, ending in a sharp spine-like

¹ *Beit. Kennt. Veget. Canar. Inseln*, fig. 63, in *Wiss. Ergeb. Deut. Exped. 'Valdivia'*, 1898-1899 (1907). This figure is a reproduction of a photograph taken by Prof. Simony. A figure of a similar tree, also growing on Palma, is given by Webb and Berthelot, *Hist. Nat. Isles Canar.*, Atlas, t. 8 (1838). ² Cf. note 5 below.

³ Dr. Geo. V. Perez of Orotava, Teneriffe, wrote in *Gard. Chron.* xl. 14 (1906), and xli. 134 (1907), that none of the seed which he sent to Kew and elsewhere germinated. He finds that seeds, soaked in water at 70° Fahr. for 15 to 30 days, germinate freely in about six weeks. Probably germination occurs, under ordinary conditions, in the second year after sowing, or in the wild state after the seeds have been eaten and voided by birds. Correvo, in *Gard. Chron.* xlii. 209 (1907), reports that seeds, which had been soaked in a weak solution of acetic acid, germinated well at Geneva.

Dr. Perez informs me that Mr. Lister has raised, from seed sent from Orotava, eight plants in the Government nursery at Pretoria, which are now 4 ft. high.—(A. H.)

⁴ *Mitt. Deut. Dend. Ges.* 1906, p. 91.

⁵ Knight and Perry's plant is undescribed, but is stated to have come from China and Japan, and is evidently the Chinese species here described, as is confirmed by Carrière's description. It is apparently not the same plant as *J. communis oblonga pendula*, Loudon, *Arb. et Frut. Brit.* iv. 2489, fig. 2345 (1838), applied to a shrub at Kew, then 5 ft. high, with fastigate branches and pendulous branchlets. Gordon, in *Gard. Chron.* 1842, p. 652, describes the latter as: "Trained to a single stem, if left to nature, it will not rise more than three feet, but will spread over a large space of ground. It is quite hardy and a native of the Caucasus." Webb, *Phyt. Canar.* ii. 277 (1840), identified this plant with *J. Cedrus*, which is, however, not hardy at Kew. It is impossible now to identify Loudon's plant, but in all probability it was a pendulous variety of *J. communis*.

point; lower surface convex, keeled; upper surface concave, with two broad white stomatic bands, separated by a very narrow green or glaucous midrib, extending from the base to near the apex, where the white bands coalesce.

Fruit globose, $\frac{1}{3}$ in. in diameter, ripening in the second year, shining dark reddish brown when ripe; smooth on the surface, with three deep radial furrows at the summit, in the centre of each of which is a dark line, showing the separation of the three scales of which the fruit is composed; outer edge of each furrow with a thin mucro, overhanging a slight depression; base of the fruit hollowed out at the insertion of the short scaly stalk. Seeds three, elongated-ovate, triquetrous, mucronate at the narrow thin apex, with several circular resin-pits at the base, above which on the outer surface are three or four larger elongated oval pits.

In cultivated specimens in Europe the branches are ascending, but the branchlets are very pendulous, giving a weeping appearance to the tree. In China it assumes various habits, but is often very pendulous, and occasionally shrubby.

The Chinese species now described, as pointed out by Hayata, is distinct from *J. taxifolia*,¹ Hooker and Arnott, with which it has been confused. The latter, so far as we can learn, has never been introduced into cultivation, and is confined to Bonin Isle, where it was discovered by Capt. Beechey in 1827, and to the Liu Kiu Islands. I cannot find any particulars of the size and habit of this species.

J. formosana is widely spread throughout the mountains of China, and is also commonly cultivated in temple grounds, being known as the *Tz'e Poh*, or "prickly cypress." It is represented in the Kew herbarium by numerous wild specimens from the provinces of Szechwan, Hupeh, Chekiang, and Fokien; and was collected in Shensi by Père Giraldi. It has lately been found on Mt. Morrison and the adjacent ranges in Formosa, between 8000 and 13,000 ft. altitude.²

This species, which is usually known in cultivation as *J. oblonga pendula*, is stated by Kent to have been introduced from China by Fortune in 1856; but this is incorrect as regards the date. It was for sale in Knight and Perry's nursery in 1850, and was probably one of the plants sent home by Fortune in 1844. Knight and Perry describe it as a very elegant drooping shrub from China and Japan, which they supposed to be possibly identical with *J. rigida*; but the latter was not introduced till 1861.

J. formosana is now rare in collections, the best specimen that we have seen being a tree at Bicton, 30 ft. by 2 ft. A vigorous tree at Eastnor Castle is about 28 ft. high. A smaller specimen at Bayfordbury is reputed to have been planted

¹ *Juniperus taxifolia*, Hooker and Arnott, *Bot. Cap. Beechey's Voyage*, 271 (1841); Siebold and Zuccarini, in *Abh. Akad. Wiss. München*, iv. 3, p. 233 (1846); Miquel, *Prod. Fl. Japonica*, 331 (1867); Parlatores, in De Candolle, *Prod.* xvi. 2, p. 481 (in part); Masters, in *Journ. Linn. Soc. (Bot.)* xviii. 496 (1882); Hayata, in *Journ. Coll. Sci. Tokyo*, xxv. art. 19, p. 210, fig. 6 (1908).

Apparently a shrub. Leaves thicker than those of *J. formosana*, rounded or acute at the apex, and not ending in a spine-like point, about $\frac{5}{8}$ in. long; upper surface with two white stomatic bands, separated by an elevated green midrib from base to apex. Fruit globose, $\frac{1}{3}$ in. in diameter, yellowish, rugose on the surface, with three prominent radial ridges at the apex, overhanging three furrows, external to each of which is a mucro. Seeds three, similar in shape and resin-pits to those of *J. formosana*. This species is closely allied to *J. formosana*, mainly differing in the blunt and not spine-tipped leaves.

² Specimens kindly sent me from Formosa by Mr. T. Kawakami are identical with specimens which I collected in central China in the mountains of Hupeh. Elwes gathered it in February 1912, at about 8000 ft. on the ridges above Arisan; but saw it only in a bushy form.

in 1845. Another at Glasnevin, which bore fruit in 1911, was obtained some years ago from Messrs. Veitch, who have, however, no longer the plant for sale.

It has been much confused with *J. rigida*; and all the reputed trees¹ of *J. oblonga pendula* on the continent are referable to this Japanese species. (A. H.)

JUNIPERUS DRUPACEA

Juniperus drupacea, Labillardière, *Icon. Pl. Syr.* ii. 14, t. 8 (1791); Loudon, *Arb. et Frut. Brit.* iv. 2494 (1838); Lindley, in *Gard. Chron.* 1854, pp. 387, 455, fig.; Webster, in *Gard. Chron.* xix. 519, fig. 80 (1896); Kent, *Veitch's Man. Conif.* 173 (1900).
Arceuthos drupacea, Antoine and Kotschy, in *Oester. Bot. Wochblatt.* iv. 249 (1854).

A dioecious tree, attaining about 60 feet in height, usually in cultivation columnar in habit, but in the wild state broadly pyramidal.² Young branchlets triangular, with three prominent linear ridges and three grooves, due to the decurrent bases of the leaves. Older branchlets, from which the leaves have fallen, terete and smooth, with a brown scaly bark. Buds, one terminal and usually two or three in the axils of the leaves on the branchlet of the first year, about $\frac{1}{8}$ inch long, surrounded by minute sharp-pointed lanceolate scales, the outermost of which persist on the apex of the second and third year's branchlets.

Leaves, all acicular, spreading in whorls of threes, about $\frac{1}{2}$ to $\frac{7}{8}$ in. long, $\frac{1}{10}$ to $\frac{1}{8}$ in. broad, jointed at the base, decurrent on the branchlet to the next whorl, linear-lanceolate, widest near the base, gradually tapering to the apex, which ends in a sharp cartilaginous point; lower surface green, convex, with a linear prominent keel; upper surface concave, with a broad green midrib deeply furrowed near the base, and two white stomatic bands, not extending to the margin, which is entire.

Staminate flowers, five or six in a head, on a short scaly stalk, arising in the axil of a leaf on the second year's branchlet; stamens nine to twelve in each flower.

Fruit ripening in the second year, larger than in any other species, $\frac{3}{4}$ to 1 in. in diameter, on a short scaly stalk, ovoid or nearly spherical, brown or bluish with a glaucous bloom, usually composed of nine fleshy scales, in whorls of threes, united together, ovate, thickened and often mucronate at the apex; enclosing a large globose hard bony stone,³ with three small cells, each containing a minute oblong kernel, one of which is often aborted.

This remarkable species is a native of the mountains of Asia Minor, Syria, and Greece. It is found throughout the Taurus range in Asia Minor, several localities being mentioned by Boissier,⁴ between Karaman and Ermenek, in the Bulgardagh, and in the Akkerdagh, close to Marasch. It grows at elevations of 1600 to 5600 feet, and either forms small pure woods or is scattered amidst the forests of cedar and

¹ Specimens sent by Späth from Berlin, and by Pardé from Nancy and Les Barres.

² Walter Siehe, in *Gartenflora*, xlvi. 207 (1897), states that this tree in the Cilician Taurus never assumes the narrow columnar form which is so common in cultivation. Young trees in the wild state are pyramidal in habit; whilst older trees, which are mainly females preserved by the peasants on account of their fruit, have a rounded head of foliage.

³ Antoine and Kotschy, *loc. cit.* consider the bony stone to arise from the union of the testa of the seeds with the inner part of the three upper scales.

⁴ *Flora Orientalis*, v. 706 (1881).

Abies cilicica. Siehe mentions¹ enormous trees between Namrun and Güllek in Cilicia, which are over 3 ft. in diameter. It also occurs in Syria, on Mount Cassio, and on the Lebanon and Anti-Lebanon ranges. In Greece it appears to be confined to Mount Malevo, in the southern part of the Morea, where, according to Halacsy,² it forms a small wood at 3700 to 4000 feet altitude. According to Boissier,³ the reported occurrence of this species in Crete is erroneous.

It is known to the Turks as *Andys* or *Habel*, and is called *Duffran* by the natives of Syria, who collect and eat the fruits, which have a pleasant though resinous flavour.

This species is said by Loudon⁴ to have been introduced in 1820, but he acknowledges that he had only seen young plants, and these were probably incorrectly named, as Lindley⁵ in 1854 speaks of *J. drupacea* as a new plant. It is generally believed to have been for the first time introduced into western Europe in that year by Kotschy, who collected it in Asia Minor in 1853.

So far as we know it has never produced fruit in England, where all the trees in cultivation are supposed to be males. It is normally dioecious, but M. Allard⁶ states that a tree in his arboretum at Angers, which bore staminate flowers for a long time, ultimately produced fruit, and afterwards remained monoecious. A female plant at Angers has, however, never produced staminate flowers. M. Mottet⁶ states that a small tree at Verrières, only 6 ft. high, has produced fruit, though no other tree of the same species is near it, and he supposes that it must have been fertilised by the pollen of another species. (A. H.)

This species usually forms a narrow column and is one of the most beautiful of the junipers, yet is rarely seen in collections. It is perfectly hardy, and, judging from the way it grows at Colesborne, thrives in a limestone soil. The best specimen which I have seen is at Eastnor Castle, where there is a well-shaped tree, 31 ft. by 3½ ft. in 1908. This produced staminate flowers in May 1899, of which there are specimens in the British Museum. At Scorrier, in Cornwall, a fine specimen was 36 ft. by 1 ft. 9 in. in 1911. There are two good trees at Kew about 30 ft. high. Henry saw at Holkham in 1911 two very narrow columnar trees, about 40 ft. high by 3 ft. in girth. At Brickendon Grange, Hertford, a fine specimen measured 36 ft. high in 1912. Smaller trees occur at Highnam, Tortworth, Chiltley Place near Liphook, Young's nursery at Milford near Godalming, and other places. In Ireland the best specimen that we have seen, a tree about 30 ft. high, is growing at Woodstock, Kilkenny.

In France it attains a larger size, and at Angers and Montpellier has produced fruit. A tree in M. Allard's arboretum at Angers, nearly 40 ft. high, is figured in *Bull. Soc. Dend. France*, 1908, p. 109. Another⁷ at Antibes, about 30 ft. high, has a leaning stem and wide-spreading branches, being very different in habit from the usual form of this species in cultivation. (H. J. E.)

¹ In *Mitt. Deut. Dend. Ges.* 1911, p. 305.

² *Comp. Fl. Græc.* iii. 455 (1904). There is a specimen in the Cambridge Herbarium collected by Orphanides on Mount Malevo.

³ *Flora Orientalis*, v. 706 (1881).

⁴ *Encycl. Trees*, 1084 (1842).

⁵ *Gard. Chron.* 1854, p. 455.

⁶ Cf. Mottet, in *Rev. Hort.* 1904, p. 356, figs. 147, 148, where a tree is figured in the park of Baron Mallet at Château des Côtes, near Versailles, which Elwes found to be 36 ft. high in 1909.

⁷ Erroneously labelled *J. Oxycedrus*, var. *macrocarpa*.

JUNIPERUS RECURVA

Juniperus recurva, Buchanan-Hamilton, ex Don, *Prod. Fl. Nepal.* 55 (1825); Loudon, *Arb. et Frut. Brit.* iv. 2504 (1838); Masters, in *Gard. Chron.* xix. 468 and 574, fig. 69 (1883), and in *Journ. Linn. Soc. (Bot.)* xxvi. 542 (1902); J. D. Hooker, *Fl. Brit. India*, v. 647 (1888); Kent, Veitch's *Man. Conif.* 185 (1900); Gamble, *Indian Timbers*, 698 (1902); Brandis, *Indian Trees*, 694 (1906).

Sabina recurva, Antoine, *Cupress. Gatt.* 67, tt. 88, 90, 91 (1857).

A tree, attaining in the Himalayas 30 ft. or more in height. Bark brown, thin, peeling off in long fibrous strips. Branches curved, more or less pendulous. Young branchlets marked between the whorls by the decurrent bases of the leaves, which are separated by three grooves. Older branchlets from which the leaves have fallen smooth, with a light reddish-brown scaly epidermis.

Leaves all acicular, densely imbricated in whorls of threes, their basal part being decurrent on the branchlet, loosely appressed, directed forwards, scarcely spreading; linear-lanceolate, ½ to ¾ in. long, ⅓ to ⅔ in. broad, ending in a sharp cartilaginous point; outer surface convex, channelled longitudinally from the insertion to about the middle, greyish green; inner surface concave, whitened throughout. The leaves persist for several years, becoming brown in the third and fourth years, the mixture of green and brown leaves giving the foliage a peculiar appearance.

Flowers monoecious.¹ Staminate flowers, terminal or solitary in the axils of one or two of the leaves on the ultimate branchlets, oblong, about ⅓ in. long, with twelve to sixteen stamens. Fruit axillary, ripening in the second year, sessile, bracteate at the base, dark purplish brown, ovoid, about ⅔ in. long, composed of three or six united scales, each bearing a triangular spreading mucro, prominent near the umbilicate apex of the fruit. Seed solitary, occupying the greater part of the berry, ovoid, with a thin narrowed apex, marked on the surface with two or three large depressions for resin-glands.

This species is a native of the eastern Himalayas, occurring in Sikkim and Bhutan, between 9000 and 12,000 feet. It is represented in the north-western Himalayas, China, and Japan by the closely allied species or variety, *J. squamata*.

(A. H.)

In the very moist climate of the interior of Sikkim, where it is common in the Lachen and Lachoong valleys, from about 10,000 to above 13,000 feet, Sir Joseph Hooker, whose sketch² of it has been reproduced in Veitch's *Coniferae*, fig. 58, gives 30 ft. as its height; but if my recollection is correct, I saw much larger trees above Lachoong; and G. A. Gammie, in his account of a botanical tour in Sikkim,³ says that in the Sebu valley he saw large trees at 11,000 feet; and at 13,000 feet in the same valley it was the only arborescent vegetation.

¹ This species appears to be always monoecious. Kent, Veitch's *Man. Conif.* 187 (1900), states that a tree at Fota is a male. We have specimens of this bearing both staminate and pistillate flowers on different branchlets of the same branch.

² *Himalayan Journals*, ii. 45, fig. (1854).

³ Published as a Government paper, No. 41 B.S.I., dated Calcutta, 26th July 1893, reprinted in *Kew Bulletin*, October-November 1893, p. 311.

According to Gamble its growth is slow, about twenty-two rings per inch of radius for the Sikkim tree; and the wood is very good, equal to the best pencil cedar, but is not used except to burn as incense in the Buddhist temples.

This is the most ornamental of the junipers on account of its graceful drooping habit; and though introduced¹ in 1830, and hardy enough to grow well and ripen its berries in Scotland, it is not common in cultivation, and is seldom found in nurseries.² Its success in cultivation seems to depend principally on sufficient moisture in summer, all the best specimens that I have seen being in districts where the rainfall is heavy.

The largest I know in England is at Bicton, where there are two trees about 40 and 35 ft. high by 3 ft. 4 in. in girth, which bear abundance of berries. At Hafodunos in Denbighshire I saw in 1911 a very fine tree with three stems from the ground, almost equal in height, 40 ft. to 41 ft., and each about 2 ft. in girth. At Bodorgan in Anglesea there is a good-sized tree. Even in the drier climate of Gloucestershire there is a thriving tree at Highgrove, near Tetbury, the seat of Arthur Mitchell, Esq., from the berries of which I have raised plants; and another occurs at Highnam. There are also good specimens at Pencarrow and Menabilly in Cornwall, Mamhead in Devon, Bayfordbury and High Canons, Herts, Rotherfield Park, Hants, and Holkham, Norfolk.

In Scotland there is a small tree at Murthly, from which I have raised seedlings; and a thriving shrub at Drumtochty Castle. Another at Dalkeith was 14 ft. high in 1907.

In Ireland there is a large bushy tree³ with nine main stems, 40 ft. high and thirty-seven paces round at Castlewellan (Plate 349). At Salterbridge, Co. Waterford, the seat of Major Chearnley, I saw in 1910 another of the same type and almost as large; and at Fota I measured a tree 38 ft. high in 1910. (H. J. E.)

JUNIPERUS SQUAMATA

- Juniperus squamata*, Buchanan-Hamilton, in Lambert, *Genus Pinus*, ii. 17 (1824); Don, *Prod. Fl. Nepal*, 55 (1825); Loudon, *Arb. et Frut. Brit.* iv. 2504 (1838); Endlicher, *Syn. Conif.* 18 (1847); Koch, *Dendrologie*, ii. pt. ii. 121 (1873).
Juniperus religiosa,⁴ Royle, *Illust. Him. Plants*, i. 351 (1839) (name only).
Juniperus densa,⁵ Gordon, *Pinet. Suppl.* 32 (1862).
Juniperus recurva, Don, var. *squamata*, Parlato, in De Candolle, *Prod.* xvi. 2, p. 482 (1868); Brandis, *Forest Flora N.W. India*, 536 (1874), and *Indian Trees*, 694 (1906); Hooker, *Fl. Brit. India*, v. 647 (1888); Masters, in *Journ. Linn. Soc. (Bot.)* xxvi. 543 (1902).
Juniperus morrisonicola, Hayata, in *Gard. Chron.* xliii. 194 (1908), in *Journ. Coll. Sci. Tokyo*, xxv. art. 19, p. 211, fig. 7 (1908), and xxx. art. i. p. 307 (1911), and in *Journ. Linn. Soc. (Bot.)* xxxviii. 298 (1908).
Sabina squamata, Antoine, *Cupress. Gatt.* tt. 89, 90 (1860).

A shrub, with long decumbent stems, running over and under the surface of the ground, from which arise numerous short erect branches. Young branchlets green,

¹ According to Loudon, *Trees and Shrubs*, 1089 (1842). Seeds were subsequently sent home to Kew by Hooker in 1850.

² It is known in some nurseries as *J. repanda*, Hort. ex Carrière, *Conif.* 27 (1867).

³ Figured by Earl Annesley, *Beautiful and Rare Trees*, 54 (1903).

⁴ This is identified with *J. squamata* by Hooker, *Fl. Brit. India*, v. 647 (1888).

⁵ Gordon's account is confused, as he states that the berries are three-seeded; otherwise his description applies to

J. squamata.

with three grooves separating the decurrent pulvini of the leaves. Leaves all acicular, densely imbricated in whorls of threes, appressed or slightly spreading, decurrent on the branchlets, broader and shorter than in *J. recurva*, the free part $\frac{1}{8}$ in. long and $\frac{1}{4}$ in. wide, curved, gradually tapering to an acute apex, which is tipped with a sharp cartilaginous point; ventral surface concave, whitened, usually with a faint or obsolete midrib; dorsal surface convex, green, with a median furrow extending from the base to near the apex. Older branchlets stout, reddish brown, covered with persistent reddish brown acicular leaves.

Fruit ellipsoid, reddish brown at first, turning black when ripe in the second year, smaller and of a different shape from that of *J. recurva*, about $\frac{1}{4}$ to $\frac{1}{3}$ in. long, somewhat less in diameter, composed of three or six scales, each with a triangular mucro, umbilicate at the apex. Seed solitary, ovoid, broadest above the base, and tapering to an apiculate apex, nearly filling the cavity of the fruit, with about four ridges running from base to apex, and three or four depressions below the middle for resin-glands.

J. squamata, differs mainly from *J. recurva* in habit and in having stouter broader needles; but it is readily distinguishable, and has a much wider distribution. It varies considerably in the colour of the leaves, and appears occasionally to become an erect instead of a prostrate shrub.

It occurs in Afghanistan, the Himalayas, and the mountains of China and Formosa. It grows at a high elevation in the Himalayas, being most common in the north-west; but is also found in Sikkim, where Gammie states that it attains 15,000 ft. altitude. Brandis describes it as a gregarious shrub, often covering large areas, either pure or mixed with *J. communis*, with decumbent stems, at times six inches in diameter, running over the ground and giving off numerous short branches, which make it very difficult to traverse such thickets.

It is also found at high elevations in China, in the provinces of Hupeh, Szechwan, and Yunnan. In Hupeh, where I saw it in 1888, it is a shrub about a foot high, usually growing on rocky ground, and spreading over the surface to a radius of six feet or more. It resembles in habit the dwarf form of *J. communis*, but is readily distinguished by its broader shorter leaves and one-seeded berries. *J. squamata* grows in Formosa on Mt. Morrison, near the summit at 13,200 ft. altitude.

J. squamata was introduced¹ into England about 1836, and is occasionally cultivated in rockeries, being known occasionally as *J. pseudosabina*,² *J. densa*, etc.

In its typical form, it has leaves of a pure green tint, which are occasionally nearly as long as those of *J. procumbens*, Siebold. There are specimens at Kew, Bicton, Bayfordbury, and Glasnevin.

The following is probably a variety of *J. squamata*; but in the absence of fruit I hesitate to assign it to that species:—

¹ Gordon, in Loudon, *Gard. Mag.* xvi. 10 (1840), states that it was raised in the Chiswick Garden from Indian seed sent three or four years previous to 1840.

² *J. pseudosabina*, Fischer and Meyer, is a Turkestan shrub. Cf. p. 1423, note 1.

Juniperus procumbens, Siebold, in *Ann. Soc. Hort. Pays-Bas*, 1844, p. 31, and in Siebold and Zuccarini, *Fl. Jap.* ii. 59, t. 127, fig. iii. (1870) (not Sargent¹).

Juniperus chinensis, var. *procumbens*, Endlicher, *Syn. Conif.* 21 (1847).

A prostrate shrub similar to *J. squamata* in habit, but differing in the branchlets being glaucous-white on the edges of the pulvini: leaves longer, their free part $\frac{1}{3}$ in. long, gradually tapering to an acuminate spine-like apex; upper surface concave and covered except along the margins with a white stomatic band, divided except near the apex by an elevated and usually green midrib; lower surface convex, bluish, spotted with white, and with a median furrow which is variable in length. Fruit not seen.

This beautiful shrub was first described by Siebold,² who stated that it was wild in the mountains of Japan, and was cultivated in gardens and temple woods at Nagasaki. It has been collected since only by Faurie,³ who found it at high elevations in Hondo.

Siebold considered it to be perhaps *J. nipponica*, Maximowicz,⁴ a species with which it has no affinity; and subsequent botanists confused it with *J. chinensis*,⁵ a totally different species. It resembles *J. squamata* very closely, differing only in the glaucous tint of the leaves and branchlets; but in the absence of fruit cannot be safely united with that species.

J. procumbens is said⁶ to have been introduced, by living plants, into the Botanic Garden at St. Petersburg in 1864; but does not appear to have been known in England until of late years.⁷ It is now imported largely from Japan, and was a striking feature in the exhibit of Japanese plants at the Anglo-Japanese Exhibition of 1909. It is the most ornamental of the creeping junipers, and is occasionally sold under the erroneous name of *J. litoralis*,⁸ a totally distinct species. So far as I know it has not yet produced fruit in England. (A. H.)

¹ *J. procumbens*, Sargent, *Forest Flora of Japan*, 78 (1894), and in *Garden and Forest*, x. 421 (1897), is a variety of *J. chinensis*, described on p. 1432.

² One of Siebold's original specimens, a branch without fruit, of *J. procumbens* is in the Kew herbarium, where it was sent from the Leyden Museum.

³ Masters, in *Bull. Herb. Boissier*, vi. 274 (1898), refers two specimens collected by Faurie, "No. 47, summit of Sennintoge, and No. 3409, summit of Ckokkai," to *J. recurva*, var. *squamata*. No. 3409 is in the Kew herbarium, and is identical with *J. procumbens*, Siebold.

⁴ *J. nipponica*, Maximowicz, in *Mél. Biol.* vi. 374 (1867), is a remarkably distinct species, of which little is known, except the original specimen described by Maximowicz. This species has not been introduced into Europe.

⁵ Siebold's plant has been much confused with *J. chinensis*, var. *japonica*, which is also cultivated in Japan. Gordon's specimen of *J. japonica procumbens* in the Kew herbarium is *J. chinensis*.

⁶ Bretschneider, *Hist. Europ. Bot. Disc. China*, 610 (1898).

⁷ The plant at Kew was introduced from Japan in 1893.

⁸ *J. litoralis*, Maximowicz, in *Mél. Biol.* vi. 375 (1867), is a sea-shore plant, which grows abundantly on the shore of Hakodate Bay in Yezo, and near Honjo on the west side of Hondo, where it was found by J. Veitch in 1892. It also grows in Kiusiu and the Liu Kiu Islands. It has three-seeded berries, and has some affinity with *J. rigida*. It has never been introduced into England so far as we are aware. Bretschneider, *op. cit.* 610, referring to it as *J. conferta*, Parlatores, says that it was introduced into St. Petersburg in 1864, along with *J. procumbens*, Siebold.

JUNIPERUS WALLICHIANA

Juniperus Wallichiana, J. D. Hooker, ex Parlatores, in De Candolle, *Prod.* xvi. 2, p. 482 (1868);

Brandis, *Forest Flora N.-W. India*, 537 (1874), and *Indian Trees*, 695 (1906).

Juniperus pseudosabina, J. D. Hooker, *Fl. Brit. India*, v. 646 (1888) (not Fischer and Meyer¹);

Kent, Veitch's *Man. Conif.* 184 (1900); Gamble, *Indian Timbers*, 698 (1907).

A tree, attaining in the Himalayas 60 ft. in height. Leaves dimorphic. Adult foliage with tetragonal ultimate branchlets, about $\frac{1}{2}$ in. in diameter, densely covered with scale-like leaves, which are arranged in four ranks in decussately opposite pairs, closely appressed, narrowly ovate, about $\frac{1}{16}$ in. long, tapering to an acute apex, bright green with a whitish margin, marked on the back with a linear glandular furrow extending from the base to near the apex. Leaves on the main axes, larger, up to $\frac{1}{4}$ in. long, tipped with acuminate points. Juvenile foliage, often preponderant on adult trees; leaves acicular, in threes, decurrent, densely clothing the branchlet in successive whorls, slightly spreading, about $\frac{1}{8}$ in. long, sharply mucronate, whitened on the inner (upper) surface, usually marked on the back with a longitudinal furrow.

Flowers dioecious. Fruit, ripening in the second year, on the ends of short curved branchlets, ovoid, $\frac{2}{3}$ in. long, $\frac{1}{3}$ in. broad near the base, dark purplish brown, becoming quite blue when ripe; smooth on the surface except for the minute mucros which indicate the three to five component scales; depressed at the summit with a minute transverse rhomboidal apiculate umbo. Seed, one in each fruit, large for the genus, $\frac{1}{4}$ in. long, ovoid, compressed, with a narrow thin pointed apex, and two or three depressions for resin-glands about the middle of each surface.

This species is a native of the Himalayas from the Indus to Bhutan, occurring between 9000 and 15,000 ft. elevation. In the western part of its range, it is a large gregarious shrub; but in Sikkim, it becomes a large tree, sometimes 60 ft. in height, with a stout trunk and dark branches and foliage. An illustration of it is given by Hooker,² who calls it the "Black Juniper." Mr. J. Claude White³ saw a large "weeping cypress," at Chalimaphe in Bhutan, which was 50 ft. round the trunk at five feet from the ground; and this remarkable tree in all probability was *J. Wallichiana*.

J. Wallichiana was introduced in 1849, when Sir J. D. Hooker sent seeds from India to Kew.⁴ It is very rare in cultivation, the only specimens which we have seen being one in the Juniper collection at Kew, about 20 ft. high; and another of the same size at Leonardslee, which bore fruit in 1911. (A. H.)

¹ *J. pseudosabina*, Fischer and Meyer, in *Index Sem. Hort. Petrop.* 65 (1841), and *Plant. Schrenk.* ii. 13 (1842), differs in appearance from the Himalayan tree, the scale-like leaves being less acute, and the fruits smaller and often globose. It was described from specimens gathered in the Altai and the Tarbagatai mountains in Turkestan. It appears to be a low shrub, like *J. Sabina* in habit, and has not apparently been introduced.

² *Him. Journ.* ii. 55, fig. (1854).

³ *Sikkim and Bhutan*, 131 (1909). No specimens of this enormous tree appear to have been collected.

⁴ See Kew archives, "List of Seeds received from Dr. Hooker during his Travels in India," where "No. 78, 1849 (No. 152), *Juniperus*, large tree," is evidently *J. Wallichiana*.

JUNIPERUS PHAENICEA

Juniperus phænicea, Linnæus, *Sp. Pl.* 1040 (1753); Loudon, *Arb. et Frut. Brit.* iv. 2501 (1838); Parlato, in De Candolle, *Prod.* xvi. 2, p. 486 (1868); Vallot, in *Journ. de Bot.* ii. 329 (1883); Mathieu, *Flore Forestière*, 517 (1897); Ascherson and Graebner, *Syn. Mitteleurop. Fl.* i. 250 (1898); De Coincy, in *Bull. Soc. Bot. France*, xlv. 432 (1898); Kent, *Veitch's Man. Conif.* 182 (1900); Kirchner and Schröter, *Lebenges. Blütenpfl. Mitteleuropas*, i. 316 (1906); Albert and Jahandiez, *Pl. Vasc. du Var*, 451 (1908).

Juniperus Lycia, Linnæus, *Sp. Pl.* 1039 (1753); Loudon, *Arb. et Frut. Brit.* iv. 2502 (1838).
Sabina phænicea and *Lycia*, Antoine, *Cupress. Gattung.* tt. 42, 44 (1860).

A shrub or tree, attaining usually about 20 ft. in height. Foliage dimorphic. Leaves on young plants, and very rarely on isolated branches of adult trees, acicular, spreading in whorls of threes, not jointed at the base, decurrent on the branchlet, about $\frac{1}{4}$ in. long, with two stomatic lines on both the upper and lower surfaces. On adult trees, branchlet systems two- to three-pinnate; ultimate branchlets terete, about $\frac{1}{25}$ in. in diameter; leaves scale-like, either in four ranks in opposite decussate pairs, or in six ranks in alternating whorls of threes, closely appressed, ovate-rhombic, about $\frac{1}{25}$ in. long, blunt at the apex, serrulate in margin, rounded on the back, which is often marked with a longitudinal or oval furrow.

Flowers usually monœcious, rarely diœcious.¹ Fruit very variable in size and shape, ripening in the second year, on short scaly stalks, shining yellow or reddish brown, with remarkably fibrous yellowish flesh; composed of six to eight scales, with no distinct lines of separation between them, each marked by a minute or obsolete mucro; in the typical form, globose or sub-globose, $\frac{1}{4}$ in. to $\frac{1}{2}$ in. in diameter. Seeds variable in number, three to nine, shining brown, separable with great difficulty from the adherent yellow flesh, triquetrous, furrowed longitudinally with two or three depressions for the closely adherent glands.

This species is remarkably variable in the size, shape, and colour of the fruits. Five or six varieties can be distinguished in specimens gathered by Jahandiez² near Hyères, which were sent to me by Lord Walsingham. The typical form of the species has globose berries; but these vary in size from $\frac{1}{4}$ in. to $\frac{1}{2}$ in. in diameter, and in colour from dark reddish brown to yellow or orange brown.

1. Var. *turbinata*, Parlato, in *Fl. Ital.* iv. 91 (1867).

Juniperus turbinata, Gussone, *Fl. Sic. Syn.* ii. 634 (1844).

Juniperus oophora, Kunze, in *Flora*, xxix. 637 (1846).

Fruit ovoid or shortly conical. Seeds deeply furrowed from base to apex, and compressed at the summit into a sharp transverse edge. This variety is met with in

¹ This is De Coincy's opinion. Most authors say that it is usually dioecious and occasionally monoecious. Some of the trees we have seen in cultivation are certainly monoecious.

² Albert and Jahandiez, *Pl. Vasc. du Var*, 451 (1908), state that shrubs with large globose berries grow on the maritime sands, whilst those with small berries occur in rocky situations. De Coincy, in *Bull. Soc. Bot. France*, xlv. 432 (1898), refers the form with large globose berries to *J. Lycia*, Linnæus, which may be named, if considered worth distinguishing, as *J. phænicea*, var. *Lycia*, Loiseleur, *Nouv. Duham.* vi. 47, t. 17 (1812).

nearly all the localities where the typical form occurs, and, like it, is variable in the size, shape, and colour of the berries.

2. Var. *filicaulis*, Carrière, *Conif.* 51 (1855) and *Conif.* 52 (1867).

Juniperus myosuros, Sénéclauze, *Catalogue*, 1854, p. 35.

A shrub with elongated twisted branches and slender pendulous branchlets. Leaves scale-like, as in the type; but occasional branchlets bear acicular juvenile foliage. The parent plant, which was 3 ft. high in 1867, is said by Carrière to have originated from a seed of *J. phænicea*, which was sown by Sénéclauze in his nursery at Bourg-Argental (Loire), sometime before 1854. Sénéclauze, however, in his *Catalogue*, 1867, p. 11, calls this plant *J. thurifera hybrida myosuros*; and its origin must be considered doubtful. We have seen no specimens.

J. phænicea is widely spread throughout the Mediterranean region, occurring in Spain and Portugal, south-eastern France, Corsica, Sardinia, Italy, Sicily, Dalmatia, Greece, Rhodes, Cyprus, Crete, and the Crimea; but appears to be unknown in Asia Minor. It is also common in Algeria, Morocco, the Canary and Madeira Islands. It usually grows in arid situations on rocky hills, and often forms extensive and impenetrable thickets, as in La Camargue at the mouth of the Rhone. It ascends in the Riviera to 4500 feet. In Algeria¹ it is common on the coast, and on the southern slopes of the mountains of the interior, where it is often the only arborescent vegetation, ascending to 6000 feet.

In the Canary Isles, *J. phænicea* was formerly one of the characteristic trees of the coast-region between 600 and 2000 ft. elevation; but has been much destroyed on account of its use for firewood. Dr. Burchard² states that it is still plentiful on the north side of Gomera and Hierro; but is nearly extinct on Grand Canary and Teneriffe, where only a few specimens remain in the south. On Gomera, it is usually seen as a globose bush on the cliffs, but becomes a tree when old. On the west point of Hierro, there are specimens supposed to be 1000 years old. Dr. Burchard² reproduces photographs of two of these remarkable trees, which have short stems, 4 to 5 ft. in diameter, with enormous crowns, spreading for an immense distance on one side of the trunk, as the result of the continuous influence for centuries of the north-east trade-wind.

Dr. Grabham tells us that in Madeira, *J. phænicea* was formerly widely distributed from sea-level to the highest summits of the mountains, but is now nearly extinct. The wood of this species is still to be seen in enormous beams and slabs in old buildings, and its fragrant roots of great size are often found underground.

According to Aiton, *J. phænicea* was first cultivated in Britain in 1683 by James Sutherland, curator of the Edinburgh Botanic Garden. It usually forms a pyramidal shrub or low tree, dense in habit; but is now rare in cultivation in this country. There are specimens at Highnam, Bicton, and Rostrevor. These bear small globose orange-coloured fruits.

It loves a warm climate, and is scarcely hardy in Germany; but a specimen,³

¹ Lefebvre, *Les Forêts de l'Algérie*, 431 (1900).

² In *Mitt. Dent. Dend. Ges.* 1911, pp. 286, 287.

³ Kirchner and Schröter, *op. cit.* 316 (1906).

sheltered by other trees and 6 ft. high, at Tübingen, bore, without any injury but a slight browning of the leaves, a minimum temperature in winter of $-29\frac{1}{2}^{\circ}$ Cent.

(A. H.)

JUNIPERUS FLACCIDA

Juniperus flaccida, Schlechtendal, in *Linnaea*, xii. 495 (1838); Sargent, *Silva N. Amer.* x. 83, t. 519 (1896), and *Trees N. Amer.* 89 (1905); Kent, *Veitch's Man. Conif.* 177 (1900).

Juniperus fetida, var. *flaccida*, Spach, in *Ann. Sc. Nat.* xvi. 300 (1841).

Juniperus gracilis, Koch, *Berl. Allg. Gartenzeit.* 1858, p. 341 (not Endlicher).

Sabina flaccida, Antoine, *Cup. Gatt.* 37, tt. 49, 50 (1857).

A tree, attaining 30 to 40 ft. in height, with brown bark separating into thin scales; branches widely spreading, with long pendulous branchlets. Leaves dimorphic. Adult foliage: leaves in opposite decussate pairs, slightly spreading, ovate-lanceolate, about $\frac{1}{2}$ in. long, decurrent, ending in a sharp cartilaginous point, rounded on the back, which is marked with a linear sunken gland, often exuding resin. Juvenile foliage, usually on the ends of some branchlets of adult trees, acicular-subulate, spreading, usually in whorls of threes, rarely in pairs, decurrent, about $\frac{1}{4}$ in. long, gradually tapering from the base to the very sharp cartilaginous apex; upper surface concave, with inflexed margins, and with two narrow stomatic lines; lower surface marked near the base with a linear gland, often exuding resin. Similar spreading acicular leaves, in pairs or in threes, are borne on the main axes of the branchlet-systems, and like these turn reddish brown in the third and fourth year, and fall in succeeding years, leaving the branchlets smooth with a scaly bark.

Flowers monœcious. Fruit, ripening in the second year, on a short ($\frac{1}{16}$ in. long) scaly stalk, four- to six-bracteate at the base, sub-globose, about $\frac{1}{2}$ in. in diameter, reddish brown with a glaucous bloom, and marked on the surface with a few minute tubercles; composed of six to eight opposite scales, each indicated by a reflexed triangular mucro. Seeds, six to twelve, several often aborted, embedded in a resinous pulp; cotyledons two.

(A. H.)

This species is a native of Texas and Mexico. It is limited in Texas to the Chisos Mountains, where it was discovered in 1888 by Dr. V. Harvard. It is common in north-eastern Mexico, at elevations of 6000 ft. to 8000 ft., on the hills to the east of the tablelands, ranging from Coahuila to Oaxaca, and extending eastward to about a hundred miles from the coast.

It was introduced¹ in 1838 from Mexico by Hartweg, but is probably too tender for our climate in most parts, as the only specimen which we know of in Britain is a fine tree at Bicton, which I found to be about 40 ft. by 3 ft. 10 in. in 1906. It grows in a sheltered hollow, and bears fruit regularly, which is smaller in size than in native specimens, and contains only imperfect seed.

Carrière states² that it is not hardy at Paris, but he mentions a tree at Angers

¹ Loudon, *Gard. Mag.* xv. 241 (1839), and xvi. 10 (1840).

² *Conif.* 49 (1867).

10 in. in diameter. It is said¹ to be occasionally cultivated in the south of France and in Algeria; but we have seen no specimens. There is a small tree in the Botanic Garden at Genoa, and a larger one in the Botanic Garden at Naples, which was bearing ripe fruit in March 1910.

(H. J. E.)

JUNIPERUS THURIFERA

Juniperus thurifera, Linnæus, *Sp. Pl.* 1039 (1753); Loudon, *Arb. et Frut. Brit.* iv. 2503 (1838); Parlatores, in De Candolle, *Prod.* xvi. 2, p. 487 (1868); Laguna, *Fl. Forest. Hispan.*, i. 103 (1883); De Coincy, in *Bull. Soc. Bot. France*, xlv. 430 (1898); Kent, *Veitch's Man. Conif.* 191 (1900).

Juniperus hispanica, Miller, *Gard. Dict.* ed. 7, No. 13 (1757), and ed. 8, No. 13 (1768).

Juniperus sabinoides, Endlicher, *Syn. Conif.* 23 (1847) (in part).

Juniperus cinerea, Carrière, *Conif.* 35 (1867).

A tree, attaining in Spain a height of 30 ft. to 40 ft. Leaves dimorphic. Adult foliage, with flattened branchlet-systems, pinnately divided mostly in one plane. Young branchlets tetragonal, slender, $\frac{1}{20}$ in. in diameter; leaves in opposite pairs in four ranks, appressed but free at their acuminate apices, ovate, about $\frac{1}{16}$ in. long, adnate to the branchlet in their basal half, marked on the back with an oblong glandular depression, minutely denticulate in margin. Juvenile foliage often present on adult trees; leaves in opposite pairs in four ranks, spreading, acicular, decurrent, $\frac{1}{2}$ to $\frac{1}{4}$ in. long, whitened on the upper surface.

Flowers diœcious. Fruit on short scaly stalks, ripening in the second year, sub-globose, $\frac{1}{3}$ in. or a little more in diameter, dark blue with a slight glaucous bloom when mature; composed of six scales in opposite decussate pairs, two at the base, the upper four scales meeting at the apex, which is marked with their lines of separation; each scale with a minute mucro. Seeds, two, three, or four, immersed in a granular sweet fragrant flesh, ovate, triquetrous, $\frac{1}{3}$ in. long, shining brown, smooth, narrowed at the apex to a curved point, with two or three oblong resin-pits at the base.

1. Var. *gallica*, De Coincy, in *Bull. Soc. Bot. France*, xlv. 232 (1897), and xlv. 430 (1898); Holmes, *Pharmac. Soc. Museum (London) Report*, 1907, p. 26.

A small tree, apparently differing only from the type, in the one to three seeds, being striate and not smooth on the surface, more prominent at the apex, and less angular.

This variety, which is the French form of the species, was first noticed in 1830 by Mutel, who gave it the name of *J. Sabina*, var. *arborea*.²

It appears to be confined to the Dauphiné, where it occurs at a few stations in the valley of the Isère, in the immediate neighbourhood of Grenoble; and in the valley of the Durance, chiefly near Embrun. Near Grenoble it is found on the

¹ Sargent, *Silva N. Amer.* x. 83 (1896).

² Mathieu, *Flore Forestière*, 519 (1897) refers the trees at Saint Crépin to *J. Sabina*. Cf. also Vidal, in *Bull. Soc. Bot. France*, xlv. 51 (1897).

mountains of Comboire, Néron, and Saint Eynard. In the valley of the Durance it is more abundant, and grows at Guillestre, Saint Clément, Saint Crépin, in the valley of Ubaye, near Gap, and at Remollon. M. Ph. Guinier informs us that in all these localities it grows on dry limestone soil, and usually as isolated trees. At Saint Crépin, however, it forms a small wood above the village, at 3500 ft. to 4000 ft. altitude. It is usually a small tree, 20 ft. to 25 ft. high, but in rare cases attains 40 ft. in height. The trunk is short, irregular, and deeply furrowed; and is frequently 6 ft. to 10 ft. in girth—one tree at Saint Crépin being as much as 17 ft. in girth. It attains a great age, a section in the Museum of the Forestry School at Nancy, 0.94 metres in girth, showing 175 annual rings, and another 1.48 metres in circumference showing 169 annual rings.

J. thurifera is a native of south-eastern France, Spain, Portugal, Sardinia,¹ Morocco, and Algeria. It is common in the mountains of central and southern Spain, occasionally forming pure open woods, one of which in the Sierra de Albarracin is figured by Willkomm;² or growing mixed with other conifers, as in the fine forests of *Pinus Laricio* in the Serrania de Cuença. Here,² on the Muela de S. Juan, near Tragacete, it attains 25 ft. to 35 ft. high, and 10 ft. to 13 ft. girth.³ Laguna, who gives many localities for this species in Spain, states that it never ascends to the high altitudes occupied by *J. Sabina*, nor descends to the hot and sandy plains, where *J. phoenicea* is often seen. It inhabits the zone between 2500 and 3500 ft. altitude, where there are abrupt changes of temperature, which it supports well. It is always met with on soils which are either pure limestone, or contain lime in considerable quantity.

In Algeria,⁴ *J. thurifera* grows mainly in the cedar forests at high elevations, where it is usually a small tree, not exceeding 20 ft. in height. It was collected in southern Morocco by Sir J. D. Hooker. (A. H.)

Although this species was cultivated by Miller in 1752, it has never become common, and according to Kent only thrives in warm and sheltered situations. Loudon records a tree at Boyton 28 ft. high in 1837, and another at Croome, forty years planted, which was 30 ft. high in 1838, but we have not found these specimens now living. The largest tree in England is one at Bicton, about 40 ft. high, 4 ft. 4 in. in girth, conical in shape, and bearing male flowers in April 1911.

There are two trees at Kew, about 30 ft. high, which were planted in 1870. Another at Bayfordbury, 30 ft. high, was planted in 1841. Smaller trees exist at Highnam and Leonardslee. I saw a tree bearing ripe fruit at Simon-Louis's nursery, Metz, which was about 40 ft. by 3 ft. in 1908. (H. J. E.)

¹ Grisebach, *Veg. der Erde*, i. 572 (1872), states that it occurs in Sardinia. Cf. Nyman, *Consp. Fl. Eur.* iii. 676 (1881).

² Willkomm, *Pflanzenverb. Iber. Halbinsel*, 160, 185, fig. 11 (1896).

³ Dillwyn, *Hort. Collinson*. 27 (1843), quotes a letter written to Collinson in 1766 by Bowles, an engineer in Spain, who states that large trees, girthing 14 ft., with wide-spreading branches like a beech, grew in the mountains near the source of the Tagus. Willkomm confirms this.

⁴ Lefebvre, *Forêts de l'Algérie*, 431 (1900).

JUNIPERUS PACHYPHLÆA

Juniperus pachyphlæa, Torrey, *Pacific R. R. Rep.* iv. pt. v. 142 (1858); Sargent, *Silva N. Amer.* x. 85, t. 520 (1896), and *Trees N. Amer.* 90 (1905); Kent, Veitch's *Man. Conif.* 181 (1900); Britton and Shafer, *North American Trees*, 113 (1908).

Juniperus plochyderma, Parlatores, in De Candolle, *Prod.* xvi. 2, p. 492 (1868).

Sabina pachyphlæa and *plochyderma*, Antoine, *Cupress. Gatt.* 39, 40, t. 52 (1857).

A tree, attaining in America 60 ft. in height and 15 ft. in girth. Bark, different from that of all the other junipers, $\frac{3}{4}$ to 4 inches thick, deeply divided into small square scaly plates. Branchlets slender, angled, becoming light brown, terete, and scaly after the fall of the leaves. Leaves dimorphic: on vigorous branchlets, acicular, spreading, in threes and in opposite pairs, $\frac{1}{8}$ to $\frac{1}{4}$ in. long, tipped with slender elongated cartilaginous points; upper surface concave and whitened, lower surface greyish green and keeled. The juvenile foliage gradually passes into the adult foliage; ultimate branchlets tetragonal, $\frac{1}{25}$ in. in diameter, with scale-like leaves in opposite pairs, imbricated, closely appressed, about $\frac{1}{16}$ in. long, ovate-rhombic, rounded at the narrowed apex, minutely toothed in margin, convex on the back, which is marked with a depressed oval gland, often exuding resin; leaves on the older branchlets tipped with a sharp point.

Flowers diœcious. Fruit ripening in the second year, sub-globose, nearly $\frac{1}{2}$ in. in diameter, sub-sessile, ebracteate, reddish brown covered with a glaucous bloom, tuberculate on the surface, with six to eight scales each marked by a slightly reflexed mucro. Seeds four, nearly filling up the cavity of the fruit, ovoid, angled, shining brown; flesh scanty, fibrous, yellow.

Reputed juvenile forms of this species, vars. *conspicua*, *elegantissima*, and *ericoides*, differing in habit and with blue or whitish-blue foliage, have lately been obtained by Barbier¹ at Orleans; and are now in cultivation at Kew² and Glasnevin.

This species grows on dry arid mountain slopes, at 4000 to 6000 feet elevation, from the Eagle and Limpio Mountains in south-western Texas, westward along the desert ranges of New Mexico and Arizona, and southwards into Mexico, where it occurs along the Sierra Madre to the state of Jalisco and over the mountains of northern Sonora and Chihuahua.

It was discovered in 1851 by Dr. S. W. Woodhouse in eastern New Mexico, and is considered by Sargent to be the most beautiful of all the west American Junipers, its thick checkered bark being unlike that of any other species.

It is uncertain when it was introduced into England. It is extremely rare, the only specimen which we have seen being a tree in Kew Gardens, about 20 ft. high, showing the peculiar bark, and producing on its stem several epicormic branches. This has not as yet produced flowers. (A. H.)

¹ *Mitt. Deut. Dend. Ges.* 1910, pp. 139 and 289.

² *Kew Bulletin*, 1911, p. 101.

JUNIPERUS CHINENSIS

Juniperus chinensis, Linnæus, *Mantissa*, i. 127 (1767); Loudon, *Arb. et Frut. Brit.* iv. 2505 (1838); Siebold et Zuccarini, *Fl. Jap.* 58, tt. 126, 127, (1844); Parlato, in De Candolle, *Prod.* xvi. 2, p. 487 (1868); Franchet et Savatier, *Enum. Pl. Jap.* i. 472 (1875); Masters, in *Journ. Linn. Soc. (Bot.)* xviii. 497 (1881), and xxvi. 541 (1902), and in *Journ. Bot.* xli. 268 (1903); Beissner, in *Mitt. Deut. Dend. Ges.* 1896, p. 69, and 1898, p. 32, and in *Bull. Soc. Bot. Ital. Firenze*, 1898, p. 167; Kent, *Veitch's Man. Conif.* 169 (1900); Shirasawa, *Icon. Ess. Forest. Japon.* i. text 29, t. 12, figs. 14-27 (1899); Diels, in Engler, *Bot. Jahrb.* xxix. 220 (1901).
Juniperus cernua and *dimorpha*, Roxburgh, *Fl. Ind.* iii. 839 (1832).
Sabina chinensis, Antoine, *Cupress. Gattung.* 54, t. 75 (1857).
Sabina Cabianca, Antoine, *Cupress. Gattung.* 41, t. 54 (1857).

A tree, attaining in China and Japan a height of 60 ft. Leaves of two kinds: on adult trees scale-like; ultimate branchlets $\frac{1}{2}$ in. in diameter, clothed with four ranks of leaves in opposite pairs, which are imbricated, closely appressed, narrowly rhombic, $\frac{1}{10}$ in. long, tapering to rather an obtuse apex, adnate to the stem, entire in margin; outer surface convex, green with a pale margin, and marked with a depressed oval or oblong gland; interiorly concave, with a raised narrow midrib, glaucous. On older branchlets the scale leaves are larger, about $\frac{1}{10}$ in. long, conspicuously glandular on the back, persistent four or five years. On young trees and on occasional branches of old trees, the juvenile foliage is linear-acicular, $\frac{1}{3}$ in. long, spreading, either in whorls of threes or in opposite pairs, tipped with a rigid spine-like point, adnate to the branchlets, swollen on the upper surface near the base, but not jointed; concave above, with a green midrib and two glaucous bands; green and convex beneath.

Flowers dioecious. Staminate flowers bright yellow, very numerous.¹ Fruit ripening in the second year, borne on the ends of short branchlets, which are covered with ordinary scale-leaves; brown covered with a thick white mealy bloom; variable in shape, commonly sub-globose, but widest and usually depressed at the summit, averaging $\frac{1}{3}$ in. in diameter, composed of four to eight scales. Seeds two or three, rarely four or five, immersed in a resinous pulp, shining deep chestnut brown, smooth, broadly ovoid, with a wide base, gradually tapering to a sharp thin-edged apiculate apex, compressed from before backwards, each surface convex, with a longitudinal groove near the thinner outer edges.

This species is readily distinguishable by the pale margins of the scale-like leaves, which mark the ultimate branchlets with a series of white crosses. In nearly all adult trees, acicular foliage with the leaves either ternate or in opposite pairs can be found on some of the branches.

VARIETIES

I. This species is very variable in habit in the wild state; and, as Beissner² points out, in the mountains of Shensi in China, both male and female trees exist,

¹ On certain trees at Kew, and in wild specimens of Shensi (*vide* Beissner) staminate flowers are borne on branchlets with acicular as well as with scale-like foliage; and this seems peculiar to *J. chinensis*.

² In *Mitt. Deut. Dend. Ges.* 1896, p. 69, and 1898, p. 32.

which bear exclusively acicular foliage; whilst others occur in both sexes with the leaves mostly scale-like. There are no grounds for supposing that the sexes are distinguished in nature by any peculiar habit; but in cultivation, owing to long-continued propagation by cuttings from trees of different habit, many female trees differ in appearance from that commonly met with in male trees. This is by no means universal, as there are two trees of the same habit, but of different sexes, in the Cambridge Botanic Garden. A common staminate form, with preponderating acicular foliage, and dense branches, forming a conical pyramid, was formerly distinguished as *J. struthiacea*, Knight, *Syn. Conif.* 12 (1850). A pistillate form, known at first as *J. flagelliformis*, Loudon, *Trees and Shrubs*, 1090 (1842), was introduced from Canton in 1839 by J. Russell Reeves, and was subsequently named *J. Reevesiana*, Knight, *Syn. Conif.* 12 (1850).

II. The following are either closely allied species or varieties of *J. chinensis*:—

1. *Juniperus sphaerica*, Lindley, in Lindley and Paxton, *Flower Garden*, i. 58, fig. 35 (1850).

Juniperus chinensis, Linnæus, var. *Smithii*, Gordon, *Pinetum*, 119 (1858) (not Loudon¹).

Juniperus Fortunei, Van Houtte, *ex* Gordon, *Pinetum*, 119 (1858).

A tree, 30 to 40 ft. high, discovered by Fortune² in the hills north-west of Ningpo and near Shanghai, where it is frequently planted around graves. The type specimen, preserved in the British Museum, does not differ from *J. chinensis* in the foliage, which is all scale-like, no acicular leaves being present; but is monœcious, and bears fruit, quite spherical in shape and larger than that of *J. chinensis*, $\frac{7}{10}$ in. in diameter, smooth, dark purple, scarcely glaucous, containing five seeds, which are larger than, but similar in shape and colour to those of *J. chinensis*.

This is kept separate from *J. chinensis*, but with some doubt, by Parlato,³ Kent,⁴ and Masters;⁵ and is probably only a variety of that species, differing mainly in the larger spherical fruit, not covered with a whitish bloom, and containing numerous seeds. The branch collected by Fortune is monœcious; but this is perhaps an abnormality.

A specimen (No. 6576) which I collected in Fang district in the province of Hupeh, with large spherical glaucous berries, resembles Fortune's plant, but is dioecious and with only three seeds in each fruit. Wilson found in the same province another specimen with smaller four-seeded fruits.⁶

Fortune sent seeds in 1850 to Standish and Noble, who probably raised *J. sphaerica* in their nursery; but I have found no living specimens, either monœcious or with the large spherical berries of Fortune's plant. The trees now known in cultivation either as *J. sphaerica* or *J. sphaerica Sheppardii*, Veitch, *Man. Conif.* 290 (1881), usually prove to be female trees of *J. chinensis*, with a rather spreading habit.

¹ *J. chinensis Smithii*, Loudon, *Arb. et Frut. Brit.* iv. 2505 (1838), described (long before Fortune's discovery of *J. sphaerica*) as monœcious with angular fruits, was supposed to be of Nepalese origin, and may have been *J. religiosa*.

² *Residence amongst the Chinese*, 63, 140 (1857).

³ In De Candolle, *Prod.* xvi. 2, p. 488 (1868).

⁴ *Veitch's Man. Conif.* 190 (1900).

⁵ In *Journ. Linn. Soc. (Bot.)* xxvi. 543 (1902).

⁶ The fruits of cultivated trees of *J. chinensis* are usually three-seeded; but occasionally four or five seeds are present, the fruits in this case being small, covered with whitish bloom, and depressed at the apex, and not in the least like the large spherical bluish fruits of *J. sphaerica*.

2. Var. *Sargentii*, Henry (var. *nova*).

Juniperus procumbens, Sargent, *Forest Flora Japan*, 78 (1894), and in *Garden and Forest*, x. 421 (1897) (not Siebold).

A sea-shore plant,¹ forming dense mats, and sending out for long distances prostrate creeping stems, which bear foliage similar to that of *J. chinensis*: branchlets tetragonal, covered with minute scale-like appressed leaves, furrowed on the back; no acicular leaves being present on adult plants. Berries bluish, covered with a slight glaucous bloom; seeds three, like those of *J. chinensis*.

This is said by Sargent, who has kindly sent a dried specimen, to grow on the coasts of Korea and Japan, on low grassy bluffs freely exposed to the ocean gales. A few plants were raised in the Arnold Arboretum from seeds gathered in 1892 near the Aino village of Horobetsu on the coast of Yezo. I have seen no living specimens.

III. The following varieties are of horticultural origin:—

3. Var. *albo-variegata*, Veitch, *Man. Conif.* 288 (1881).

A compact shrub, differing from the type in many of the branchlets being creamy white at the tips. It usually bears adult scale-like foliage; but a form with acicular foliage is also in cultivation. It is said to have been first introduced from Japan by Fortune, and subsequently by J. Gould Veitch. It is known by several names, as var. *variegata*, Fortune; var. *argentea*, Gordon; and var. *argenteo-variegata*, Rehder.

4. Var. *aurea*, Young, *ex Gard. Chron.* 1872, pp. 8, 1193.

An upright form, with adult scale-like foliage, having the whole of the young growth suffused with a deep golden yellow, which gradually turns green in the summer. The colour is heightened by exposure to the sun. This originated in Maurice Young's nursery at Milford, Godalming, where the original plant was 12 ft. high in 1872, and when Elwes saw it in 1909 was still a small tree. The best specimens we know of this are at Burnham Park, the residence of Sir Harry J. Veitch, and are about 18 ft. high.

5. Var. *japonica aurea*, Masters, in *Journ. R. Hort. Soc.* xiv. 211 (1892).

Juniperus japonica aurea, Carrière, *Conif.* 32 (1867).

A straggling shrub, with long decumbent branches; branchlets tinged with golden yellow. This is said to have been first introduced by Fortune from Japan, and subsequently by J. Gould Veitch.

6. Var. *japonica aureo-variegata*, Masters, in *Journ. R. Hort. Soc.* xiv. 211 (1892).

Juniperus japonica variegata, Carrière, *Conif.* 31 (1867).

A dense dwarf shrub, with many of the branchlets of a deep golden yellow. Also of Japanese origin.

7. Var. *Pfitzeriana*, Späth, *Catalogue*, No. 104, p. 142 (1899).

A broad pyramidal shrub, with dense horizontal branches, and long and slightly pendulous branchlets, clothed with glaucous foliage. This originated in Späth's nursery at Berlin, where the original plant was 10 ft. high in 1901.

8. Var. *japonica*, Vilmorin, in *Hortus Vilmorin.* 58 (1906).

Juniperus japonica, Carrière, *Conif.* 31 (1855).

¹ *J. Thunbergii*, Hooker and Arnott, *Bot. Beechey's Voyage*, 271 (1841), gathered in the Liu Kiu Islands, is represented at Kew by a specimen with acicular leaves, which bears no fruit. It cannot be identified with certainty; but may be a form of *J. chinensis*.

A diffuse bushy plant, with mostly juvenile acicular foliage in threes; some of the terminal branchlets being covered with adult scale-like leaves, and occasionally bearing fruit.¹

This is a juvenile form of *J. chinensis*, of which the Japanese make dwarf plants, that are frequently imported into Europe. It was erroneously identified by Carrière with *J. procumbens*,² Siebold; and this mistake has been copied by Kent and other writers. Sargent describes,³ as *J. japonica*, a plant of compact habit, with many erect branches and acicular bluish-green needles, which is often cultivated in Japanese gardens, and is very hardy and distinct in appearance. It retains its peculiar compact juvenile habit for several years, but often becomes thin and ragged before it is 12 ft. high, and loses its value as an ornamental plant. Sargent adds that this is one of the most difficult conifers to transplant. Judging from the description, the variety alluded to by Sargent is *J. japonica pyramidalis*, Carrière, *Conif.* 32 (1867), but I have seen no specimen. (A. H.)

DISTRIBUTION

J. chinensis is a native of China, Mongolia, and Japan. In China, it is frequently cultivated in temple grounds; but appears to be truly wild in the mountains of Hupeh, Shensi, and Szechwan, where it is usually found growing solitary on cliffs, but occasionally as underwood⁴ in the forests. Père David⁵ found it abundant on the Moni-ula range of the Ourato territory in south-western Mongolia.

This is a favourite tree in the parks and temples of Peking, where it attains a great age. The largest I saw were at the temple of Confucius, and were said to be over 700 years old. In a double avenue here, one tree on the left-hand side was about 40 ft. by 17 ft.; and another whose trunk was covered with burrs was 14 ft. in girth. At the Ming Tombs there are many very old junipers and fine specimens of arbor vitæ, together with numerous pine trees (*Pinus Bungeana* and *P. funebris*).

In Japan, it is also common in cultivation; but is recognised as a native tree by Japanese botanists⁶ and foresters. Shirasawa states that it is wild in the mountains of the Shinano province in central Hondo, mixed with *Pinus densiflora* and *Quercus serrata*, and forming a tree 30 to 40 ft. in height, with straggling contorted branches and greyish green foliage. It occasionally attains a large size, as Sargent⁷ mentions two venerable trees at the temple of Zenkogi in Nagano,⁸ which are 70 to 80 ft. high with hollow trunks about 6 ft. in diameter. I never saw it wild; but I saw several handsome trees in the ancient temple of Tennoji at Osaka, with fine large round heads, the best with a trunk 10 ft. high and 10 ft. in girth, and with a spread of branches of about 14 yards. One had a very twisted and fluted stem. This species is known to the Japanese as *Bya Kushin*.

¹ This is *J. japonica*, Carrière, and what is cultivated under that name in Veitch's nursery at Coombe Wood.

² *J. procumbens*, Siebold, is a very distinct species. Cf. p. 1422.

³ In *Garden and Forest*, x. 421 (1897).

⁴ Diels, in Engler, *Bot. Jahrb.* xxix. 220 (1901).

⁵ Franchet, *Pl. David.* i. 291 (1884), describes, as var. *pendula*, a form with elongated pendulous branches, found by Père David in Shensi.

⁶ Matsumura, *Index Pl. Jap.* 10 (1905), gives as localities, Kunasiri in the Kuriles, Rebunsiri in Yezo, Hakoda in Nippon, and the Liu Kiu Islands.

⁷ *Forest Flora of Japan*, 78 (1894).

⁸ Shirasawa states "the temple of Keuchoji in the province of Sagami."

This tree was first described in 1767 by Linnæus, who states that it was then cultivated at Upsala. It appears, however, to have been first introduced into England by William Kerr, who sent plants from Canton to Kew in 1804. Next to the Virginian juniper, it is the species now most commonly cultivated in nurseries and private gardens. It is absolutely hardy everywhere, seems quite indifferent to soil, and in many places is a very ornamental shrub or small tree. It ripens seed, which, so far as my observations go, germinate the year after they are sown. The finest trees we have seen are:—At Arley Castle, several old specimens, the largest of which was 48 ft. by 5 ft. 3 in. in 1907; at Eastnor Castle, a well-shaped tree, 48 ft. by 3 ft. which was bearing fruit in 1908; at Hardwicke, near Bury St. Edmunds, a fine tree, 38 ft. by 3 ft. 10 in., with abundant ripe berries in 1905; at Redleaf in Kent, a tree about 35 ft. high in 1907; at Westonbirt, a tree 32 ft. high and growing fast, which in 1909 was covered with fruit. A tree growing at Rood Ashton, Wilts, about 25 ft. high, wide-spreading in habit, was figured in *Gardeners' Chronicle*, xlii. 163, fig. 63 (1907). (H. J. E.)

JUNIPERUS BERMUDIANA

Juniperus bermudiana, Linnæus, *Sp. Pl.* 1039 (1753); Loudon, *Arb. et Frut. Brit.* iv. 2498 (1838); W. J. Hooker, in *London Journ. Bot.* ii. 141, t. 1 (1843); Endlicher, *Syn. Conif.* 29 (1847); Parlato, in De Candolle, *Prod.* xvi. 2, p. 490 (1868) (in part); J. M. Jones, *Botany of Bermuda*, 272 (1873); Hemsley, in *Gard. Chron.* xix. 656, figs. 105, 106 (1883), in *Journ. Bot.* xxi. 259 (1883), and in *Voy. Challenger, Bot.* i. 81, t. 5 (1885); Sargent, in *Garden and Forest*, iv. 289, figs. 51, 52 (1891); Masters, in *Journ. Bot.* xxxvii. 1-11 (1899); Kent, Veitch's *Man. Conif.* 166 (1900).

Juniperus oppositifolia, Moench, *Meth.* 698 (1794).

Juniperus pyramidalis, Salisbury, *Prod.* 397 (1796).

A tree, attaining 50 ft. in height in the Bermudas, with dark red bark and spreading branches. Foliage of two kinds: on adult trees scale-like; ultimate branchlets tetragonal, about $\frac{1}{10}$ in. in diameter, densely covered with imbricated leaves, which are usually in four ranks, about $\frac{1}{2}$ in. long, ovate, obtuse at the narrow incurved apex, greyish green or glaucous on the back, which is usually marked with a longitudinal furrow, entire in margin; on older branchlets, in four ranks or ternate in six ranks, those on the main axes always ternate, up to $\frac{1}{4}$ in. long, and becoming acuminate at the apex. Juvenile foliage, occasionally present on some branches on old trees, in alternate whorls of threes, about $\frac{1}{3}$ in. long, acicular, slightly spreading; upper surface whitened with a raised midrib; lower surface greyish green, very convex, and marked with a longitudinal furrow.

Flowers dioecious.¹ Fruit ripening in the first year, sub-globose, about $\frac{1}{4}$ in. in diameter, dark brown, covered more or less with a bluish bloom, with six to eight scales, each marked by a depression with a minute mucro. Seeds, two to three, immersed in fleshy pulp, shining chestnut brown, ovoid, oblique at the broad base, tapering to the thin-edged apex, with two furrows on the outer surface.

¹ Stewardson Brown, in *Proc. Acad. Nat. Sc. Philadelphia*, lxi. 488 (1909), says that the tree is dioecious: "At the time of flowering in March and April the staminate trees are a golden colour, presenting a strong contrast with the rich blue-green of the pistillate tree." Most authorities say it is monoecious, but specimens with fruit in the British Museum bear no male flowers.

This species is confined¹ to the Bermuda Islands, where it is the only indigenous exogenous tree. It was formerly abundant² on the islands, thriving both on the dry limestone hills and in the brackish swamps. The trees grow to a large size in the salt-water marshes, and have much darker heartwood than those on the hills, but not nearly so durable.³ Large trees are no longer common. Sargent⁴ gives an illustration of one in the churchyard of Devonshire parish, which was about 50 ft. high and 15 ft. in girth, and states that only two larger trees were known to exist. Another illustration shows the habit of this species in the Devonshire marshes. The wood was formerly much used in shipbuilding and in making beautiful furniture. "Cedar" chests and cabinets over two hundred years old are preserved as heirlooms by the descendants of the old Bermuda families, who live in houses finished with this wood, which becomes with age a rich dark colour like mahogany.

The Bermuda juniper was cultivated⁵ in England as early as 1684, but it is not hardy in the climate of London. Knight and Perry⁶ state that it was hardy in their day in Devonshire, and that plants remained uninjured in the open air during the winter of 1849 in Oxfordshire. We have seen, however, no living specimens in England except a shrub at Bicton, about 2 ft. high, which is not thriving, and small plants which were received at Kew⁷ in 1910. Reputed specimens of this species at Castlewellan,⁸ as well as some plants that were formerly cultivated at Kew under the name *J. bermudiana*, turned out to be *Cupressus funebris*.

This species is cultivated in the south of France, Italy, and the Canary Isles. There is a good specimen, which bears fruit regularly, in Dr. Perez' garden at Orotava. Dr. Perez,⁹ as the result of numerous experiments, finds that seeds of this species germinate speedily when immersed in boiling water for three, six, or ten seconds, and at the end of the time are plunged into water at 65° to cool. Longer exposure to boiling water destroys the embryos. (A. H.)

JUNIPERUS VIRGINIANA, PENCIL CEDAR

Juniperus virginiana, Linnæus, *Sp. Pl.* 1039 (1753); Loudon, *Arb. et Frut. Brit.* iv. 2495 (1838); Parlato, in De Candolle, *Prod.* xvi. 2, p. 488 (1868); Sargent, *Silva N. Amer.* x. 93 (in part), t. 524 (1896), and *Trees N. Amer.* 94 (1905); Kent, Veitch's *Man. Conif.* 192 (1900); Mohr, *U.S. Forestry Bull.* No. 31 (1901); Pinchot, *U.S. Forestry Circ.* No. 73 (1907); White, *U.S. Forestry Circ.* No. 102 (1907); Clinton-Baker, *Illust. Conif.* ii. t. 74, fig. 4 (1909).

Juniperus caroliniana, Miller, *Dict.* ed. 8, No. 4 (1768).

Juniperus arborescens, Moench, *Meth.* 699 (1794).

Juniperus fragrans, Salisbury, *Prod.* 397 (1796).

Sabina virginiana, Antoine, *Cupress. Gattung.* 61, tt. 83, 84 (1857).

A tree, attaining in North America 100 ft. in height and 12 ft. in girth, often

¹ Kent states that pieces of its wood were found 50 ft. below low-water mark, during dredging operations undertaken for the construction of a dock.

² J. M. Jones, *Botany of Bermuda*, 272 (1873), states that the trees are becoming extinct, no longer growing in the salt-marshes; but Sargent's later account does not confirm this.

³ A. Haycock, in *Gard. Chron.* xxv. 176 (1899). Capt. L. Clinton-Baker informs us that the best trees in 1911 averaged 40 to 50 ft. in height and 9 ft. in girth.

⁴ *Garden and Forest*, iv. 289, figs. 51, 52 (1891).

⁶ For the early history of this species, see Hemsley's account, cited at the head of this article. ⁶ *Syn. Conif.* 11 (1850).

⁷ A tree in the Temperate House at Kew, which was about thirty years old, was cut down in 1905.

⁸ *List of Plants Hardy at Castlewellan*, 65 (1897). ⁹ In *Gard. Chron.* l. 127 (1911).

with the trunk fluted at the base. Bark, $\frac{1}{4}$ in. thick, reddish brown, shredding off in long strips. Leaves of two kinds: on adult trees scale-like; ultimate branchlets very slender, $\frac{1}{30}$ in. in diameter, clothed with four ranks of leaves in opposite pairs, which are imbricated, appressed but free towards the apex, ovate, acute or acuminate with a short point, $\frac{1}{16}$ in. long, adnate, entire in margin; green and glabrous on the back, which is often marked with a small oval glandular depression. On older branchlets the scale-leaves are broadly ovate, acute, larger, about $\frac{1}{2}$ in. long, and become brown and withered, ultimately disappearing in the fifth or sixth year. Acicular leaves often present on occasional branches of adult trees, spreading in pairs, $\frac{1}{5}$ to $\frac{1}{4}$ in. long, ending in a spine-tipped apex, adnate, swollen at the base, but not jointed; concave and glaucous above; green and convex beneath. The acicular leaves on seedlings and young plants are arranged in alternate whorls of threes.

Flowers usually diœcious, rarely monœcious. Fruit ripening in one year, borne at the ends of short branchlets, which are furnished with ordinary adult scale-leaves; sub-globose, but usually longer than broad, about $\frac{1}{4}$ in. long, bluish, covered with a glaucous bloom, composed of four or six scales. Seeds, one or two, immersed in a resinous flesh, ovoid, broad at the base, tapering towards the apex, smooth, shining chestnut brown, with two indistinct longitudinal furrows, and with or without resin-pits at the base. Seedling¹ with two ligulate cotyledons, which have no resin-canals; primary needles with one resin-canal immediately below the dorsal ridge.

ALLIED SPECIES AND VARIETIES

This species was formerly supposed to spread over the greater part of the North American continent; but the geographical forms of the west and south are now considered by American botanists to be two distinct species.

I. *Juniperus scopulorum*, Sargent, in *Garden and Forest*, x. 420, fig. 54 (1897), *Silva N. Amer.* xiv. 93, t. 739 (1902), and *Trees N. Amer.* 96 (1905).

Juniperus excelsa, Pursh, *Fl. Amer. Sept.* ii. 647 (1814) (not Bieberstein).

Juniperus dealbata, Loudon, in *Gard. Mag.* xvi. 639 (1840), and *Trees and Shrubs*, 1090 (1842) (not Douglas²).

(?) *Juniperus fragrans*, Knight and Perry, *Syn. Conif.* 13 (1850); Carrière, *Conif.* 57 (1855).

Juniperus bacciformis, Carrière, *Conif.* 56 (1855).

Juniperus Henryana, Brown (Camptst.), in *Trans. Bot. Soc. Edin.* ix. 377 (1868), and in *Gard. Chron.* 1873, p. 8.

Juniperus virginiana, Linnæus, var. *scopulorum*, M. E. Jones, in *Bull. Univ. Montana, Biol. Ser.* No. 13, p. 12 (1910).

Sabina scopulorum, Rydberg, *Flora of Colorado*, 10 (1906).

A tree about 40 ft. high and 9 ft. in girth, often divided near the base into several stems. Adult foliage like that of *J. virginiana*, but with a disagreeable pungent smell, and with stouter branchlets and leaves marked on the back by a conspicuous glandular pit. Fruit ripening in the second year, globose, $\frac{1}{4}$ in. in diameter, bright blue covered with a glaucous bloom. Seeds, two, triquetrous, reddish brown, prominently angled, and with one longitudinal groove.

This tree grows on dry rocky ridges and, except near the coast, usually at over

¹ Hill and De Fraine, in *Ann. Bot.* xlii. 696 (1908).

² Gordon, in *Gard. Chron.* 1842, p. 562, states that *J. dealbata*, Douglas, is the same as *J. nana*, Willdenow. Cf. p. 1401, note 1.

5000 feet elevation, from the eastern foothills of the Rocky Mountains from Alberta to Texas, westward to the coast of British Columbia and Washington, and to eastern Oregon, Nevada, and northern Arizona. This species was introduced into England from north-western America in 1839, under the name *J. dealbata*, Loudon; and was erroneously identified with *J. occidentalis*, Hooker, a species that has apparently never been in cultivation in this country. Soon after its introduction, *J. scopulorum* seems to have been known as *J. fragrans*, a name which still exists in nursery catalogues. It is a rare tree; but there is a specimen at Kew, not very thriving and about 15 ft. high, which is labelled *J. occidentalis fragrans*. We obtained in 1911 a fruiting branch from a small plant, named *J. fragrans*, in Dicksons' nursery, Chester. It is cultivated in Germany,¹ at Darmstadt and at Tübingen, where it has borne a temperature of -24° Cent.

II. *Juniperus barbadensis*, Linnæus, *Sp. Pl.* 1039 (1753); Loudon, *Arb. et Frut. Brit.* 2504 (1838); Mohr, *U.S. Forestry Bull.* No. 31, p. 37, plate ii. (1901); Sargent, *Silva N. Amer.* xiv. 89, t. 738 (1902), and *Trees N. Amer.* 95 (1905).

Juniperus virginiana, Linnæus, var. *australis*, Endlicher, *Syn. Conif.* 28 (1847).

Juniperus virginiana barbadensis, Gordon, *Pinetum*, 114 (1858) (in part).

Juniperus bermudiana, Lunan, *Hort. Jamaic.* i. 84 (1814) (not Linnæus).

Sabina barbadensis, Small, *Flora S.E. United States*, 33 (1903).

A tree, attaining 50 ft. in height and 6 ft. in girth; branches and branchlets pendulous. Adult foliage similar to that of *J. virginiana*, but branchlets more slender, and leaves smaller, acuminate, and conspicuously marked on the back by an oblong or linear oil-gland. Flowers diœcious. Fruit ripening in the first year, sub-globose, $\frac{1}{8}$ to $\frac{1}{6}$ in. in diameter, bluish with a glaucous bloom; seeds, one or two, ovoid, pointed, ridged.

This species occurs in inundated coastal river swamps from southern Georgia southward to the Indian River, Florida; and on the west coast of Florida from Charlotte Harbour to the Appalachicola River, often forming thickets under the shade of larger trees. It is often planted in the cities and towns near the coast from Florida to western Louisiana, and is now said to be naturalised on the Gulf Coast. This species also occurs in the West Indies, in San Domingo, the Bahamas, Antigua, St. Lucia,² and the mountains of Jamaica. It appears to be now extinct in Barbadoes.²

The "red cedar" which grows on the northern Bahama Islands is usually referred to this species, but it has lately been separated³ as *Juniperus lucayana*, Britton, on account of its depressed globose and somewhat laterally flattened fruit. Little is left of it on account of its use formerly for construction and in more recent times for making pencils. The juniper of eastern Cuba is closely related to, if not identical with, that of the Bahamas.³

III. *Juniperus Bedfordiana*, Loudon, *Trees and Shrubs*, 1090 (1842).

Juniperus gracilis, Endlicher, *Syn. Conif.* 31 (1847).

Juniperus virginiana, Linnæus, var. *Bedfordiana*, Knight, *Syn. Conif.* 12 (1850); Parlatores, in De Candolle, *Prod.* xvi. 2, p. 489 (1868); Veitch, *Man. Conif.* 284 (1881); Kent, Veitch's *Man. Conif.* 193 (1900).

Juniperus virginiana, Linnæus, var. *gracilis*, Sargent, in *Silva N. Amer.* x. 96, note 1 (1896).

¹ *Mitt. Dent. Dend. Ges.* 1906, p. 37, and 1908, p. 144.

² Cf. Stapf, in *Kew Bull.* 1911, p. 377.

³ Britton and Shafer, *North American Trees*, 121 (1908).

A dense low tree, columnar in habit, with slender elongated pendulous branchlets; leaves bright green, acicular, like the juvenile foliage of *J. virginiana*. This handsome tree was first mentioned by Loudon, who merely states that it closely resembles *J. virginiana*. Its origin is unknown,¹ but it is usually considered to be identical with *J. barbadensis*, and the fact that it is rather tender in England supports this view. As it has only juvenile foliage, and apparently never bears fruit, the question cannot be decided.

IV. Many varieties of *J. virginiana*, which are always propagated by cuttings, have arisen in nurseries, no less than twenty-one varieties being enumerated in the Kew Hand-List. According to Loudon, it varies much when raised from seed, as at White Knights, where there were hundreds of trees in 1838, differing much in appearance. Some were low and spreading, others were tall and fastigate, and some had pendulous branches. The foliage varied much in colour, being light green, dark green, or glaucous. The fruit also differed in size. The most important varieties are:—

1. Var. *pendula*, Knight, *Syn. Conif.* 12 (1850).

This exists in at least three forms:—

(a) Branches spreading, branchlets pendulous, leaves scale-like, bearing staminate flowers.

(b) Var. *pendula viridis*. Branches and branchlets pendulous; leaves scale-like, bright green.

(c) Var. *Chamberlainii*, Knight, *loc. cit.* Branches spreading and reflexed; branchlets pendulous; leaves mostly acicular, of a greyish tint.

2. Var. *pyramidalis*, Carrière, *Conif.* 47 (1867).

Columnar in habit, with either glaucous or bright green foliage.

3. Var. *dumosa*, Carrière, *Conif.* 45 (1855).

A dense rounded shrub, with both acicular and scale-like leaves.

4. Var. *Schottii*, Gordon, *Pinetum*, 157 (1875).

A narrow pyramidal tree, dense in habit, with bright green scale-like leaves.

5. Var. *tripartita*, R. Smith, *ex Gordon*, *Pinetum*, 157 (1875).

A low spreading bush with dense branches, and bright green, usually acicular foliage.

6. Var. *glauca*, Knight, *Syn. Conif.* 12 (1850).

Differs from the type in its beautiful glaucous silvery foliage, which is most pronounced in spring.

7. Var. *Triomphe d'Angers*, Beissner, *Nadelholzkunde*, 127 (1891).

Young branchlets creamy white, contrasting well with the dark bluish-green of the older foliage.

8. There are several variegated varieties, as *alba variegata* and *aurea variegata*, Gordon, *Pinetum*, 157 (1875), which are usually poor in colour.

9. Var. *elegantissima*, Beissner, *Nadelholzkunde*, 128 (1891).

A pyramidal tree, with the tips of the young branchlets golden yellow.

¹ There appears to be no ground for Loudon's statement, *Trees and Shrubs*, 1118 (1842), that it is identical with *J. gossainthana*, Loddiges, as the latter and *J. Bedfordiana* are kept distinct by Knight and Perry, *Syn. Conif.* 11, 12, 13 (1850). Endlicher states that *J. Bedfordiana* is a native of Mexico.

10. The dwarf forms are often like *J. Sabina*, and are hard to distinguish in the absence of fruits, except by the much stronger disagreeable odour of the bruised branchlets of the latter species. (A. H.)

DISTRIBUTION

The distribution of this species, as now limited by Sargent,¹ is as follows:— From southern Nova Scotia and New Brunswick southward, often close to the sea-coast, to Georgia, southern Alabama and Mississippi, westward to the valley of the lower Ottawa river, eastern Dakota, eastern Nebraska, Kansas, Indian Territory, and eastern Texas; not ascending the mountains of New England and New York, nor the high southern Alleghanies; in middle Kentucky and Tennessee and northern Alabama and Mississippi, covering great areas of low rolling limestone hills with nearly pure forests of small bushy trees.

In New England it is very common in the south, rarer in Maine, New Hampshire, and Vermont; but nowhere, so far as I saw, attains the size of old trees in England. Dame and Brooks² give 25 to 40 ft. with a trunk diameter of 8 to 20 in. as the average size, and I saw none larger. It grows here on principally dry, rocky, and exposed hills, but also sometimes in wet ground; and on the abandoned cultivated fields which are so numerous in the hilly and poorer parts of Massachusetts is taking possession of the soil in many places. At Boston I noticed that both in Prof. Sargent's own grounds and in the Arboretum, pencil cedar was coming up freely from seed; and I have no doubt it will be planted largely in suitable localities farther south. The rapidly increasing demand for its useful wood has cleared out the accessible timber already in many districts.

In Canada, it is a comparatively rare tree, and is confined³ to the limestone districts in the St. Lawrence valley and along Lake Ontario to the Niagara peninsula, where considerable areas were covered with it in 1888. All the timber of any value has now been cut here, as it has been in New England generally.

Mohr says that there is hardly any tree in the Eastern States which is so indifferent to soil and climate as the juniper. It thrives in the valley of the St. Lawrence and in New England, often growing on barren hillsides where few trees succeed; on the exposed arid regions of Kansas and Nebraska, in air and climate with great extremes of heat and cold; on the limestone plateaux and hills of the south-western States, and on the deep soil of the coast of Georgia, but not ascending the mountains or descending to the alluvial river bottoms. It attains its maximum development south of lat. 36°, where in Alabama it is sometimes as much as 100 ft. in height, but is much oftener 60 to 70 ft. high, and in the north rarely exceeds 40 to 50 ft. and is often a mere shrub. As a rule it is scattered among other trees and forms a small proportion of the forest; but in the so-called "Cedar Barrens" of Tennessee, it formerly formed an almost pure forest extending over large areas;

¹ Sargent, in *Garden and Forest*, viii. 61, fig. 9 (1895), gives an excellent illustration of a mature tree near Wawa Station, Delaware County, Pennsylvania.

² *Trees of New England*, 27 (1902).

³ Britton and Shafer, *North American Trees*, 117 (1908), state that it also occurs in poor and rocky soil in Nova Scotia and New Brunswick; and there is a specimen in the Kew herbarium from Newfoundland.

and in the rocky hills of the Tennessee valley grows in mixture with ash, maple, and oak, and in the prairies of Alabama, with magnolia, lime, and hickory.

It grows best on a light loamy soil containing lime, and does not come to perfection on clay or sand. It reproduces itself freely from seed, which it bears every year, the berries being a favourite food of many birds, which scatter it widely. The seedlings endure shade, and spread over abandoned farms in New England and in the south; but Mohr says that its habit of reproducing itself from suckers seems to have weakened the vitality of the seed, and that under the best conditions only 15 to 25 per cent of the seed will germinate.

Excellent illustrations are given in Mohr's paper showing the botanical details and the structure of the wood, with a map giving the distribution of both this species and *J. barbadensis*.

CULTIVATION

Though described by Parkinson in 1640, and introduced to England before 1664 by Evelyn,¹ it has never become an abundant tree in England; and was much more generally planted a century ago than it is now. In most old places it may be found in a more or less damaged condition, for though a long-lived tree it is often broken by wind and snow; and it varies so much from seed that it is often mistaken for other species. As, however, it is very hardy, and will grow in almost any kind of dry and well-drained soil, but only to a large size where this is also deep and fertile, it should be planted more generally, and in some parts of the south of England might be tried for the sake of its very valuable timber. It is easily raised from seed,² and grows faster than the common juniper, but it does not produce seed freely in most places; and I am unable to say what part of America seed suitable for English planting is most likely to come from. Though in the northern United States and Canada it is usually a small and scrubby tree as compared with the large size it attains in the south, I can find no evidence that under cultivation this difference is reproduced. Prof. N. E. Hansen of the South Dakota Agricultural College, however, states, in a paper³ on the "Breeding of Cold-Resistant Fruits," that "The red cedar was formerly brought in large quantities from Tennessee, which is well to the south; northern nurserymen have learned that they must cultivate only the northern form of the red cedar to avoid total failure."

It seems to require fairly close planting, as well as pruning, in order to get a clean trunk; but I do not know to what extent it is capable of bearing shade in this climate. Under favourable conditions in America the growth at first is very rapid, trees only twelve years old having attained in Alabama 25 ft. high and 1 ft. in diameter. Up to from seventy to one hundred and twenty years the increase continues good, but after that age the trees often begin to decay, though they may live for several centuries, and attain a diameter at the butt of 2 to 4 ft.

¹ Aiton, *Hort. Kew.* v. 414 (1813).

² Sargent, in *Garden and Forest*, viii. 61 (1895) says that the seeds should be gathered in autumn and then moistened and mixed with sand, and kept in a pit till the following autumn, or the second spring, when they will produce strong plants, 6 to 8 in. high at the end of their second season and ready for transplanting.

³ *Report of Conference on Genetics (Roy. Hort. Soc.)*, 1906, p. 402.

Sargent says¹ that it bears pruning well, and is suitable for formal gardening; but is not good as a hedge plant, as its branches die when they come in contact with those of a neighbouring tree. There is, however, a thick hedge of this species in Barbier's nursery at Orleans, which is said to grow at the rate of a foot per year.

Trees in the American forest are often attacked by two species of *Polyporus*, which cause white rot and red rot of the timber, spoiling it for commercial purposes. These diseases have been described by Schrenk.²

As a rule, this species, like other junipers, is seen in a bushy form, but on good soil it is capable of producing a clean trunk of considerable length, and this would no doubt be more often the case if planted closer and pruned when young. Mr. A. D. Webster assures me that a tree which grew on sandy loam at Esher, had a trunk with a clean and well-rounded stem free from branches, for 33 ft. in length, and when measured by him contained fully 51 cubic ft. of timber.

REMARKABLE TREES

Among the finest specimens I have seen in England the largest is an immense old tree at Pains Hill, close to the cedar figured on Plate 128. It measures 13 ft. 9 in. in girth, with a bole about 5 ft. high, dividing into several stems, more or less broken, but one attains 68 ft. in height. At Woolbeding, in Col. Lascelles' grounds, there is a fine tree 65 ft. by 6 ft. 8 in. in 1906. At Bagshot Park a tree with a clean trunk measured 64 ft. by 7 ft. in 1907. At Sherborne, Dorsetshire, a clean-stemmed tree on the ruins of the old castle, 60 ft. by 7 ft. 3 in., is long past its prime. At Coolhurst, Sussex, there is a symmetrical tree 62 ft. by 7 ft. 3 in., and another, 56 ft. by 4½ ft. with a clean trunk of 25 ft. At Arley Castle,³ a tree in 1910 measured 68 ft. by 4 ft. 10 in. It is supported by a wire, as it was blown over and pulled upright again several years ago. At Raglan Castle, Monmouthshire, inside the ruins there is a fine old tree 53 ft. by 4 ft. 10 in. in 1906. At Wimpole, Cambridgeshire, a very handsome tree with pendulous branchlets was 50 ft. high in 1908.

In Scotland, the tree does not seem to attain so large a size, the best I have seen being one at Moncrieffe, Perthshire, which⁴ was 47 ft. by 6 ft. 10 in. in 1907. Another, at Murthly, in the Tayside walk, which in 1906 was bearing many berries, measured 40 ft. by 3½ ft.

We have seen no large trees in Ireland; but there is a good specimen of var. *glauca* at Hamwood.

The most remarkable trees that I have seen in Europe are two in the grounds of the Trianon, at Versailles, one of which, not more than about 30 ft. high, has immense spreading branches, which cover an area 57 paces round. The other, close to the château, I could not measure, but estimated it to be 75 ft. high. At Colombe, near Metz, there is an avenue of about fifty old trees, 40 to 50 ft. high, with trunks 4 to 5 ft. in girth, growing in an exposed situation.

¹ *Garden and Forest*, x. 142 (1897).

² *U.S. Dept. Agric. Bull.* No. 21 (1900).

³ Woodward, *Hortus Arleyensis*, No. 4 (1907).

⁴ Mentioned by Hunter, *Woods, Forests, and Estates of Perthshire*, 136 (1883), as *Cupressus thyoides viridis*.

In some parts of Germany the tree grows very well, but does not seem to have any economic value, and in Dr. Mayr's¹ opinion is only likely to be useful in the south of Europe.

TIMBER

The timber of the common and of the southern species present no essential difference and are not distinguished in commerce, though at the present time the greater part of that imported to Europe comes from the Southern States, that from Florida produced by *J. barbadensis* being considered the best.

Its great resistance to decay makes it very valuable, and formerly, when commoner, it was largely used in America for fencing, telegraph poles, boat- and house-building. Now, however, trees large enough for such purposes can hardly be found in the north, and the principal use for which it serves is to make the casing of lead-pencils. Mohr states that for this purpose alone 500,000 cubic feet are annually used in the United States, and 75,000 more exported, most of this going to Germany.

At Greenville, Alabama, the logs are cut into pieces of five standard sizes, varying from $\frac{3}{4}$ to $2\frac{1}{4}$ in. thick, which are packed for shipment in square wooden cases. The waste and sawdust from the mills is made into fine shavings, used for protecting furs and woollen goods against moths, and into paper for underlaying carpets.

Cigar-boxes are also made from this wood in Germany; but most of the so-called cedar in which Havana cigars are packed is the wood of *Cedrela odorata*, a very different tree of the West Indies.

Though in former times the wood was commonly used in this country for the finer kinds of joiner's work and interior decoration, under the name of cedar, red cedar, or pencil cedar, yet it has, during the last generation, become so scarce and dear, that its use is almost confined to the making of pencils. The greater part of the logs imported at present are from Jamaica, Alabama, and Georgia; and are usually small and faulty. The few large and clean ones which arrive are worth from 6s. to 8s. per cubic foot, whilst small logs and billets are sold at 2s. to 6s. per cubic foot in London.

The heart-wood is of a pinkish brown, becoming darker with age, and fading on exposure to the sun, and the sap-wood is whitish. It is distinguished by its fragrance, which, however, is fainter than that of Lebanon cedar, Lawson cypress, or camphor wood; and not too strong to use for the panelling or ceilings of living rooms. No wood is better adapted for delicate mouldings or carvings, though it is too soft to be used in any positions exposed to friction or contact with furniture. In some cases the heart-wood of old trees is beautifully variegated and twisted, and such pieces would be of the highest value for cabinetmaking, if procurable; but I have hardly ever seen the waved or curly grain, which is so ornamental in some other conifers, as pitch pine, redwood, or American cypress.

One of the best examples of the use of this wood for ornamental work is in the

¹ *Fremdländ. Wald- u. Parkbäume*, 292 (1906). Cf. Schwappach, in *Zeitschr. Forst- u. Jagdwesen*, xliii. 602 (1911), and in *Mitt. Deut. Dend. Ges.* 1911, p. 11.

library of Lord Llangattock's house, The Hendre, near Monmouth, which was panelled and ceiled by Messrs. Norman and Burt, from the design of Sir Aston Webb. Overmantels of this wood have been taken out of old London houses, where they have been for probably two centuries, and have realised very high prices; and on account of its scent, it was a favourite wood in early Victorian times for lining wardrobes, or for matchboarding bathrooms in country mansions. The roof of the fine old church at Bitton, near Bath, is entirely lined with pencil cedar, which was executed under Canon Ellacombe's direction, with wood purchased from a ship wrecked in the Bristol Channel; and though the odour is not strong enough to be very noticeable, except in damp weather, the effect is very good.

Oil of cedar, for which there is a large demand in the United States, is distilled from sawdust and other refuse of the wood, at Cedar Keys in Florida.¹ The wood contains as much as 4 or 5 per cent of this oil, which is used as a taenifuge. The shoots of *J. virginiana* are sometimes used medicinally in the United States, as a substitute for the true savin, but contain considerably less essential oil.²

(H. J. E.)

JUNIPERUS SABINA, SAVIN

Juniperus Sabina, Linnæus, *Sp. Pl.* 1039 (1753); Loudon, *Arb. et Frut. Brit.* iv. 2499 (1838); Parlatore, in De Candolle, *Prod.* xvi. 2, p. 483 (1868); Bentley and Trimen, *Medicinal Plants*, iv. t. 254 (1880); Mathieu, *Flore Forestière*, 518 (1897); Ascherson and Graebner, *Syn. Mitteleurop. Flora*, i. 251 (1898); Kent, *Veitch's Man. Conif.* 189 (1900); Kirchner and Schröter, *Lebengesch. Blütenfl. Mitteleuropas*, i. 320 (1906).
Sabina officinalis, Garcke, *Fl. Nord- u. Mitteleuropas*, 387 (1858).

A shrub, attaining about 15 ft. in height, with foliage of a strong and disagreeable odour, and bitter to the taste. Leaves of two kinds; on adult shrubs scale-like; ultimate branchlets very slender, tetragonal, $\frac{1}{30}$ in. in diameter, clothed with 4 ranks of leaves in opposite pairs, which are imbricated, appressed, ovate, acute or blunt at the apex, about $\frac{1}{20}$ in. long, adnate in their lower half, entire in margin, rounded on the back, which usually bears an elliptic depressed resin-gland. On older branchlets, the leaves are more elongated, about $\frac{1}{8}$ in. long, acuminate, becoming brown and withered in the third and fourth years. On young plants, and on isolated branches of adult shrubs, the juvenile foliage is acicular, slightly spreading, in opposite pairs, about $\frac{1}{8}$ in. long, acuminate at the apex, adnate and not jointed at the base; upper surface concave, glaucous, and with a prominent midrib; lower surface, green, convex, marked with a longitudinal depressed gland.

Flowers monœcious or diœcious. Fruit ripening in the autumn of the first year or in the following spring, borne on the ends of short scaly recurved branchlets; irregularly globose or ovoid, about $\frac{1}{8}$ in. in diameter, brownish blue, covered with a glaucous bloom, composed of four to six scales, each marked with an obsolete

¹ *Garden and Forest*, ii. 301 (1889).

² Flückiger and Hanbury, *Pharmacographia*, 628 (1879).

micro.¹ Seeds usually two, rarely one or three, immersed in a resinous flesh, ovoid-triquetrous, compressed, narrowed towards the apex, shining brown, with two or three longitudinal furrows, and verrucose on both surfaces towards the summit.

VARIETIES

The Savin, like most species of juniper, is variable in habit in the wild state in Europe, either occurring as a low prostrate shrub with the branches widely extended and lying on the ground, or as a tall upright dense pyramidal shrub, with horizontal or ascending branches. A fastigiate form has also been observed, similar in appearance to the Swedish variety of the common juniper.

The leaves on the adult plant are usually small, scale-like, blunt at the apex, and closely appressed, acicular leaves being not very common in the typical form. The following varieties, differing in foliage, have been described:—

1. Var. *lusitanica*, Ascherson and Graebner, *Syn. Mitteleurop. Flora*, i. 253 (1898).

Juniperus lusitanica, Miller, *Gard. Dict.* ed. 8, No. 111 (1768).

Juniperus sabinoïdes, Grisebach, *Spicil. Fl. Rum.* ii. 352 (1848) (not Nees²).

An upright shrub, with scale-like leaves, which are sharply acuminate at the apex. This variety is common in southern Europe.

2. Var. *tamariscifolia*, Solander, in Aiton, *Hort. Kew.* iii. 414 (1789).

A low spreading shrub, with mostly persistent juvenile acicular foliage; leaves on the ultimate branchlets in opposite pairs, slightly spreading, glandular on the dorsal surface, bright green in tint, about $\frac{1}{8}$ in. long; on the older branchlets, occasionally in whorls of threes. This variety, which has been known in cultivation for at least 200 years, is occasionally met with in the wild state in Europe.

3. Var. *variegata*, Carrière, *Conif.* 36 (1855).

A dwarf shrub, with adult scale-like foliage, the tips of some of the young branchlets being creamy white. This is mentioned by Loudon, and was known over a century ago in gardens. It is often planted in rockeries.

4. Var. *prostrata*, Loudon, *Arb. et Frut. Brit.* iv. 2499 (1838).

Juniperus prostrata, Persoon, *Syn. Pl.* ii. 632 (1807); Kent, Veitch's *Man. Conif.* 183 (1900); Britton and Shafer, *N. Amer. Trees*, 120 (1908).

Juniperus Sabina, var. *procumbens*, Pursh, *Fl. Amer. Sept.* 647 (1814); Jack, in *Bot. Gaz.* xviii. 372 (1893).

Juniperus repens, Nuttall, *Gen. Amer.* ii. 245 (1818).

A depressed, usually procumbent shrub, seldom more than 3 ft. high. Leaves usually of two kinds; the scale-like leaves appressed in four ranks, mucronate at the apex, with a well-marked depressed resin-gland, and similar to those of the type;

¹ The berries are in rare cases open and not coalesced at the summit, the tips of the seeds protruding. This sport is known as var. *gymnosperma*, Schröter, *op. cit.* 333, fig. 176 (1906).

² *J. sabinoïdes*, Nees, in *Linnaea*, xix. 706 (1847), is better known as *J. mexicana*, Sprengel, *Syst.* iii. 909 (1826), and is a native of Texas and Mexico.

the acicular leaves on a few of the branchlets, in opposite pairs, slightly spreading, with a longitudinal depressed gland on the back, about $\frac{1}{6}$ in. long. Fruit, on recurved stalks, light blue and scarcely glaucous, $\frac{1}{4}$ in. in diameter, with one to four seeds.

This, which is the American form¹ of the Savin, is considered by some botanists to be a distinct species. It is distributed from southern Maine to the shores of Hudson Bay, and westward from Newfoundland and northern New England through New York along the shores of the Great Lakes and through northern Minnesota and south Dakota to the eastern slopes of the Rocky Mountains in Alberta, Montana, and Wyoming. The American Savin grows mainly on sandy soil, as on the seashore of the Atlantic coast and on inland dunes and barrens, and thus differs remarkably from the lime-loving savin of Europe.

The American Savin is said to have been first introduced by Loddiges, who called it *J. hudsonica* in his catalogue of 1836. The shrub cultivated as var. *prostrata* is low and prostrate, bearing only acicular very glaucous foliage; leaves in their free part $\frac{1}{6}$ in. long, spreading, the glaucous bloom appearing on the dorsal surface near the base; ventral surface whitened; branchlets of the second and third year bright reddish brown, with persistent needles of the same colour. I have not seen this cultivated shrub in fruit or bearing scale-like leaves; but it has the disagreeable odour of the savin, and in all probability is, as reputed, of American origin. Sargent states² that it is the hardiest and most beautiful of all the prostrate junipers that can be grown in New England gardens.

DISTRIBUTION

The Savin is widely distributed, occurring in central and southern Europe, the Caucasus, and North America. It occurs mainly in Europe in extensive thickets on dry rocky sunny mountain slopes; but is also met with as undergrowth in many pine forests, as those of *Pinus sylvestris* in the Sierra Nevada in Spain, and of *P. leucodermis* in Herzegovina. It grows usually on limestone; but is occasionally seen on other formations. In Europe it is most common in Spain and Portugal, and in the Balkan peninsula. It is widely spread throughout the whole Alpine mountain system, but is rare towards the north, though it is met with in the Bavarian Alps and in a few stations in Switzerland. Its distribution in Russia is remarkable, as it occurs in isolated spots throughout the great plain, reaching as far north as the Baltic coast; but is a mountain plant, as usual elsewhere, in the Crimea and in the southern part of the Ural range. It also occurs in the Caucasus and the mountains of northern Persia; but is not met with in Asia Minor, and is totally absent from northern Africa. Its occurrence in Siberia is attested by Russian botanists; but we have seen no specimens. (A. H.)

The Savin was early introduced into England, as it is mentioned in Turner's *Names of Herbes*, published in 1548.

¹ Rehder, in Bailey, *Cycl. Amer. Hort.* 850 (1900), says that it is sometimes called in America the Waukegan juniper.

² In *Garden and Forest*, x. 421 (1897). Sargent adds that the European savin, if it has ever been tried in gardens in Massachusetts, has probably not proved hardy.

The finest specimen in Britain is probably one growing in the garden of Stourton Court, Stourbridge, the residence of R. Matthews, Esq. This is well figured in *Journ. R. Hort. Soc.* xxxiii. 327 (1908), where it is stated to measure 6 ft. high and $57\frac{1}{2}$ ft. in circumference. The soil is Old Red Sandstone.

The young green shoots of the Savin are used in medicine, and yield a volatile oil, which is officinal and possesses extremely active properties.¹ (H. J. E.)

JUNIPERUS EXCELSA

Juniperus excelsa,² Bieberstein, *Beschr. Länd. Casp.* 204, App. No. 72 (1800), and *Fl. Taur. Cauc.* ii. 425 (1808); Parlatores, in De Candolle, *Prod.* xvi. 2, p. 484 (1868); Boissier, *Fl. Orient.* v. 708 (1881); Siehe, in *Gartenflora*, xlv. 208, t. 26 (1897); Kent, *Veitch's Man. Conif.* 174 (1900).

Juniperus Sabina, Linnæus, var. *taurica*, Pallas, *Fl. Ross.* ii. 15 (1788).

Juniperus Sabina, Linnæus, var. *excelsa*, Georgi, *Besch. Russ. Reichs*, iii. 1358 (1802).

Juniperus foetida, var. *excelsa*, Spach (excl. syn. Amer.), in *Ann. Sc. Nat.* xvi. 297 (1841).

Juniperus polycarpus and *isophyllos*, Koch, in *Linnaea*, xxii. 303, 304 (1849).

Juniperus Olivierii, Carrière, *Conif.* 57 (1855).

Juniperus aegæa, Grisebach, *Veg. der Erde*, 378, 572 (1872).

Sabina excelsa, *polycarpus*, and *isophyllos*, Antoine, *Cupress. Gatt.* 45, 47, 48 (1857).

A tree, occasionally attaining in Asia Minor a height of 70 to 100 ft. Leaves dimorphic in wild specimens; but juvenile foliage is rarely seen on cultivated adult trees of the typical form. Adult foliage; ultimate branchlets very slender, $\frac{1}{30}$ in. or less in diameter; leaves scale-like, closely appressed, in four ranks in opposite decussate pairs, ovate-rhombic, about $\frac{1}{4}$ in. long, acute or obtuse, marked in the middle on the back with a depressed oval or linear gland; leaves on older branchlets, in pairs or in threes, spreading, mucronate, glandular on the back. Juvenile foliage, when present³; leaves acicular, spreading, in opposite pairs, $\frac{1}{8}$ to $\frac{1}{4}$ in. long, concave above with two stomatic bands, marked on the lower surface with a linear gland at the base.

Flowers monœcious or diœcious. Fruit, ripening in the second year, on short scaly stalks, globose, $\frac{1}{8}$ to $\frac{1}{2}$ in. in diameter, smooth, dark purplish brown, covered with a bluish bloom when ripe, composed of four or six scales, each marked by a minute mucro. Seeds, about six in each fruit, oblong, more or less triquetrous, apiculate at the apex.

1. Var. *stricta*, Rollisson, *ex Gordon, Pinetum*, 144 (1875).

A tree, narrowly pyramidal in habit, with glaucous juvenile foliage; leaves acicular, slightly spreading, about $\frac{1}{8}$ in. long including the basal decurrent part, whitened with a stomatic band above, marked with a minute gland near the base on the lower surface.

This originated in Messrs. Rollisson's nursery at Tooting, and appears to be

¹ Cf. Flückiger and Hanbury, *Pharmacographia*, 628 (1879).

² *J. excelsa*, Loudon, *Arb. et Frut. Brit.* iv. 2503 (1838), includes a mixture of junipers from Siberia, the Himalayas, and North America, and does not appear to refer to the true plant from Asia Minor.

³ Described from a native specimen collected by Haussknecht.

perfectly hardy, retaining its characters in old age. There are three trees at Kew, 25 to 30 ft. high, which were obtained from Rollisson in 1868.

Var. *Perkinsii* and var. *venusta*, Gordon, *Pinetum*, 144 (1875), are similar to var. *stricta*, only differing in the more glaucous leaves. A specimen of var. *Perkinsii* at Kew is almost columnar in habit.

J. excelsa is a native of the Balkan States, Island of Thasos,¹ Crimea, Asia Minor, Syria, Armenia, and the Caucasus. In Thrace, Macedonia, and the Rhodope mountains of Rumelia it is, according to Adamovic,² a shrub rather than a tree, ascending occasionally to 4000 ft. It is recorded for one station in Bulgaria, near the village of Beli Iskar. Köppen³ states that in the Crimea it is common on the coast side of the mountains, forming pure woods of considerable extent; but never attaining a large size, the tallest tree noted being about 30 ft.

J. excelsa appears to attain its greatest development in Asia Minor, where it forms extensive woods in the mountains, either pure or mixed with Lebanon Cedar and *Abies cilicica*. Siehe⁴ gives an illustration of a tree in the Cilician Taurus, nearly 100 ft. high, and states that it assumes two forms, being either a tall narrow pyramidal tree, or a shorter tree with wide-spreading branches; occasionally with a trunk $4\frac{1}{2}$ ft. in diameter. There are very fine woods at Namrun, Efrenk, and Güllek in Cilicia, where the trees are tall, slender, and dense upon the ground. Siehe considers that the timber will prove of great value for railway sleepers. The Turkish name of the tree is *arytsch*.

The date of introduction is uncertain, as Loudon's account of *J. excelsa* does not relate to this species; but it was probably brought into England about 1836. It usually forms a narrow columnar or pyramidal tree. A tree at Arley Castle, said to have been planted in 1877, measured⁵ 32 ft. by 3 ft. 1 in. in 1904. Another at High Canons, Herts, was 32 ft. by $2\frac{1}{2}$ ft. in 1908. There are trees of similar size in the botanic gardens at Kew and Cambridge. We have also seen good specimens at Hardwicke, Tortworth, Westonbirt, Highnam, and Eastnor. In Ireland there are trees at Glasnevin and Powerscourt.

J. excelsa has been much confused with the two following species, which are not apparently in cultivation. These are remarkably distinct from *J. excelsa* both in foliage and fruit.

1. *Juniperus macropoda*, Boissier, *Flora Orientalis*, v. 709 (1881).

A tree, occasionally attaining 70 ft. in height, but often shrub-like, which is a native of Persia, Afghanistan, and Baluchistan, where it forms extensive open forests, east of Quetta.⁶

This has much coarser foliage than *J. excelsa*, resembling that of *J. chinensis*. Fruit globose, $\frac{1}{8}$ in. in diameter, brownish purple, tinged with a glaucous bloom, each of the four to six scales with a prominent mucro. Seeds, two to four, ovoid.

¹ It is not recorded for any of the islands in the Ægean Archipelago except Thasos, where it grows in the pine woods on the coast. Cf. Grisebach, *Veg. der Erde*, 378, 572 (1872).

² *Veget. Balkanländer*, 152 (1909).

³ *Holzgewächse Europ. Russlands*, ii. 423 (1889).

⁴ In *Gartenflora*, xlv. 208, t. 26 (1897), and in *Mitt. Dent. Dent. Ges.* 1911, p. 306.

⁵ Woodward, *Hortus Arleyensis*, 19 (1907).

⁶ Cf. Lace, in *Journ. Linn. Soc. (Bot.)* xxviii. 307 (1891). Gamble, *Indian Timbers*, 698 (1902), gives also some particulars concerning this tree, which he considers to be identical with the Himalayan *J. religiosa*.

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II. *Juniperus religiosa*, Carrière, *Conif.* 41 (1855) (not Royle¹).

Juniperus gossainthanea,² Loddiges, *Catalogue*, 48 (1836); Loudon, *Trees and Shrubs*, 1090 (1842).

Juniperus chinensis, Parlatore, in De Candolle, *Prod.* xvi. 2, p. 488 (1868 (in part) (not Linnaeus)).

Juniperus excelsa, Brandis, *Forest Flora, N.W. India*, 538, t. 68 (1874) (not Bieberstein).

Juniperus macropoda, Hooker, *Fl. Brit. India*, v. 647 (1888) (not Boissier).

A tree, occurring in the inner dry ranges of the north-western Himalayas from Chitral and Kashmir to Nepal, at 5000 to 10,000 ft. altitude. It often attains 50 ft. in height, with a girth of 6 or 7 ft.; but occasionally trees of enormous girth are met with, one at Lahoul measuring $33\frac{1}{2}$ ft. in circumference.

This species has foliage similar to that of *J. macropoda* and *J. chinensis*. Fruit obovoid, widest at the apex, which is depressed, $\frac{1}{4}$ in. in diameter, bluish black with a soft juicy pulp. Seeds, one to three, ovoid, sharp-pointed, with large resin-glands.

(A. H.)

¹ *J. religiosa*, Carrière, the first published name with a description, should be adopted for this species. *J. religiosa*, Royle, *Illustr. Himal.* i. 351 (1839), without any description, is possibly *J. squamata*. Cf. p. 1420, note 4.

² This name was published without any description, and, moreover, is somewhat doubtful. Cf. p. 1438, note 1.

ATHROTAXIS

Athrotaxis,¹ Don, in *Trans. Linn. Soc.* xviii. 172, tt. 13, 14 (1839); Bentham et Hooker, *Gen. Pl.* iii. 430 (1880); Masters, in *Journ. Linn. Soc. (Bot.)* xxx. 21 (1893).

EVERGREEN trees belonging to the division Taxodineæ of the order Coniferae. Leaves persistent for several years, spirally arranged, homomorphic, crowded, imbricate, spreading or closely appressed, adnate at the base, free at the apex; without scaly buds.

Flowers monœcious, solitary at the apices of the branchlets. Staminate flowers catkin-like, with crowded stamens spirally arranged on an axis; each stamen with a slender stalk and a sagittate connective, which bears two pollen sacs dehiscing longitudinally. Ovuliferous flowers, of ten to twenty-five spirally arranged scales; each scale with an adnate fleshy disc, bearing three to six ovules. Cones ripening in one year; scales, ten to twenty-five, woody, spirally arranged, cuneate and narrow at the base, horizontally spreading, dilated into a clavate or peltate lamina, which bears on the back or at the apex a triangular cuspidate process.² Seeds, three to six, pendulous from the thickened part of the scale below the apex; oblong, compressed, with a transverse hilum and two lateral wings. Cotyledons two, longer than the primary leaves.³

Athrotaxis is closely related to *Cryptomeria*; and Kent states that rooted cuttings of *Cryptomeria elegans* are used as stocks for grafting scions taken from the different species of Athrotaxis.

Fossil remains found in various deposits in Europe have been identified, but perhaps erroneously, with Athrotaxis. C. Reid⁴ has lately shown that the remains in the Bovey Tracey lignites belong to *Sequoia Couttsiae*, Heer, and not to Athrotaxis, as had been supposed by Starkie Gardner.

This genus is confined in the living state to Tasmania, where there are three species⁵ distinguishable as follows:—

¹ Derived from ἀθρός, crowded, and τάξις, arrangement. Endlicher, *Gen. Suppl.* i. 1372 (1841), and *Syn. Conif.* 193 (1847), gives the erroneous spelling *Arthrotaxis*, which has been followed by several writers.

² This process is the extremity of the scale in the flowering stage, which has coalesced almost completely with the ovuliferous disc, the latter having increased much in size during the ripening of the ovules into seed.

³ Masters, in *Journ. Linn. Soc. (Bot.)* xxvii. 235, 237 (1890).

⁴ In *Phil. Trans.* series B, vol. 201, p. 171, pl. 15, figs. 40, 41 (1910), where the distinctive characters of the epidermis of the leaves of *Sequoia* and *Athrotaxis* are made plain.

⁵ *Athrotaxis* (?) *tetragona*, W. J. Hooker, *Icon. Plant.* t. 560 (1843) belongs to a distinct genus, and is *Microcachrys tetragona*, J. D. Hooker, in *London Journ. Bot.* iv. 149 (1845). This is a low rambling shrub, also a native of Tasmania. It is occasionally cultivated in conservatories.

I. Leaves spreading, entire in margin, with two continuous white stomatic bands on the ventral surface, and two lateral stomatic depressions confined to near the base on the dorsal surface.

1. *Athrotaxis selaginoides*, Don.

Leaves very spreading, $\frac{1}{2}$ in. long, with a rigid spine-like acuminate apex, and an opaque margin.

2. *Athrotaxis laxifolia*, W. J. Hooker.

Leaves slightly spreading, $\frac{1}{4}$ in. long, obtuse or acute at the apex, and with a translucent margin.

II. Leaves closely appressed, scale-like and apparently in four ranks like Cupressus, but really spirally arranged; margin translucent and denticulate; ventral surface concealed; dorsal surface with indistinct stomatic lines.

3. *Athrotaxis cupressoides*, Don.

Leaves rhombic-ovate, obtuse at the apex, $\frac{1}{8}$ in. long. (A. H.)

ATHROTAXIS SELAGINOIDES

Athrotaxis selaginoides, Don, in *Trans. Linn. Soc.* xviii. 172, t. 14 (1839); W. J. Hooker, *Icon. Plant.* t. 574 (1843); J. D. Hooker, in *Lond. Journ. Bot.* iv. 148 (1845), and *Fl. Tasman.* i. 354 (1860); Masters, in *Gard. Chron.* ii. 724, figs. 140, 141 (1887), and iv. 544, fig. 79 (1888); Kent, Veitch's *Man. Conif.* 262 (1900); Rodway, *Tasmanian Flora*, 277 (1903); Baker and Smith, *Pines of Australia*, 303, plates on pp. 304, 305, figs. 217-228 (1910).

Athrotaxis Gunneana, Carrière, *Conif.* 207 (1867).

Athrotaxis Gunniana, Gordon, *Pinetum*, 47 (1875).

Cunninghamia selaginoides, Zuccarini, in Siebold, *Fl. Jap.* ii. 9, note (1844).

A tree, attaining a larger size than the other two species, up to 100 feet in height and 10 feet in girth. Bark described by Baker and Smith, as slightly furrowed and fibrous, but not very rough. Branchlets stout, entirely covered by the decurrent bases of the leaves. Leaves spirally arranged, loosely imbricated, widely spreading but incurved at the apex, rigid, coriaceous, about $\frac{1}{2}$ in. long, subulate, adnate but not jointed at the base, tapering to an acuminate spine-like apex; dorsal surface keeled with two lateral depressions near the base, which are whitened by stomatic lines; ventral surface concave, with two longitudinal white stomatic bands from the apex to the base separated by a green midrib; margin entire, opaque.

Cones ovoid or globose, about 1 in. in diameter, composed of 20 to 24 brown woody scales, which are about $\frac{1}{2}$ in. long, with a narrow cuneate base, and an oval or ovate expanded inflexed lamina, which terminates in a triangular thin process.

The species, which is known in Tasmania as King William Pine, is said by Rodway to occur in the western mountains, extending from Mount Field, Mount Hartz, Adamson Peak, and Mount La Perouse to the west coast. Baker and Smith state that it is common in the immediate neighbourhood of Williamsford,

at about 1000 ft. above sea-level. It is a prominent tree in the dense scrub which covers this locality, being associated with *Phyllocladus rhomboidalis*, *Nothofagus Cunninghami*, &c. These authors figure an old tree, said to be typical in habit, which shows a twisted stem, free of branches for three quarters of its height, and surmounted by a small irregular dense crown of foliage. *A. selaginoides* ascends to 3000 ft. or more, as it occurs on the summit of Mt. Reed and other mountains, usually in a much dwarfed and stunted form.

Baker and Smith, who give excellent figures of the structure of the leaves and wood, state that the wood is not unlike that of *Sequoia sempervirens*, both in general characters and in texture, being open and straight in the grain, easy to work, and very light in weight. It is pale reddish when freshly cut, but becomes lighter in colour on exposure. Possessing great durability, and considerable toughness and strength, it is used in Tasmania for cabinet-work, coach-building, and for making oars. Penny¹ states that it occurs in limited quantities; and is apparently never exported.

This species was introduced about the year 1857 by Mr. W. Archer of Cheshunt; but appears to be less common in cultivation than *A. laxifolia*. A thriving specimen at Osborne, Isle of Wight, planted in 1879, was 17 $\frac{1}{2}$ feet high in January 1912, when it bore both young and old cones. A tree at Lamellen, St. Tudy, Cornwall, which was 26 ft. high, died in 1909. From it Mr. Magor raised a few seedlings, which are still small plants. A specimen at Abbotsbury was killed by drought in the summer of 1911. The finest specimen is at Kilmacurragh, in Ireland, and measured 32 ft. high in March 1912, when it was bearing numerous old cones. A smaller tree is thriving at Rostrevor. (A. H.)

ATHROTAXIS LAXIFOLIA

Athrotaxis laxifolia, W. J. Hooker, *Icon. Plant.* t. 573 (1843); J. D. Hooker, in *Lond. Journ. Bot.* iv. 149 (1845), and *Fl. Tasman.* i. 354 (1860); Masters, in *Gard. Chron.* xxiv. 584, fig. 134 (1885), ii. 724, figs. 142, 143 (1887), and ix. 144, 147, figs. 37, 38 (1891), and in *Journ. Linn. Soc. (Bot.)* xxii. 201, fig. 26 (1886); Kent, Veitch's *Man. Conif.* 261 (1900); Rodway, *Tasmanian Flora*, 277 (1903); Baker and Smith, *Pines of Australia*, 313 (1910).
Athrotaxis Doniana, Maule, ex Gordon, *Pinet. Suppl.* 16 (1862).

A tree, attaining about 40 ft. in height. Bark reddish, fibrous, peeling off in long vertical ribbons. Branchlets slender, covered by the decurrent bases of the leaves. Leaves spirally arranged, closely imbricated, slightly spreading, about $\frac{1}{4}$ in. long; incurved at the acute or obtuse, rarely mucronate, apex; dorsal surface keeled, with two lateral depressions near the base, which are whitened by stomatic lines; ventral surface concave, with two longitudinal white stomatic bands; margin entire, thin and translucent towards the apex.

Cones sub-globose, $\frac{3}{4}$ in. in diameter, composed of 15 to 20 brown woody scales,

¹ *Tasmanian Forestry*, xi. 42 (1905). Penny quotes A. O. Green's tests of various Tasmanian timbers. This species is one of the lightest, a cubic foot weighing only 22 lbs.

which are about $\frac{3}{8}$ in. long, with a slender cuneate claw, and a thickened oval expanded lamina, bearing on the back a large ovate acute process.

This species was found by Gunn and Archer at the falls of the Meander river, and along rivulets near the summit of the western mountains in Tasmania; and is said by Rodway to occur on Field Range and near Mount La Perouse. It appears to occur at higher altitudes than the other species, reaching 4000 ft.

A. laxifolia was also introduced by Archer in 1857, and appears to be the most successful of the three species in cultivation in this country. The largest specimens are in Cornwall, where Elwes measured in 1911 a fine tree at Scorrier, 38 ft. high and 3 ft. 9 in. in girth; from it three seedlings were raised about twenty years ago, which are now 15 to 20 ft. high. Another fine specimen at Penjerrick was 32 ft. by 2 ft. 8 in. in the same year. One in Mr. R. Gill's nursery at Tremough near Penryn, measured 27 ft. high, and was bearing fruit in January 1912. Another, 17 ft. high, occurs at Trewidden near Penzance.

There is also a good tree at Menabilly, growing at 100 feet above sea-level in an exposed position, which was planted in 1880, and reported to be a perfect pyramid, 12 ft. high in 1891; it was 27 ft. high and 3 ft. in girth in January 1912. A branch of this tree with cones was figured¹ by Dr. Masters.

This species appears to be very hardy, and succeeds as far north as Durris in Kincardineshire, where a tree about 10 ft. high produced cones in 1909, from which numerous seedlings were raised; some of these have been planted out at Bayfordbury and in the Cambridge Botanic Garden.

In Ireland, there is a fine specimen at Kilmacurragh, 28 ft. high in 1912; and a smaller one at Castlewellan. (A. H.)

ATHROTAXIS CUPRESSOIDES

Athrotaxis cupressoides, Don, in *Trans. Linn. Soc.* xviii. 173, t. 13, fig. 2 (1839); W. J. Hooker, *Icon. Plant.* t. 559 (1843); J. D. Hooker in *Lond. Journ. Bot.* iv. 148 (1845), and *Fl. Tasman.* i. 354 (1860); Masters, in *Gard. Chron.* xxiv. 270, fig. 60 (1885), and ii. 725, figs. 144, 145 (1887); Kent, Veitch's *Man. Conif.* 261 (1900); Rodway, *Tasmanian Flora*, 277 (1903); Baker and Smith, *Pines of Australia*, 313 (1910).
Cunninghamia cupressoides, Zuccarini, in Siebold, *Fl. Jap.* ii. 9, note (1844).

A tree, attaining 40 ft. in height and 6 feet in girth, with ascending branches. Branchlets pseudo-opposite or alternate, densely covered with scale-like leaves, which appear to be in opposite decussate pairs, but in reality are in a spiral arrangement. Leaves on the ultimate branchlets, similar to those in *Cupressus*, homomorphic, densely appressed, closely imbricated, rhombic-ovate, about $\frac{1}{8}$ in. long, obtuse at the apex; ventral surface entirely concealed; dorsal surface keeled and marked with white stomatic dots in lines on the two sides; margin denticulate

¹ *Gard. Chron.* xxiv. 584, fig. 134 (1885) and *Journ. Linn. Soc. (Bot.)* xxii. 201, fig. 26 (1886). In *Gard. Chron.* xxiv. 660 (1885), it is stated that a tree produced cones in 1875 in Mr. Robert Loder's garden at Whittlebury, Towcester; but this cannot now be found and was probably cut down some years ago.

and translucent. Leaves on the older branchlets increasing in size, becoming dark brown and about $\frac{1}{2}$ in. long in the fifth or sixth year.

Cones, nodding on curved branchlets, $\frac{2}{3}$ in. in diameter; scales 10 or 12, much smaller than in the other species, less than $\frac{1}{4}$ in. long, with a triangular recurved process on the middle of the expanded lamina.

This species is said by Rodway to be a small erect tree, about 40 ft. high, found in the western mountains of Tasmania, near St. Clair and to the west and south-west of Field Range. It rarely exceeds 5 or 6 feet in girth; but Sir J. Hooker mentions one very old and hollow tree, which was 15 ft. in girth at $3\frac{1}{2}$ feet from the ground. Baker and Smith state that the timber resembles in all respects that of *A. selaginoides*.

It was introduced in 1857 by Mr. Archer at the same time as the other species, and resembles them in cultivation; but it is rare and has not attained in this country as great a height as *A. laxifolia*. In Cornwall, a tree 20 ft. high was bearing cones in Gill's nursery, near Penryn, in January 1912; and a smaller specimen, also bearing fruit, occurs at Trewidden. Kent mentioned in 1900 a fine specimen at Upcott, near Barnstaple; which, Mr. W. Harris informs us, has lately lost its leader and is now only 13 ft. high. In Hillier's nursery at Shroner, near Winchester, a tree, planted in 1887, was 12 ft. high in 1910, and had commenced to bear cones in small quantity. There is also a small specimen at Brickendon Grange, Hertford, which was 5 ft. high in 1911.

In Ireland, a fine specimen bearing fruit at Kilmacurragh was 21 ft. high in March 1912; while another at Powerscourt¹ was 22 ft. high. A thriving tree at Castlewellan, 15 ft. high, bore 18° of frost without injury in February 1912. (A. H.)

¹ Erroneously called *A. Doniana* in *Gard. Chron.* xlix. 219 (1911).

FITZROYA

Fitzroya, J. D. Hooker, ex Lindley, in *Journ. Hort. Soc. Lond.*, vi. 264 (1851), and ex W. J. Hooker, *Bot. Mag.* t. 4616 (1851); Bentham et Hooker, *Gen. Pl.* iii. 425 (excl. *Diselma*) (1880); Masters, in *Journ. Linn. Soc. (Bot.)* xxx. 17 (1893).

A GENUS belonging to the division Cupressineæ of the order Coniferæ, characterised by the cones, composed of nine scales, in three alternating whorls, the three lowermost scales minute and sterile; those of the intermediate whorl larger, and either empty or each bearing a single two-winged seed; the three upper scales largest and fertile, each bearing two to six seeds, which are partly three- and partly two-winged. The apex of the axis of the cone terminates in three peculiar processes,¹ the precise morphological nature of which is unknown, but possibly they may represent an aborted whorl of scales. Only one species is known, in the description of which below, the vegetative and other characters of the genus are given in detail.

Diselma, a genus founded by Sir J. D. Hooker,² was united by Bentham and Hooker³ with *Fitzroya*, but appears to be sufficiently distinct. In *Diselma*, the cones are composed of two pairs of opposite scales, the outer pair small and empty, the inner two scales larger and fertile, each with two seeds, which are three-winged. *Diselma Archeri*, J. D. Hooker, *Fl. Tasman.* i. 353, t. 98 (1860), the only known species, differs greatly from *Fitzroya* in habit, having minute scale-like appressed leaves, like those of a *Cupressus*, in opposite decussate pairs; and is a shrub⁴ about 6 ft. high, growing between 3000 and 4500 feet elevation in the western mountains of Tasmania. *D. Archeri* was formerly represented in the Temperate House at Kew by a single specimen, which is no longer living. At present it is apparently not in cultivation in England. (A. H.)

FITZROYA PATAGONICA

Fitzroya patagonica, J. D. Hooker, ex Lindley in *Journ. Hort. Soc. Lond.* vi. 264 (1851), and ex W. J. Hooker, *Bot. Mag.* t. 4616 (1851); Lindley, in Paxton, *Flower Garden*, ii. 115 (1852); Kent, Veitch's *Man. Conif.* 198 (1900); Castillo and Dey, *Jeog. Vej. Rio. Valdivia*, 27, fig. 8 (1908).

An evergreen tree, attaining in Chile 100 to 160 ft. in height, and 10 to 16 ft. in girth; but dwarfed to a low shrub at high elevations. Bark reddish, longitudinally fissured, and peeling off in narrow ribbons. Young branchlets green,

¹ These gland-like processes secrete resin and exhale a slight fragrant odour.

² *Fl. Tasman.* i. 353, t. 98 (1860).

³ *Gen. Plant.* iii. 425 (1880).

⁴ Cf. Baker and Smith, *Pines of Australia*, 300 (1910).

glabrous, flexile, slender, covered by the decurrent bases of the leaves, which are separated between the whorls by three linear grooves. Older branchlets until the seventh year, stouter, reddish, marked by withered leaves and their remains. Buds ovoid or globose, composed of green scales, which are slightly modified and shortened ordinary leaves. Leaves persistent for several years, in alternating whorls of threes, decurrent by their bases on the branchlets; their free part spreading, spatulate, incurved at the rounded apiculate apex, about $\frac{1}{8}$ in. long; upper surface concave, with two narrow white stomatic depressions extending from the apex to the middle of the leaf or beyond, and separated by a raised green midrib; lower surface convex, with a broad green raised midrib, on each side of which is a narrow white stomatic depression often extending from near the apex to the adnate base of the leaf. On the main axes, the leaves are often $\frac{1}{2}$ in. long, adnate in greater part to the branchlet, and becoming reddish brown in the third and fourth years.

Flowers¹ usually dioecious; sometimes monoecious or hermaphrodite. Staminate flowers solitary in the axils of the leaves towards the apex of the branchlet, cylindrical, subtended at the base by a few scales, composed of 15 to 24 stamens in ternate whorls; anthers 4-celled. Ovuliferous flowers, solitary and sessile on the ends of short leafy branchlets near the apex of a branch, composed of nine scales, in three alternating whorls; the three lowermost scales minute and sterile; the three scales of the intermediate whorl either empty or each bearing a single two-winged ovule; the uppermost three scales always fertile, each bearing a central three-winged ovule and one to five lateral two-winged ovules; oblong tubercles at the summit of the axis of the cone, three, yellowish, translucent, about $\frac{1}{8}$ in. long. Cones, scarcely larger when mature than in the flowering stage, sub-globose when closed and about $\frac{1}{3}$ in. in diameter, ripening in one year, with three minute scales at the base of the six large woody scales, each of the latter with a dorsal process, spreading widely to let loose the seeds, which are variable (nine to sixteen) in number (equalling the number of ovules in the flower). Seed with an oblong compressed body and two or three broad lateral membranous wings; the seed with the wings nearly orbicular and about $\frac{1}{6}$ to $\frac{1}{5}$ in. in diameter. Cotyledons two.

This species is a native of South America, occurring in Chile and northern Patagonia. It extends from the coast range immediately north of Valdivia southward to the island of Chiloe and the mainland opposite in about lat. 42° 40', and reaches inland to the central cordillera of the Andes. It is known to the inhabitants as *alerce*,² and covers immense tracts of marshy and peaty ground with extensive woods, which are called *alerzales*. These woods are widely distributed, the best known being in the coast range of Valdivia, around Lakes Llanquihue and Nahuelhuapi, in the neighbourhood of Puerto Montt, and in the valley of the river Maullin.³

¹ The flowers of *Fitzroya*, which are complicated and variable, are being investigated at Cambridge by Mr. R. C. Maclean. Monoecious flowers occur in Chilean specimens, as well as on the tree at Hewell Grange. The hermaphrodite flowers of the latter have several whorls of scales; the scales in the three lowermost whorls bear anthers, those in the upper two whorls bear ovules; the axis ends in the normal three gland-like processes.

² *Alerce* is used in Spain as the name of the larch; and is derived from the Arabic, *al-arzah*, signifying cedar.

³ Cf. Reiche, *Verbreit. Chilen. Conif.* 5 (1900), and *Pflanzenverb. Chile*, 63, 238 (1907).

Castillo and Dey¹ state that enormous trees still occur, up to 160 ft. in height and 16 ft. in girth; and mention veterans, which are said when felled to have shown 4000 annual rings; but this seems scarcely credible. Captain Fitzroy² in whose honour the genus was named, and who commanded the "Beagle" between 1828 and 1836, states on good authority, that a tree in the cordillera on the mainland opposite Chiloe had a stem measuring 76 ft. in length to the first branch, and 30 ft. in girth at five feet from the ground. It yielded 1500 planks. W. Lobb saw on the precipices around Valdivia trees 100 ft. in height and 8 ft. in diameter; and states³ that it ascends the mountains to the limit of perpetual snow, where it is occasionally only a few inches high.

Fitzroya patagonica was first introduced⁴ in 1849 by W. Lobb, who sent home seeds from Valdivia; and again by R. Pearce, who collected in Chile for Messrs. Veitch in 1859-1862. It is perfectly hardy in this country, and at Kew⁵ bore without injury the severe frost of 1908-1909, when the temperature fell to 10° Fahr.; nevertheless, it is slow in growth, and seems to develop oftener into a bushy shrub than a tree, but this may be due to most of the specimens in cultivation being derived from cuttings.

The finest trees are in Cornwall and Devon. One at Killerton, planted in 1864, was 34½ ft. by 3 ft. 2 in. in 1911. Another at Bicton was 35 ft. high in the same year. An ill-shaped tree at Penjerrick, dividing into several stems at the base, was about 35 ft. high in 1910. At Coldrenick a similar tree with several stems was 25 ft. high in 1911. Masters figured⁶ a tree at Pencarrow, planted in 1852 by Sir W. Molesworth, which was reported in 1902 to have been 21 ft. in height, with a spread of branches of 46 ft. At Abbotsbury, a tree was killed by drought in the summer of 1911. At Upcott, Barnstaple, a well-grown and healthy specimen was 28½ ft. high in January 1912. There are smaller trees at Highnam near Gloucester, and at Leaton Knolls, Shrewsbury. In the pinetum at Uplyme, Dorset, there is a fine tree, 30 ft. by 3 ft. 3 in. in 1912.

At Belsay Castle, Newcastle-on-Tyne, there is a fine specimen, which was planted about 1856, and measured 28½ ft. high in January 1912. Sir Arthur E. Middleton, Bart., informs me that it is growing in a sheltered place in an old sandstone quarry, where the soil contains a considerable admixture of clay. This tree has been kept from an early date to one leader; otherwise it would have spread in an irregular way. There are also several bushy specimens at Belsay Castle, where this species has never been touched in the slightest degree by frost.

Nearly all the cultivated trees which we have seen bear only female flowers, and in consequence the seed, which is freely produced, is infertile. A tree, however, at Hewell Grange, Redditch, which is about 28 ft. high, is monœcious, and bore in May 1912 both male and female flowers in profusion, as well as a few which were hermaphrodite.

¹ *Jesq. Veg. Rio Valdivia*, 28 (Santiago, 1908). Reiche gives the maximum as 180 ft. high, 16 ft. in diameter, and 2500 years old.

² *Narrative of Voyages of the Beagle*, i. 275, 282, and ii. 391 (1839). Cf. also Cook, in Loudon, *Gard. Mag.* xv. 694 (1839).

⁴ *Hortus Veitchii*, 38, 46, 340 (1906).

⁶ *Gard. Chron.* xxxi. 392, Supply. Illust. (1902).

³ *Journ. Hort. Soc.* vi. 262 (1851).

⁵ *Kew Bull.* 1909, p. 235.

The only specimen that we know of in Scotland is one at Ardgowan, which was about 25 ft. high in 1909. A tree at Murthly, recorded at the Conifer Conference as 16 ft. high and 30 years old in 1891, was killed in the severe winter of 1893-1894, when the thermometer registered at Murthly 11° Fahr. below zero.

In Ireland a tree at Powerscourt was 30 ft. high in 1910; and another at Fota was 25 ft. high in 1912. There are also good specimens at Kilmacurragh, Rostrevor, and Castlewellan.¹ (A. H.)

TIMBER

The wood is very valuable; and is remarkable for the extraordinary straightness of the grain, which makes it very easy to rend into thin boards. These are used as shingles for roofing, which after exposure to the weather turn blue and resemble slates; and also for floors and partitions. Castillo and Dey state that it is very durable in contact with water, is unaffected by heat or humidity, and has lasted in roofs without alteration for over 100 years. Captain Fitzroy² says that "it does not shrink or warp; and, though brittle, is of very close grain and well adapted for furniture. Of this wood, the country people make staves for casks; and the bark of the tree is used for caulking the seams of vessels, being extremely durable when constantly wet, though it soon decays when exposed to the sun and air." Spars of alerce, which proved to be very strong, were obtainable 80 or 90 ft. in length. I saw mule-loads of these shingles 8 ft. long and very thin, on my journey from Nahuelhuapi to Puerto Montt, and very large stumps of trees in the country near that port; but I was unable to visit the forest where it grows. The wood is apparently still unknown in Europe; but I bought three boards in London imported from Chile, which are of a rich reddish colour with very fine and close grain. (H. J. E.)

¹ Figured by Earl Annesley, *Beautiful and Rare Trees*, t. 68 (1903), who states that this species should be planted in deep loam and peat, as it is a deep-rooting tree which grows slowly till it is well established.

² *Narrative of Voyages of the Beagle*, i. 275, 282, and ii. 391 (1839). Cf. also Cook, in Loudon, *Gard. Mag.* xv. 694 (1839).

SAXEGOTHÆA

Saxegothæa, Lindley, in *Journ. Hort. Soc. Lond.* vi. 258 (1851); Bentham et Hooker, *Gen. Pl.* iii. 434 (1880); Masters, in *Journ. Linn. Soc. (Bot.)* xxvii. 299 (1889), and xxx. 10 (1893); Pilger, in Engler, *Pflanzenreich*, iv. 5, *Taxaceæ*, 42 (1903); Stiles, in *New Phytologist*, vii. 209-222, figs. 28-34 (1908), and *Ann. Bot.* xxvi. 446, 463 (1912); R. B. Thomson, in *Bot. Gaz.* xlvii. 344-354, pl. 22-24 (1909).

A GENUS belonging to the division Podocarpeæ of the order Taxaceæ, mainly characterised by the yew-like foliage with true scaly buds, and by the female cones composed of spirally and loosely imbricated carpellary scales, the uppermost of which are fertile, each bearing internally near the base a cavity from which hangs a single free minute ovule; scales ultimately becoming fleshy, coalescing to form an irregular globose head, only a few of the ovules ripening into seeds, which when mature are set free by the gaping apart of the fertile scales. The genus, which has been studied by W. Stiles at Cambridge, is a remarkable one, all parts of the plant having a simple structure, suggesting that it is a primitive type. *Saxegothæa* is allied to *Araucaria* as well as to *Podocarpus*, resembling the latter in leaf, but the former in the female flowers and in the wingless pollen grains. Only one species is known, in the following description of which the other characters of the genus are given in detail.

(A. H.)

SAXEGOTHÆA CONSPICUA

Saxegothæa conspicua, Lindley, in *Journ. Hort. Soc. Lond.* vi. 258, figs. A and B (1851), and in Paxton, *Flower Garden*, ii. 111, fig. 190 (1852); Masters, in *Gard. Chron.* ii. 684, figs. 130, 131 (1887), and v. 782, fig. 125 (1889); Kent, Veitch's *Man. Conif.* 158 (1900); Pilger, in Engler, *Pflanzenreich*, iv. 5, *Taxaceæ*, 42 (1903); Castillo and Dey, *Jeog. Vej. Rio Valdivia*, 31, fig. 12 (1908).

An evergreen tree, attaining in South America 30 to 40 ft. in height, becoming at high elevations a low dense shrub. Bark greyish brown, scaling off like that of a plane tree, leaving the reddish brown cortex beneath exposed in patches. Branches widely spreading, pendulous at the ends, giving off the branchlets in opposite pairs or in whorls of three or four; young branchlets slender, glabrous, marked by the decurrent bases of the leaves, green with inconspicuous white dots on the lower side. Buds minute, globose, surrounded by three to seven ovate greenish scales, which persist brown and withered at the apex of the branchlet of the second year. Leaves, persistent about five years, arising in spiral order, spreading radially on

leading shoots, but thrown into a pectinate arrangement on lateral branches; linear, straight or curved, $\frac{1}{2}$ to $\frac{3}{4}$ in. long, narrowed into a petiolate base, decurrent on the branchlet, tapering at the apex, which ends in a sharp cartilaginous point; upper surface dark green with a raised narrow midrib; lower surface with a narrow green midrib, on each side of which is a broad stomatic band, composed of about twelve close lines of dots, and wider than the green margins.

Flowers monœcious. Staminate flowers cylindrical, solitary or two or three in the axils of the leaves near the end of the branchlet, shortly stalked, subtended by four to six scales; composed of numerous spirally arranged anthers, each with two cells, dehiscing longitudinally. Ovuliferous flowers solitary on the ends of the branchlets, on short peduncles bearing a few modified leaves; succeeded by numerous, spirally arranged, densely imbricated, triangular-ovate, pointed carpellary scales, the lower sterile, the upper fertile, each with a depression on the upper surface near the base, in which is borne an inverted ovule. Fruiting head, ripening in the first year, irregularly globose, $\frac{1}{3}$ to $\frac{1}{2}$ in. in diameter, with fleshy scales coalescent at the base and free at the apex, containing six to twelve ripened seeds, which are set free by the separating of the fertile scales. Seed, about $\frac{1}{8}$ in. in width and length, smooth, shining brown, ovoid, compressed from back to front, with two sharp lateral edges; base broad, marked by the rough surface of the hilum. Cotyledons two.

This species is a native of Chile and western Patagonia,¹ where it grows in the lower regions of the mountains in the dense forests, composed mainly of evergreen bush and conifers, like *Fitzroya patagonica*, *Libocedrus tetragona*, *Podocarpus chilina*, and *Podocarpus nubigena*. Castillo and Dey say that these two species of Podocarpus and Saxegothæa are known in Chile as *mañiu*, and yield a fine homogeneous wood, yellow in tint, and admirably suited for joiner's work.²

Saxegothæa conspicua was discovered³ by W. Lobb in southern Chile in 1846, and introduced in 1847. It does not appear to have succeeded in our climate, and is now very rare. At Kew, it is perfectly hardy, but grows slowly, and has a stunted appearance.

There are two specimens at Strete Raleigh, near Exeter, the seat of Mr. Imbert Terry, both probably original introductions, and about 30 ft. high in 1909, when the larger was 4 ft. 3 in. in girth at two feet from the ground.⁴

There is a fine specimen at Coldrenick, about 35 ft. high, with a short bole, only a foot long, dividing into about nine stems, 4 to 6 in. in diameter, with wide-spreading branches, which I saw in 1911. Both this tree, and those at Strete

¹ Dusen, in Scott, *Princetown Univ. Exped. Patagonia*, viii. 20 (1903), says it grows in the forests of the middle and lower Aysen valley in Patagonia. Reiche, *Verbreit. Chilen. Conif.* 5 (1900), gives the Aysen valley, lat. 45° 10', as its known southerly limit, while it extends northwards to the Rio Maule in lat. 35° 20'. It occurs on Chiloe, but not in the Guaytecas and Chonos islands.

² Capt. Fitzroy, *Narrative of Voyages of the Beagle*, i. 280 (1839), says:—"Mañiu, a tree of great dimensions, tall and straight, the leaf is like that of a yew: it is a very useful wood for shipbuilding, for planks, and next to *alerce*, is the best for spars that the island of Chiloe produces; but the large trees have a great tendency to become rotten at the heart owing possibly to the humidity of the climate, and to the very wet soil. Of twenty trees that were cut down, not one was sound at the heart. The wood is heavy, with large knots, which penetrate into the trunk to a great depth. A great deal of this timber grows in the Gulf of Peñas." It is doubtful what species is here referred to; but Saxegothæa does not now occur so far south as the Gulf of Peñas.

³ *Hortus Veitchii*, 38, 345 (1906).

⁴ Cf. Dallimore, in *Kew Bull.* 1909, p. 336.

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Ralegh, produce flowers and fruit abundantly; but I am not aware that seedlings have been raised. In the pinetum at Uplyme, Dorset, there is a remarkably fine specimen with a single stem, which was 40 ft. high and 3 ft. 4 in. in girth, when I saw it in July 1912. At Abbotsbury this species is represented by a shrubby plant, 4 ft. high and 4 ft. across. At Bury Hill near Dorking there is a tree about 20 ft. high.

Bean¹ saw in 1907 a specimen, about 12 ft. high, at Ochertyre in Perthshire.

The only specimens that we know of in Ireland are a spreading bush at Rostrevor, where, Sir John Ross-of-Bladensburg informs us, it was planted in 1891; and two bushy trees, about 20 ft. high, which Elwes saw at Kilmacurragh in 1908.

(A. H.)

¹ *Gard. Chron.* xli. 168 (1907)

TORREYA

Torreya,¹ Arnott, in *Ann. Nat. Hist.* i. 130 (1838); Bentham et Hooker, *Gen. Pl.* iii. 431 (1880); Eichler, in Engler and Prantl, *Pflanzenfam.* ii. 1, p. 111 (1889); Masters, in *Journ. Linn. Soc. (Bot.)* xxx. 5 (1893); Pilger, in Engler, *Pflanzenreich*, iv. 5, *Taxaceae*, 105 (1903); Sargent, in *Bot. Gaz.* xlv. 226 (1907).
Tumion, Rafinesque, *Amenities of Nature*, 63 (1840); Sargent, *Silva N. Amer.* x. 55 (1896).
Caryotaxus, Zuccarini, ex Endlicher, *Syn. Conif.* 241 (1847).

EVERGREEN trees belonging to the order Taxaceæ, with fissured bark and opposite or whorled branches. Young branchlets green, with linear pulvini, separated by slight grooves. Buds, one terminal, and occasionally two to four lateral, clustered at the end of the branchlet, composed of a few decussately opposite scales. Base of the branchlet marked with scars, left by the fall of the bud-scales of the previous season; occasionally two or three of these persisting brown, unenlarged, and inconspicuous. Leaves spirally arranged, but thrown, by twisting and turning of their bases, into a pectinate arrangement on lateral branches, as in the yew; persistent three or four years; stalked, linear, tipped with a bristle-like cartilaginous point; upper surface green, convex; lower surface with a raised green midrib, and two white stomatic bands, sunk in longitudinal depressions; fibro-vascular bundle undivided, with a solitary resin-canal beneath it.

Flowers diœcious, or monœcious² with the sexes on different branches. Staminate flowers solitary in the axils of the leaves of the current year's branchlet, surrounded at the base by several pairs of decussate scales, composed of numerous stamens, in whorls of fours, on a stipitate slender axis; filament expanded into four pollen-sacs; connective truncate or crest-like and dentate.

Pistillate flowers in pairs on rudimentary branchlets,³ which are solitary in the axils of a few leaves towards the base of the current year's shoot; each flower subtended by four decussate scales and a bract, and consisting of a solitary terminal ovule, surrounded at the base by a small disc, the aril, which grows upwards and ultimately becomes confluent with the succulent testa of the seed. Seed, as only one flower of each pair develops, solitary; ripening in the second year, drupe-like, with an outer succulent resinous coat and an inner woody shell, within which is the ruminant albumen and a minute embryo with two cotyledons. The shell bears a slightly projecting point at the apex, around which there is a dark-coloured oval,

¹ According to the Vienna rules of nomenclature, the name *Torreya* is to be retained for this genus. It had previously been applied to a species of *Clerodendron* by Sprengel, *Neue Entd.* ii. 121 (1821).

² The flowers are usually said to be diœcious, but the trees in cultivation are monœcious.

³ This occasionally terminates in a third ovule, or produces an extra bract. Cf. Miss Robertson, in *New Phytologist*, iii. 142 (1904).

circular, or saddle-shaped area, representing the outer surface of the integument where it is free from the aril; and below this are two opposite minute shield-like prominences, each with a minute aperture. The seed is sessile or short-stalked, and subtended at the base by six decussate scales,¹ from which it separates, when it falls after ripening.

Seedling: see under *T. californica*.

All species of *Torreya* sprout freely from the stump and roots when cut; and bear pruning freely. They are propagated by cuttings² or by grafting on the common yew or on species of *Cephalotaxus*.

During the tertiary period the genus inhabited the Arctic region, and spreading southward existed in Europe. All the living species produce handsome, close-grained, pale yellow wood,³ useful for cabinet-making, and durable when placed in contact with the soil as posts for fencing.

The species of *Torreya* superficially resemble those of *Cephalotaxus*; but the two genera are readily distinguishable.

Torreya.—Leaves with long spines at the apex, and narrow stomatic bands beneath. Buds with few decussate scales, all deciduous or two to four persisting minute and inconspicuous at the base of the branchlet.

Cephalotaxus.—Leaves with short-pointed apices; under surface with broad stomatic bands extending from the midrib almost to the outer margin. Buds with numerous imbricated scales, which persist at the base of the branchlet.

The four living species of *Torreya* are distinguishable as follows:—

I. *Leaves and branchlets foetid.*

1. *Torreya taxifolia*, Arnott. Florida. See p. 1466.

Leaves linear, $\frac{3}{4}$ to $1\frac{1}{2}$ in. long, $\frac{1}{8}$ in. broad, pale green beneath, with a broad midrib and narrow scarcely depressed stomatic bands; petiole, $\frac{1}{25}$ in.

II. *Leaves and branchlets pungent-aromatic.*

2. *Torreya californica*, Torrey. California. See p. 1465.

Leaves linear, $1\frac{1}{4}$ to 3 in. long, $\frac{1}{8}$ in. broad; glaucous beneath with a broad midrib and slightly depressed narrow stomatic bands; petiole, $\frac{1}{12}$ in.

3. *Torreya nucifera*, Siebold and Zuccarini. Japan. See p. 1463.

Leaves lanceolate-linear, $\frac{3}{4}$ to $1\frac{1}{4}$ in. long, $\frac{1}{8}$ to $\frac{1}{6}$ in. wide; green beneath with deeply depressed broad stomatic bands, about as wide as the midrib.

III. *Leaves and branchlets devoid of any peculiar odour or taste.*

4. *Torreya grandis*, Fortune. China. See p. 1464.

Leaves lanceolate-linear, $\frac{1}{2}$ to 1 in. long, $\frac{1}{8}$ in. wide; thinner in texture than those of *T. nucifera*, but with similar stomatic bands. (A. H.)

¹ These are the four decussate scales and bract of the flower which develops—the sixth scale being the bract and remains of the other flower which does not develop.

² Rehder states, in Bailey, *Cycl. Am. Hort.* iv. 1822 (1902), that plants raised from cuttings grow slowly and remain bushy. This may account for the few good specimens of *Torreya* which exist in cultivation. The seeds are difficult to transport, as they soon become rancid.

³ Figured by Mayr, *Fremdländ. Wald- u. Parkbäume*, 423, pl. x. 23 (1906).

TORREYA NUCIFERA

Torreya nucifera, Siebold and Zuccarini, in *Abh. Akad. München*, iv. 3, p. 234 (1846); Franchet et Savatier, *Enum. Pl. Jap.* i. 475 (1875); Masters, in *Journ. Linn. Soc. (Bot.)* xviii. 500 (1881), and xxvi. 546 (1902); Shirasawa, *Icon. Ess. Forest. Japon.* i. text 32, t. 15, figs. 19-34 (1900); Kent, Veitch's *Man. Conif.* 119 (1900); F. W. Oliver, in *New Phytologist*, i. 151, fig. 6 (1902); Pilger, in Engler, *Pflanzenreich*, iv. 5, *Taxaceae*, 105 (1903).

Taxus nucifera, Linnæus, *Sp. Pl.* 1040 (1753); Thunberg, *Fl. Jap.* 275 (1784).

Podocarpus nucifera, Persoon, *Syn.* ii. 633 (1807); Loudon, *Arb. et Frut. Brit.* iv. 2100 (1838).

Caryotaxus nucifera, Zuccarini, ex Endlicher, *Syn. Conif.* 241 (1847); Henkel and Hochstetter, *Syn. Nadelholz.* 366 (1865).

Tumion nuciferum, Greene, in *Pittonia*, ii. 194 (1891).

A tree, attaining in Japan 80 ft. in height, with bright red bark, and pungent aromatic branchlets and leaves. Young branchlets green, glabrous, becoming reddish in the second year. Buds prismatic, about $\frac{1}{8}$ in. long, with six to eight decussate external scales. Leaves, $\frac{3}{4}$ to $1\frac{1}{4}$ in. long, $\frac{1}{8}$ to $\frac{1}{6}$ in. wide, lanceolate-linear, tapering from near the base to the narrow acuminate spine-tipped apex; shining dark or yellowish green above; lower surface with two deeply depressed white stomatic bands, about as wide as the midrib, but not so wide as the marginal green bands; petiole about $\frac{1}{16}$ in. long.

Staminate flowers, $\frac{1}{3}$ in. long; connective crest-like, denticulate. Fruit narrowly obovoid, $\frac{3}{4}$ to 1 in. long, green tinged with purple; flesh thin, resinous; shell light brown, with irregular longitudinal depressions; inner coat dark red, folded for a short distance into the albumen. (A. H.)

This species is a native of Japan, occurring as a rare tree in the southern islands and in the forests of southern and central Hondo, where, according to Sargent, it reaches a height of 80 ft., and is remarkable for the beauty of its bright red bark and lustrous dark green foliage. The only place where I saw the tree wild was in virgin forest on the slopes of the Kiresima volcano in southern Kiusiu. Here there were trees up to about 10 in. in diameter, scattered in a dense forest of *Abies firma* and *Tsuga*, mixed with oaks, chestnut, and other broad-leaved trees. Seedlings were found in dense shade and could be distinguished by the sharp points of their leaves. I was told by the foresters that much larger trees existed, but only in remote and inaccessible places. Where it was planted in Kisogawa and below Koyasan at 1500 ft. elevation, it attained a height of 40 to 50 ft. with a girth of 8 ft. or more; and had very much the habit of a yew, but made a cleaner trunk with less tendency to branch. It is known in Japan as *Kaya*; and an oil is extracted from the seeds, which is used in cooking. The wood, according to Rein, is light yellowish in colour, and is used for making chests and boxes. The wood is also used for making Japanese chess-men.

The Japanese *Torreya* was described and figured by Kaempfer, *Amœn. Exot.* 815 (1712); and seems to have been introduced¹ into England in 1764 under the

¹ Aiton, *Hort. Kew.* v. 416 (1813).

name *Taxus nucifera*. Loudon gives the date of introduction as 1820, and states that a tree at White Knights was 13 ft. high in 1834. Siebold sent it to Holland about 1840. It is rare in cultivation, and is never seen except as a shrub.

(H. J. E.)

TORREYA GRANDIS

Torreya grandis, Fortune, in *Gard. Chron.* 1857, p. 788, and 1860, p. 170, and in Gordon, *Pinetum*, 326 (1858); Masters, in *Journ. Linn. Soc. (Bot.)* xviii. 500 (1881), xxvii. 323, fig. 28 (1890), and xxvi. 546 (1902), and in *Gard. Chron.* ii. 681, fig. 117 (1884); Franchet, *Pl. David.* i. 292 (1884).

Torreya Fargesii, Franchet, in *Journ. de Bot.* xiii. 264 (1899); Pilger, in Engler, *Pflanzenreich*, iv. 5, *Taxaceae*, 108 (1903).

Torreya nucifera, Siebold and Zuccarini, var. *grandis*, Pilger, *op. cit.* 107 (1903).

Caryotaxus grandis, Henkel and Hochstetter, *Syn. Nadelholz.* 366 (1865).

Tunion grande, Greene, in *Pittonia*, ii. 194 (1891).

A tree, attaining 80 ft. in height in China, with leaves and branchlets devoid of a disagreeable or pungent odour. Young branchlets green, glabrous, becoming yellowish brown in the second year. Leaves, $\frac{1}{2}$ to 1 in. long, $\frac{1}{8}$ in. broad, linear-lanceolate, similar to those of *T. nucifera* in shape, but thinner in texture, with similar deeply depressed stomatic bands, nearly as wide as the midrib, but narrower than the marginal green bands.

Fruit broadly ellipsoid, $\frac{3}{4}$ to 1 in. long; flesh not disagreeable in odour; shell reddish brown, with irregular shallow depressions over the surface; inner coat only slightly folded into the albumen.

Torreya grandis was discovered by Fortune in 1855 in the coast province of Chekiang in China, in the mountains south-west of Ningpo, at 4000 ft. elevation. Here numerous fine trees were seen, many of which were 60 to 80 ft. in height. It was subsequently collected in the adjoining province of Fukien by Père David. The same tree¹ also exists in the central provinces of Hupeh and Szechwan, in the mountains between 4000 and 6000 ft. elevation; where it occasionally attains a height of 50 ft., but it is more commonly shrubby, bearing fruit when only 8 ft. high.

This tree is known to the Chinese as *fei*; and the kernels, called *fei-shih*,² are sold in the drug-shops of most Chinese towns, being considered a valuable remedy in cases of cough, asthma, etc. They are occasionally eaten like hazel nuts, and though reputed laxative, are considered wholesome.

Torreya grandis was introduced by Fortune, who sent seeds in 1855 to Glendinning's nursery at Chiswick, where they germinated freely. This species is not common in collections, the only specimen which we have seen being a small shrub in the Cambridge Botanic Garden, which was obtained from Veitch in 1894.

(A. H.)

¹ The *Torreya* of Central China is considered by Franchet and Pilger to be a distinct species, *T. Fargesii*; but I can see no characters by which it can be separated from the Chekiang species.

² Cf. Hanbury, *Sc. Papers*, 233 (1876).

TORREYA CALIFORNICA

Torreya californica, Torrey, in *New York Journ. Pharm.* iii. 49 (1854); J. D. Hooker, in *Gard. Chron.* xxiv. 553 (1885); Masters, in *Gard. Chron.* v. 800, figs. 126, 127 (1889); Kent, Veitch's *Man. Conif.* 117 (1900); Pilger, in Engler, *Pflanzenreich*, iv. 5, *Taxaceae*, 109 (1903); Jepson, *Silva of California*, 167 (1910).

Torreya Myristica, J. D. Hooker, in *Bot. Mag.* t. 4780 (1854); Murray, in *Trans. Bot. Soc. Edin.* vi. 217, pl. iii. (1860); Masters, in *Gard. Chron.* xxii. 681, fig. 116 (1884).

Caryotaxus Myristica, Henkel and Hochstetter, *Syn. Nadelh.* 368 (1865).

Tunion californicum, Greene, in *Pittonia*, ii. 195 (1891); Sargent, *Silva N. Amer.* x. 59, t. 513 (1896), and *Trees N. Amer.* 98 (1905).

A tree, attaining in California 100 ft. in height, and 12 ft. in girth, usually considerably smaller. Leaves, branches, and wood pungent-aromatic. Young branchlets glabrous, green, becoming brown in the second year. Buds, up to $\frac{1}{4}$ in. long, prismatic, with eight to ten decussate outer scales, those towards the apex elongated. Leaves, $1\frac{1}{4}$ to 3 in. long, $\frac{1}{8}$ in. wide; linear, tapering in the anterior third to an acuminate spine-tipped apex; dark shining green above; lower surface flat, glaucous, with two slightly depressed white stomatic bands (about 0.3 mm. wide), much narrower than the broad midrib (about 1 mm. wide), and the two outer glaucous bands (each about 0.7 mm. wide); petiole stout, $\frac{1}{2}$ in. long.

Staminate flowers $\frac{1}{3}$ in. long; connective truncate, not dentate. Fruit¹ ellipsoid or obovoid, 1 to $1\frac{1}{2}$ in. long; light green streaked with purple; flesh thin, resinous; shell fawn-coloured, smooth or with irregular slight longitudinal ridges; inner coat reddish, deeply folded into the white albumen.

Seedling² similar to that of *Ginkgo biloba*, with two thick and fleshy cotyledons, remaining underground; the stem bearing below a few scales, which are succeeded by ordinary leaves, the transition between the scales and the leaves being gradual.

(A. H.)

This species is a native of California, growing on the borders of mountain streams, nowhere common, but widely distributed from Mendocino County to the Santa Cruz mountains in the coast region, and along the western slopes of the Sierra Nevada from Eldorado to Tulare County, at 3000 to 5000 ft. elevation. It is most abundant and of its largest size in the northern coast ranges. Hough, in *American Woods*, pt. vi. p. 50, describes a fine tree overthrown by a flood near the coast in Mendocino County, from which the specimens of wood in his book were cut. It was 85 ft. long to the point, 5 in. in diameter, where its dead top was broken off. Its straight columnar trunk was 12 ft. in girth at eighteen inches, and 8 ft. at thirty-five feet from the ground. Assuming that the growth of this tree had been as uniform as in the section, which shows ten rings to the inch, it would have been from 250 to 300 years old, and the contents of the log about 300 cubic feet.

¹ Described from specimens grown at Orton. Cf. F. W. Oliver, in *Ann. Bot.* xvii. 466, pl. xxiv. (1903), for a detailed description of the remarkable structure of the seed of this species.

² Miss Chick (Mrs. Tansley) describes seedlings grown from seed produced at Orton, in *New Phytologist*, ii. 83, plates vii. viii. (1903).

Hough states that it is an excellent, light, and durable wood, well suited for boat-building and cabinetmaking, but too rare to be generally known or used. Jepson adds that the wood is strongly odorous, with white sapwood and clear light yellow heartwood, susceptible of a fine polish.

This tree was discovered in 1851 by William Lobb, who sent specimens and seeds in that year to Messrs. Veitch, which were described as *T. Myristica* in 1854 by J. D. Hooker, a short time after it had been published as *T. californica* by Dr. Torrey, who had received specimens from Mr. Shelton.

Though hardy in most parts of Great Britain, this species requires a heavy rainfall together with rich deep soil to grow to any size; and owing to its being usually planted in open situations, instead of in the densely wooded ravines which it likes, it has a tendency to spread and form branches rather than make a trunk.

By far the largest specimen that I know is at Tregothnan, which, when I first saw it in 1905, was 35 ft. by 6 ft.; and in 1911 had increased to 45 ft. high. Its shape is spoilt by three large lower branches; its trunk shows some large nipple-like protuberances resembling those often seen on the deodar.

Another tree at Orton Hall, Peterborough, has produced fruit regularly for the last twenty years, from which numerous seedlings¹ have been raised. It measured about 25 ft. by 4 ft. in 1905. At Poles, near Ware (Herts), a tree, which has never flowered, measured 40 ft. by 4 ft. in 1910. It was planted in 1858.

At Tortworth,² there is a handsome specimen, 25 ft. by 4 ft. in 1904, with branches spreading to a diameter of 36 ft.; and at Westonbirt, there is a tree in a shaded position, 29 ft. by 2 ft. 9 in. in 1907. At Chipping Campden, there is a tree about 30 ft. high, which bore staminate flowers in profusion in May 1911.

In Scotland it succeeds as far north as Durris in Kincardineshire, where a healthy specimen is about 20 feet high.

In Ireland, the best example is at Verner's Bridge, near Lough Neagh, where a tree measured 40 ft. by 4 ft. 7 in. in 1904. There are also specimens at Fota and Castlemartyr; the latter, forking near the ground, was 30 ft. high when I saw it in 1908.

(H. J. E.)

TORREYA TAXIFOLIA

Torreya taxifolia, Arnott, in *Ann. Nat. Hist.* i. 130 (1838); W. J. Hooker, *Icon. Plant.* tt. 232, 233 (1840); Kent, *Veitch's Man. Conif.* 119 (1900); Pilger, in Engler, *Pflanzenreich*, iv. 5, *Taxaceae*, 108 (1903).

Taxus montana, Nuttall, in *Journ. Acad. Sc. Phil.* vii. 96 (1834) (not Willdenow).

Caryotaxus taxifolia, Henkel and Hochstetter, *Syn. Nadelh.* 367 (1865).

Tumion taxifolium, Greene, in *Pittonia*, ii. 194 (1891); Sargent, *Silva N. Amer.* x. 57, t. 512 (1896), and *Trees N. Amer.* 98 (1905).

A tree, attaining in Florida 40 ft. in height and 6 ft. in girth, with foetid leaves, branches, and wood. Young branchlets green, with occasional minute hairs; older

¹ These grow very slowly at Colesborne and are now at eleven years old under two feet high.

² A section from another tree which died at Tortworth was sent by the Earl of Ducie to the Cambridge Forestry Museum.

branchlets yellowish red. Buds as in *T. californica*. Leaves $\frac{3}{4}$ to $1\frac{1}{2}$ in. long, $\frac{1}{8}$ in. wide; linear, tapering in the anterior third to an acuminate spine-tipped apex; shining green above; lower surface pale green, with two stomatic bands, scarcely depressed, and narrower than the midrib and the external bands; rounded at the base, with a short petiole, about $\frac{1}{5}$ in. long.

Staminate flowers, $\frac{1}{4}$ in. long; connective minute, rounded, not dentate. Fruit obovoid, 1 to $1\frac{1}{2}$ in. long, dark purple; flesh foetid, coriaceous; shell smooth, light brown; inner coat brownish and not so deeply folded into the albumen as in *T. californica*.

This species, of which I have seen no living specimen, appears to be very similar to *T. californica*, but has smaller leaves, with very short petioles, and, according to Sargent, is different in odour.

T. taxifolia is restricted to north-western Florida, where it grows on limestone cliffs and in swamps¹ along the banks of the Appalachicola River, from River Junction to near Bristol in Gadsden County. The wood, according to Sargent, is hard, strong, clear bright yellow, with thin lighter-coloured sapwood, and is used locally for fence-posts. Owing to the peculiar odour of the whole tree, noticeable also in the wood when burnt, it is known as "stinking cedar." Dr. Torrey informed Arnott that a blood-red turpentine, of a pasty consistence, flows sparingly from the bark, and is soluble in alcohol.

This species was discovered in 1833 by H. C. Croom, and was introduced² into England, in 1840, by A. J. Downing, who sent a living plant to London, which was propagated³ by Masters of the Canterbury Nursery. It probably proved unsuitable to our climate; and I have seen no specimen which could be identified with this species.

According to Sargent⁴ it can be kept alive in eastern Massachusetts in sheltered, well-shaded situations; and occasional individuals have survived a number of years near New York and Philadelphia.

(A. H.)

¹ Cf. Britton, *N. Amer. Trees*, 126 (1908).

² Loudon, *Gard. Mag.* xvi. 658 (1840).

³ Loudon, *Trees and Shrubs*, 944 (1842), states that it was propagated by grafting on the yew.

⁴ Sargent, in *Garden and Forest*, x. 400 (1897).

CEPHALOTAXUS

Cephalotaxus, Siebold and Zuccarini, *ex* Endlicher, *Gen. Suppl.* ii. 27 (1842); Bentham et Hooker, *Gen. Pl.* iii. 430 (1880); Masters, in *Journ. Linn. Soc. (Bot.)* xxx. 4 (1893), and in *Gard. Chron.* xxxiii. 227 (1903); Worsdell, in *Ann. Bot.* xv. 637 (1901); Pilger, in Engler, *Pflanzenreich*, iv. 5, *Taxaceae*, 99 (1903).

EVERGREEN shrubs or small trees, belonging to the order Taxaceae, with opposite or whorled branches. Young branchlets green, marked by white stomatic dots, and with linear pulvini, separated by slight grooves. Buds, with numerous imbricated scales, which persist as a conspicuous sheath at the apex of the branchlet of the second year. Leaves spirally arranged, radially spreading on vertical shoots, but on lateral branches thrown by twisting of their bases into a pectinate arrangement; persistent three or four years, very shortly stalked, linear, acute at the apex; upper surface green with a prominent midrib in a depression; lower surface with two whitish broad bands, composed of numerous stomatic lines, separated by a narrow raised green midrib, and bounded on each outer side by a very narrow marginal green band; fibro-vascular bundle undivided, with a single resin-canal beneath it.

Flowers dioecious.¹ Staminate flowers in globose heads, which are solitary in the axils of the leaves of the branchlets of the previous year; each head with six to eleven flowers, each of which is subtended by a bract and has seven to twelve stamens; pollen-sacs two or three, dehiscing longitudinally.² Pistillate heads few, each solitary in the axil of a scale-leaf near the base of the branchlet of the current year, and composed of a stipitate axis, towards the end of which are three or four decussate pairs of opposite bracts; each bract is cup-shaped at the base and bears two erect ovules side by side. Usually only one or two of the ovules in a head develops, forming a drupe-like seed, with a fleshy outer covering, and an inner hard woody shell, which encloses the albumen and embryo. The seedling³ has two long linear cotyledons, immediately above which and decussate with them on the stem is a pair of primary leaves, which are followed at intervals by either whorls or pairs of larger leaves.

Six species⁴ of *Cephalotaxus* are known, one of which is possibly a hybrid,

¹ In rare cases, the flowers are monoecious, as in a shrub of *C. Fortunei*, described by Carrière in *Rev. Hort.* 1878, p. 116, fig. 24.

² Kerner, *Nat. Hist. Plants*, Eng. Trans. ii. 124 (1898), states that the anthers open and shut periodically.

³ Cf. Masters, in *Journ. Linn. Soc. (Bot.)* xxvii. 241 (1889).

⁴ *C. Mannii*, Hooker, native of the Khasi Mountains; *C. Griffithii*, Hooker, of Assam and Manipur; and *C. Oliveri*, Masters, of Central China, are not now in cultivation. The plants of *C. Griffithii*, formerly in the temperate house at Kew, mentioned by Hooker, *Fl. Brit. India*, v. 648 (1890), died many years ago. The young plants at Coombe Wood, referred to *C. Oliveri* in *Gard. Chron.* xxxiii. 227 (1903), and *Hortus Veitchii*, 338 (1906), are *C. drupacea*.

Podocarpus argotania, Hance, a peculiar conifer in southern China, is referred to *Cephalotaxus* by Pilger; but is distinct.

natives of China, Japan, Khasi Mountains, Assam and Manipur. As none of the three species in cultivation forms a tree in this country, they do not properly come within the scope of our work; but are now briefly described, owing to their interest as conifers, which are frequently seen in gardens. All the three species are perfectly hardy; but succeed best in shady situations, sheltered from the wind. When propagated by scions or cuttings, terminal shoots should be selected, as these form regular plants with whorled branches like seedlings; whereas cuttings from lateral branches grow into irregular low spreading shrubs.¹ (A. H.)

CEPHALOTAXUS DRUPACEA

Cephalotaxus drupacea, Siebold et Zuccarini, *Fl. Jap. Fam. Nat.* ii. 108 (1846), and *Fl. Jap.* ii. 66, tt. 130 and 131 (1870); Franchet et Savatier, *Enum. Fl. Jap.* i. 473 (1875); Masters, in *Gard. Chron.* xxi. 113 (1884), and xxxiii. 228, fig. 94 (1903), and *Journ. Linn. Soc. (Bot.)* xxii. 201 (1886) and xxvi. 544 (1902); Kent, Veitch's *Man. Conif.* 112 (1900); Shirasawa, *Icon. Ess. Forest. Japon.* i. text 31, t. xiv. figs. 1-12 (1900); Pilger, *Taxaceae*, 100, figs. 19, 20 (1903); Hemsley, in *Bot. Mag.* 8285 (1909).
Taxus baccata, Thunberg, *Fl. Jap.* 275 (1784) (not Linnæus).

A large shrub or small tree, occasionally attaining in Japan 40 ft. in height. Leaves on lateral branches pectinate, but spreading outwards usually in a V-shaped arrangement and not remaining in one plane, linear, $\frac{3}{4}$ to $1\frac{1}{2}$ in. long, straight or falcate, tapering towards the triangular acute apex, which is often tipped with a short spine-like point; stomatic bands beneath, each composed of about thirteen to fifteen lines. Staminate heads $\frac{1}{3}$ in. in diameter, on very short scaly stalks. Fruit brown, $\frac{3}{4}$ to 1 in. long, pyriform, broadest at the rounded apex, which has a circular depression bearing a minute mucro, and narrowed towards the base; kernel light brown, smooth, ellipsoid, $\frac{3}{8}$ in. long, $\frac{2}{8}$ in. wide, rounded at the base, the two sharp lateral edges in the upper half uniting into a slight apiculus at the apex.

This species is a native of Japan and central China. In Japan,² it is generally scattered through the mountain forests, extending northward to central Hokkaido, where it grows on low hills as an undershrub, 2 or 3 ft. high, of the deciduous forest; while in Hondo, where it ranges between 2000 and 3000 ft. altitude, it becomes a bushy tree, averaging 25 ft. high, and occasionally attaining 40 ft.³ It is known to the Japanese as *Inu-gaya*. In China, it has been found in the mountains of Hupeh and Chekiang and in the Chusan Archipelago.

C. drupacea was introduced by Siebold into the Botanic Garden at Leyden in 1829; but does not appear to have been known⁴ in English gardens till 1844. It

¹ Cf. Rehder, in Bailey, *Cycl. Amer. Hort.* 276 (1900).

² A species of *Cephalotaxus*, not yet determined, occurs in the mountains of Formosa at about 8000 feet altitude. Cf. Hayata, in *Journ. Coll. Sci. Tokyo*, xxv. 215 (1908). Elwes saw this as a bush without flowers or fruit on Arisan in 1912.

³ Mayr, *Fremdländ. Wald- u. Parkbäume*, 269 (1906), says that in the warmer parts of Japan it becomes a tree, rarely attaining 60 ft. in height.

⁴ Nicholson, *Gard. Dict.* i. 294 (1884), gives 1844 as the date of introduction into England. It was mentioned as a cultivated plant by Knight and Perry, *Syn. Conif.* 51 (1850), who gave for it the synonyms *Taxus coriacea* and *Cephalotaxus coriacea*.

always remains a spreading bush in this country, an old specimen at Kew being about 10 ft. high and 15 ft. through, and clothed to the ground with luxuriant dark green foliage.
(A. H.)

CEPHALOTAXUS FORTUNI

Cephalotaxus Fortunei, W. J. Hooker, in *Bot. Mag.* t. 4499 (1850); Masters, in *Gard. Chron.* xxi. 114, fig. 21 (1884), and xxxiii. 228 (1903), and *Journ. Linn. Soc. (Bot.)* xxvi. 545 (1902); Franchet, *Pl. David.* i. 292 (1884), and in *Journ. de Bot.* 1899, p. 265; Kent, Veitch's *Man. Conif.* 113 (1900); Pilger, *Taxaceae*, 103 (1903).

A small tree or large shrub, attaining the same dimensions as *C. drupacea*. Leaves on lateral branches pectinate and spreading in one plane, falcate, $1\frac{1}{2}$ to 3 in. long, tapering gradually in the anterior third to an acuminate, usually spine-tipped apex; stomatic bands beneath conspicuously white, each of eighteen to twenty-one lines, covering nearly the whole surface, the midrib and green margins being narrower than in *C. drupacea*. Staminate heads, less than $\frac{1}{4}$ in. in diameter, on scaly stalks, which are $\frac{1}{6}$ in. long. Fruit olive-green, about $1\frac{1}{4}$ in. long and $\frac{5}{8}$ in. in diameter, elongated ovoid, contracted towards the base, and broadest at the rounded apex, which is tipped with a short elevated point, arising from a circular depression; kernel elongated ellipsoid, about 1 in. long and $\frac{2}{8}$ in. wide, light mottled brown, minutely tuberculate on the surface, rounded at the base; upper half with two sharp lateral edges which unite at the apex to form an apiculus.

This species is occasionally monœcious.¹ In the Cheshunt Nurseries,² there was a female plant, which bore fruit in 1862 and 1863, though no flowers were borne on a staminate plant close by; and it was supposed to have been pollinated by a yew; but the seeds were not sown, and may have been infertile.

C. Fortunei is a native of China, occurring in the mountain woods of Szechwan, Hupeh, Yunnan, Kiangsu, and Chekiang, where it usually grows as a large bush in the shade of broad-leaved trees. It was discovered in the mountains south-west of Ningpo,³ in 1848, by Fortune, who sent seeds to the Bagshot Nursery in that year, which germinated freely. It is perfectly hardy in this country, and may be seen in many collections of conifers, forming a spreading shrub, with handsome foliage. The largest that we have seen is about 25 ft. high at Coldrenick. It appears to be little known in America.⁴
(A. H.)

¹ Cf. Carrière, in *Rev. Hort.* 1878, p. 116, fig. 24, where a branch, bearing both male and female flowers, is depicted.

² Cf. *Gard. Chron.* 1863, p. 1062.

³ Bretschneider, *Hist. Europ. Bot. Disc. China*, 502 (1908), points out that the statement usually made, that Fortune found it in North China, is erroneous.

⁴ Sargent, in *Garden and Forest*, x. 391 (1897).

CEPHALOTAXUS PEDUNCULATA

Cephalotaxus pedunculata, Siebold and Zuccarini, *Fl. Jap. Fam. Nat.* ii. 108 (1846), and *Fl. Jap.* ii. 67, t. 132 (1870); Franchet et Savatier, *Enum. Pl. Jap.* i. 473 (1875); Franchet, *Pl. David.* i. 292 (1884); Masters, in *Gard. Chron.* xxi. 113, fig. 22 (1884), and xxxiii. 228 (1903), and *Journ. Linn. Soc. (Bot.)* xxii. 201 (1886), and xxvi. 545 (1902); Kent, Veitch's *Man. Conif.* 114 (1900); Diels, *Flora von Central China*, 214 (1901).
Taxus Harringtonia, Knight, *ex Forbes, Pin. Woburn.* 217, t. 66 (1839); Loudon, *Gard. Mag.* xv. 273 (1839), and *Trees and Shrubs*, 942 (1842).
Cephalotaxus Harringtonia, Koch, *Dendrologie*, ii. 2, p. 102 (1873).
Cephalotaxus drupacea, Siebold and Zuccarini, var. *pedunculata*, Miquel, *Procl. Fl. Jap.* 333 (1867).
Cephalotaxus drupacea, Siebold and Zuccarini, var. *Harringtonia*, Pilger, *Taxaceae*, 102 (1903).

A large shrub or small tree. Leaves on lateral branches, pectinate, spreading either in one plane or in a V-shaped arrangement, straight or falcate, $1\frac{1}{2}$ to $2\frac{1}{2}$ in. long, tapering in the anterior third to an acute apex, which is often tipped with a spine; stomatic bands beneath each of sixteen to twenty-one lines, not so white as in *C. Fortunei*. Staminate heads in clusters of two to five, or occasionally solitary, on scaly peduncles, which are $\frac{1}{4}$ to 1 in. in length. Fruit olive-green, $\frac{3}{4}$ to 1 in. long, ellipsoid, not contracted at the basal end, with a circular depression at the apex from which arises a short mucro; kernel similar in size and shape to that of *C. drupacea*, but mottled light brown and slightly tuberculate on the surface.

The following varieties have been described:—

1. Var. *sphaeralis*, Masters, in *Gard. Chron.* xxi. 113, fig. 23 (1884), and in *Journ. Linn. Soc. (Bot.)* xxii. 203, plate vii. (1886).

Fruit smaller, globose, not depressed at the apex, which bears a long mucro. This was described by Masters from a specimen growing in the Rev. J. Goring's garden at Steyning; and a shrub at Kew has also borne similar fruit.

2. Var. *fastigiata*, Carrière, *Prod. et Fix. Var.* 44, fig. 1 (1865), and *Conif.* 717 (1867); Masters, in *Gard. Chron.* xxi. 113, fig. 20 (1884).

Cephalotaxus Buergeri, Miquel, *Procl. Fl. Jap.* 333 (1867).

Podocarpus koraiana, Siebold, in *Ann. Soc. Hort. Pays-Bas*, 1844, p. 34; Carrière, in *Rev. Hort.* 1863, p. 349, fig. 36; Maximowicz, *Mé. Biol.* vii. 563 (1870).

A fastigiate form, similar to the Irish yew in habit; branches and branchlets directed vertically upwards; leaves spreading radially on the branchlets.

This handsome shrub appears to have originated in Japan, whence it was introduced in 1861 into England, where it is perfectly hardy.¹ It has never, so far as is known, borne flowers either in Japan or in Europe; and is always propagated by cuttings. It frequently produces near the base lateral branches² with normal foliage; and grafts, that are taken from these branches, reproduce the ordinary form of the species.

¹ Sargent, in *Garden and Forest*, x. 391 (1897), states that it is not hardy in eastern New England, but there are good plants near New York and Philadelphia.

² Figured by Masters, in *Journ. Linn. Soc. (Bot.)* xxvii. 245, fig. 5 (1889), and *Gard. Chron.* xxxiii. 227, fig. 96 (1903). Cf. De Vries, *Mutation Theory*, 110, fig. 16 (1911), who instances these reverted branches as showing the phenomenon of atavism by bud-variation.

C. pedunculata has been long in cultivation in Japan, where it is known as *Chosen-gaya* or *To-gaya*, meaning Korean or Chinese Cephalotaxus; and was introduced there in ancient times from Korea or China by the Buddhist monks. It is unknown in the wild state, and in all probability is a hybrid between *C. Fortunei* and *C. drupacea*, which originated in China, where these two species are both native. It usually resembles more the former species in foliage, and the latter species in fruit; but differs from both in the clustered staminate heads, which is possibly an abnormal condition. There are plants in gardens reputed to be, but not exactly matching *C. Fortunei*, which may be seedlings of *C. pedunculata*. The latter species has leaves of a darker hue than *C. Fortunei* and *C. drupacea*; and is equally hardy, but is scarcely so ornamental as the true *C. Fortunei*, which has the leaves much whiter beneath.

The original *C. pedunculata*, long cultivated in Japan, was always a male plant, no doubt propagated by grafts and cuttings; and it was introduced¹ into England in 1837. So far as can be ascertained, the history of the female plant is as follows:—The seeds of *C. Fortunei*, which were sent by Fortune² from China in 1848 to the Bagshot Nursery, produced two kinds of plants; one kind with long leaves, identical with the true wild plant of *C. Fortunei*; and the other kind with shorter leaves, identical with *C. pedunculata*, and comprising individuals which bore fruit.³

(A. H.)

¹ Cf. Loudon, *Trees and Shrubs*, 943 (1842). It appears to have been introduced by Siebold into Holland in 1829.

² Cf. Fortune, in *Gard. Chron.* 1863, p. 1134.

³ W. Gorrie, in *Gard. Chron.* 1861, p. 51, points out that the shorter-leaved plants bearing fruit were certainly not *C. drupacea*. Fortune, believing that these plants constituted a new species, sent specimens from Chekiang in 1858, which are now preserved in the Lindley herbarium at Cambridge. These specimens, however, are simply a ♀ branch of *C. Fortunei*, and a ♂ branch of *C. drupacea*; and only show, that as both these species occur in Chekiang, the seed which he sent in 1848 may have been in part of hybrid origin.

KETELEERIA

Keteleeria, Carrière, in *Rev. Hort.* 449 (1866); Pirota, in *Ann. R. Ist. Roma*, iv. 200 (1889);

Masters, in *Journ. Linn. Soc. (Bot.)* xxx. 33 (1893).

Abies, Bentham et Hooker, *Gen. Pl.* iii. 442 (in part) (1880) (not Linnæus).

EVERGREEN trees belonging to the division Abietinæ of the order Coniferae, and closely allied to *Abies*, from which they differ mainly in the persistent scales of the cones, in the fascicled staminate flowers, and in the leaves with the midrib prominent on both surfaces and ending in a spine on young plants. Branchlets smooth, with circular depressions, from which the leaves arise. Buds, of numerous imbricated scales, persisting after the branch has developed as a conspicuous sheath at its base. Leaves solitary, spiral on the branchlets, but thrown usually into a pectinate arrangement on lateral branches; linear, with the narrow stalk-like base expanded into a circular disc; acute or retuse at the apex (spine-tipped in young plants); upper surface with the midrib prominent in a longitudinal depression; lower surface with a raised midrib, two longitudinal sets of white stomatic lines, and two green marginal bands; fibro-vascular bundle undivided, with two resin-canals close to the epidermis of the lower surface near the outer angles.

Staminate flowers, in umbel-like clusters, each cluster of five to ten flowers either terminal or in the axil of a leaf on the current year's branchlet, arising on a short stalk covered with imbricated scales; each flower with a stipitate axis bearing numerous anthers, each with two pollen sacs; pollen grains with air-vesicles.

Cones erect on the branches, ripening in one year, and very similar to those of *Abies*, but differing in the persistent bracts and scales, the latter gaping apart to shed the seeds. Seed as in *Abies*, with resin-vesicles, and a hatchet-shaped wing, but detachable from the latter, which envelops it on one surface and two edges.

About five species of *Keteleeria* are known in the living state, natives of China, Formosa, and Tonking. They are closely related¹ to the silver firs, but exist in a warmer and drier climate, to which their varnished coriaceous needles are adapted. The leaves resemble superficially those of *Cephalotaxus*, but are readily distinguishable by the circular disc at the base.

Two species have been introduced into Europe.

¹ They have been erroneously supposed by various authors to be allied to *Pseudotsuga* and *Torreya*.

KETELEERIA FORTUNEI

- Keteleeria Fortunei*, Carrière, in *Rev. Hort.* 1868, p. 132, and 1887, p. 207; Pirotta, in *Bull. Soc. Tosc. Ort.* 1889, p. 200; Masters, in *Gard. Chron.* ii. 440 (1887), and in *Journ. Linn. Soc. (Bot.)* xxvi. 555 (1902); Mayr, *Fremdländ. Wald- u. Parkbäume*, 292, fig. 86 (1906); Clinton-Baker, *Illust. Conif.* i. 73 (1909).
- Picea Fortuni*, Murray, in *Proc. Hort. Soc.* 1862, p. 421.
- Abies Fortunei*, Murray, *Pines and Firs of Japan*, 49 (1863); Hance, in *Journ. Bot.* xx. 32 (1882); Masters, in *Journ. Linn. Soc. (Bot.)* xviii. 519 (1881), xxii. 197, figs. 22-25 (1886), and in *Gard. Chron.* xxi. 348, figs. 64-67 (1884), and xxv. 428, figs. 82, 83 (1886).
- Pinus Fortunei*, Parlatores, in De Candolle, *Prod.* xvi. 2, p. 430 (1868).
- Abies jezoensis*, Lindley, in Paxton, *Flower Garden*, i. 42 (1850), and *Gard. Chron.* 1850, p. 311 (not Siebold and Zuccarini).
- Pseudotsuga jezoensis*, Bertrand, in *Ann. Sc. Nat.* xx. 87 (1874).
- Abictia Fortunei*, Kent, Veitch's *Man. Conif.* 485 (1900).

A tree, attaining in China 80 ft. in height, with thick whitish bark, divided into irregular plates, and somewhat like that of the cork oak. Young branchlets¹ slender, with a scattered short wavy soft pubescence. Buds ovoid, rounded at the apex, with numerous scales. Leaves on adult trees $\frac{1}{2}$ to $1\frac{1}{4}$ in. long, $\frac{1}{8}$ in. wide, linear; rounded, retuse or acute at the apex; midrib prominent in a longitudinal depression on the upper surface; lower surface with twelve to sixteen lines of stomata on each side, extending from the raised midrib nearly to the margin, which shows a very narrow green depressed border.

Leaves on young plants 1 in. long, $\frac{1}{8}$ in. broad, ending in an acuminate apex, tipped by a spine-like point; upper surface as in adult leaves; lower surface with a very narrow raised midrib, and two wide bands, each of sixteen stomatic lines, extending to a linear groove just inside the margin.

Cones on pubescent scaly stalks, nearly cylindrical, 4 to 5 in. long, $2\frac{1}{4}$ in. wide, bluish before ripening, brown tinged with purple when mature; scales about $1\frac{1}{4}$ in. wide, broadly oval with a short claw, concave internally from side to side, with the upper part inflexed, and the margin slightly denticulate; externally covered with slight pubescence towards the base; bract $\frac{5}{8}$ in. long, with a linear claw, expanded above into a denticulate lamina, ending in a sharp mucro. Seeds covering the whole of the scale, except its lateral borders.

This species is a native of the coast range of the province of Fukien in eastern China, where it was seen by Maries² in 1878, growing wild in quantity and associated with *Pinus Massoniana*. It was discovered in 1844 by Fortune, who found a single tree near the Kushan temple, which is situated in the mountains a few miles to the eastward of Foochow at about 2000 ft. elevation. Fortune sent specimens and seed to Messrs. Standish and Noble, who raised young plants, most of which appear to have been distributed on the continent by Van Houtte. None of the original

¹ On the tree at Pallanza the branchlets in November are dark red, with merely traces of pubescence.

² *Hortus Veitchii*, 341 (1906).

plants survived in England, but a fine specimen¹ is growing in Rovelli's nursery at Pallanza, which measured 55 ft. by 8 ft. in 1909. This tree produces seed freely, from which numerous plants have been raised since 1884. Mr. Rovelli states that they are very difficult to transplant; and we know of none which have as yet attained any size in England. (A. H.)

KETELEERIA DAVIDIANA

- Keteleeria Davidiana*, Beissner, *Nadelholzkunde*, 425, fig. 117 (1891); Van Tieghem, in *Bull. Soc. Bot. France*, 411 (1891); Diels, *Flora von Central-China*, 217 (1901); Masters, in *Journ. Linn. Soc. (Bot.)* xxvi. 554 (1902), and in *Gard. Chron.* xxxiii. 84, figs. 37, 38 (1903); Clinton-Baker, *Illust. Conif.* i. 72 (1909).
- Keteleeria sacra*, Beissner, *Nadelholzkunde*, 426 (1891).
- Keteleeria formosana*, Hayata, in *Gard. Chron.* xliii. 194 (1908).
- Abies Davidiana*, Franchet, *Pl. David.* i. 288, t. 13 (1884), and in *Journ. de Bot.* 1899, p. 260; Masters, in *Gard. Chron.* i. 481 (1887).
- Abies sacra*, Franchet, *Pl. David.* i. 290, t. 14 (1884).
- Pseudotsuga Davidiana*, Bertrand, in *Ann. Sc. Nat.* xx. 86 (1874).
- Podocarpus sutchuenensis*, Franchet, in *Journ. de Bot.* 1899, p. 265, ex Diels in Engler, *Jahrb.* xxxvi. No. 5, p. 3 (1905).

A tree, attaining² in China 100 ft. in height and 16 ft. in girth. Young branchlets slender, with short stiff erect hairs. Buds as in *K. Fortunei*, but with scales not keeled on the back. Leaves on adult trees similar to those of that species, but slightly larger, with a wider prominent midrib beneath, on each side of which are nine lines of stomata.

Leaves on young plants $1\frac{1}{4}$ in. long, $\frac{1}{7}$ in. broad, tapering to an acuminate spine-tipped apex; lower surface with a broad green midrib, elevated in the central line as a narrow ridge, two stomatic bands, each of eight to nine lines, and two marginal green bands, near the edge of each of which is a linear longitudinal groove.

Cones sub-sessile or stalked, nearly cylindrical, 6 to 8 in. long, 2 in. in diameter, brown when ripe: scales about 1 in. long and $\frac{3}{4}$ in. wide, ovate, with a rounded or slightly contracted truncate apex, which is inflexed; concave internally from side to side; outer surface minutely pubescent towards the base: bract $\frac{1}{2}$ in. long, with an oblong claw ending in a denticulate lamina, scarcely broader than the claw, and tipped with an acuminate point. Seeds not extending quite to the apex or lateral margins of the scale.

This species, which was discovered by Père David in 1869, is widely distributed throughout the interior of China, occurring in the provinces of Shensi, Hupeh, Szechwan, and Yunnan; and has recently been found in the mountains of Formosa. In China it is a tree of lower elevations than *Abies* or *Picea*, and forms woods in a warm climate on dry hills at about 2000 to 4000 ft. altitude in western Hupeh, and

¹ Figured in *Gard. Chron.* xxv. 428, fig. 83 (1886). According to Carrière, *Rev. Hort.* 1887, p. 211, it was planted in 1859. Carrière adds some interesting details of this species, which he states can be multiplied, but with difficulty, by cuttings and layers.

² I measured a tree of this size in the Wushan district, north of the Yangtse in eastern Szechwan, in 1888.

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at 4000 to 5000 ft. in southern Yunnan. It shows a considerable amount of variation in the wild state; and Franchet described as a distinct species (*Abies sacra*) a form with glabrous branchlets in Shensi. The Formosan tree¹ is distinguished by Hayata² as var. *formosana*.

I sent seed from Hupeh in 1888, which was raised at Kew, where there is a specimen in the Temperate House about 4 ft. high. Wilson³ sent to Coombe Wood in 1901 seeds from western China, which germinated freely, producing hardy plants which are now about 4 ft. high. These appear to constitute two varieties, differing slightly in the length of the foliage.

A log of this species, about 10 in. in diameter, which is now in the Cambridge Forestry Exhibition, was obtained in the mountains of Hupeh by Mr. E. H. Wilson in 1910, during his last voyage in Central China. This was quickly grown, averaging 12 rings to an inch of radius. The wood strongly resembles in appearance that of the common silver fir, and is soft, light, and easily worked. It differs from *Abies* slightly in structure, having resin-canals. (A. H.)

¹ I saw this fine tree in North Formosa in March 1912, at about 2000 ft. above sea-level, in a thick virgin forest at Kinkaryo on the Hokusii river, about 6 miles from Heirimbi. It attains a very large size; but I was unable to measure any old trees on account of the difficulty of reaching them. When the Japanese occupied Formosa it was abundant in this district; but most of the large trees were cut down and used in building houses at Taihoku. I saw in the house of S. Nanasumi, chief of police at Heirimbi, very wide boards, cut from this tree, of a rich purplish brown colour, unlike that of any conifer known to me. A specimen of this wood is now in the Cambridge Forestry Museum. *Keteleeria* is known to the Chinese as *Yu-san*, and to the Japanese as *Shima-momi*. The only other part of Formosa where it is known to occur is near Bosan in the south-west.—H. J. E.

² *Journ. Coll. Sci. Tokyo*, xxv. art. 19, p. 221 (1908).

³ *Hortus Veitchii*, 341 (1906).

PSEUDOLARIX

Pseudolarix, Gordon, *Pinetum*, 292 (1858); Bentham et Hooker,¹ *Gen. Pl.* iii. 442 (1880); Masters, in *Journ. Linn. Soc. (Bot.)* xxii. 208 (1886), and xxx. 32 (1893); Eichler, in Engler and Prantl, *Natur. Pflanzensfam.* ii. pt. i. p. 77 (1889); Sargent, in *Garden and Forest*, x. 501 (1897).
Laricopsis, Kent, Veitch's *Man. Conif.* 403 (1900).

A GENUS belonging to the division Abietinæ of the order Coniferæ, similar to *Larix* in the mode of branching, and in the deciduous needle-like leaves, clustered on the short shoots, and solitary and spiral on the long shoots; differing in the subulate scales of the buds, in the staminate flowers clustered at the tips of leafless short shoots, and in the cones with deciduous scales. *Pseudolarix* comprises one species, a native of China described in detail below.

PSEUDOLARIX FORTUNEI

Pseudolarix Fortunei, Mayr, *Monog. Abiet. Jap.* 99 (1890), and *Fremdländ. Wald- u. Parkbäume*, 392 (1906); Masters, in *Journ. Linn. Soc. (Bot.)* xxvi. 557 (1902), and xxxvii. 424 (1906); Hemsley, in *Bot. Mag.* t. 8176 (1908).
Pseudolarix Kaempferi, Gordon, *Pinetum*, 292 (1858); Masters, in *Gard. Chron.* xxi. 584, figs. 112, 113, and xxii. 238, fig. 48 (1884), and in *Journ. Linn. Soc. (Bot.)* xxii. 208, fig. 32, and plates ix. x. (1886); Clinton-Baker, *Illust. Conif.* ii. 62 (1909).
Abies Kaempferi, Lindley, in *Gard. Chron.* 1854, pp. 255 and 455 (with figure) (not² *Abies Kaempferi*, Lindley, in *Penny Cycl.* i. 34 (1833)); Murray, in *Proc. Hort. Soc.* ii. 644, figs. 172-182 (1862); Fortune, in *Gard. Chron.* 1855, pp. 242, 644, and 1860, p. 170.
Larix Kaempferi, Carrière, in *Flore des Serres*, xi. 97 (1856); Masters, in *Journ. Linn. Soc. (Bot.)* xviii. 523 (1881); Franchet, *Pl. David.* i. 286 (1884).
Pinus Kaempferi, Parlatore, in De Candolle, *Prod.* xvi. 2, p. 412 (not² Lambert).
Laricopsis Kaempferi, Kent, Veitch's *Man. Conif.* 404 (1900).

A tree, attaining in China 120 or 130 feet in height. Bark reddish brown, fissured into small narrow scaly plates. Branchlets of two kinds, long shoots and short shoots or spurs, as in the larches (cf. Vol. II. p. 345). Long shoots in the first year glabrous, glaucous, with linear pulvini, separated by slight grooves; in the second year reddish brown with broad white corky fissures between the pulvini.

¹ Bentham and Hooker mention *Pseudolarix*, in a note under *Larix*, as probably a distinct genus.

² *Pinus Kaempferi*, Lambert, *Genus Pinus*, ii. preface, p. v (1824), and the original *Abies Kaempferi*, Lindley, *Penny Cycl.* i. 34 (1833), were names applied to the true larch of Japan, *Larix leptolepis*, which was first mentioned as "*Larix conifera, nucleis pyramidalis foliis deciduis*," by Kaempfer, *Amen. Exot.* 833 (1712). The name *Abies Kaempferi* was subsequently applied by Lindley in error to the Chinese *Pseudolarix*, which was quite unknown to Kaempfer or to Lambert; and Gordon's name, *Pseudolarix Kaempferi*, founded on Lindley's erroneous application, was rightly changed by Mayr to *Pseudolarix Fortunei*.

Short shoots with annual zones of growth, each zone marked by a depression and a ring of subulate scales. Buds of three kinds, as in the larches; those terminating (*a*) the long shoots and (*b*) the short shoots, conic, surrounded by acuminate scales, ending in long subulate points; and (*c*) lateral buds, solitary in the axils of a few leaves of the long shoots, globose, with rounded or short-pointed scales.

Leaves deciduous, solitary and spirally arranged on the long shoots, and in clusters of fifteen to thirty at the apices of the short shoots; jointed at the base with the tip of a pulvinus, linear, straight or falcate, $1\frac{1}{2}$ to 2 in. long, $\frac{1}{12}$ in. broad, acute or acuminate, green and slightly convex above; under surface with a raised green midrib, two longitudinal channels covered with white stomatic lines, and a narrow thin outer margin. Fibro-vascular bundle undivided; resin-canals three, all close to the epidermis, one in the median line near the upper surface, and two lateral, near the outer edges of the lower surface.

Flowers monœcious. Staminate flowers, pendulous, twenty-five to thirty in a cluster, at the apex of a leafless short shoot, each subtended by loose scarious scales, and including the slender stalk about $\frac{3}{8}$ in. long; anthers twenty, two-celled, opening transversely; pollen grains winged as in *Pinus*, and different from the simple pollen of *Larix*. Pistillate flowers globose, $\frac{3}{4}$ in. in diameter, terminating a short leafy branch, which arises from the apex of a short shoot; ovules, two on each scale, reversed. Cones, erect on the branches, ripening in the autumn of the first year, ovoid, $1\frac{1}{2}$ to 2 in. long; scales numerous, imbricated, coriaceous, reddish brown when ripe, $\frac{3}{4}$ to $1\frac{1}{4}$ in. long, ovate, tapering to a blunt, acute, or notched apex, sagittate at the base, with a claw bent upwards at a right angle, which arises by a narrow linear attachment from the axis of the cone: bract, ovate-lanceolate, $\frac{1}{5}$ to $\frac{1}{3}$ in. long, acuminate, denticulate, adnate to the base of the scale, and deciduous with it. Seeds, two on each scale, which they completely cover with their short body and long wing; wing oval-lanceolate on the outer edge, straight on the inner edge, pale brown, translucent, enclosing the body of the seed on the front and sides in a cavity; body detachable from the wing, white, obovate, with two large resin-vesicles; cotyledons five to seven. As the cone ripens the scales gape apart, showing the wings of the seeds projecting beyond them, and giving them the appearance of a whitish margin. Soon afterwards the scales, bracts, and seeds fall together to the ground, the central axis of the cone being the only part of it left on the branch, as is the case in *Cedrus* and *Abies*.

This remarkable conifer is a native of the provinces of Chekiang and Kiangsu in eastern China, where it is known from two localities, both in about lat. $29^{\circ} 30'$. Fortune discovered it in 1853, in the mountains south-west of Ningpo, where there were some fine trees growing near the Tsan-tsin monastery¹ at 1000 to 1500 ft. elevation; and in 1854 he found a plantation, about twenty miles westward, in the vicinity of the Quan-ting monastery, on a mountain slope at about 4000 ft. altitude, one of the trees, standing alone and clothed with branches to near the ground, being 130 ft. in height and 8 ft. in girth. The Rev. G. E. Moule also found

¹ This monastery is about a day's journey from Ningpo. Cf. Bretschneider, *Hist. Europ. Bot. Disc. China*, 416 (1898).

some trees¹ in the hills west of Ningpo in 1874. The only other locality where this species has been seen is the Lüshan mountains, south of Kiukiang in Kiangsu, where it was discovered by Abbé David in 1868, and afterwards by Maries,² who mentions immense trees; but Wilson³ only succeeded in finding in these mountains, some wild, and half a dozen planted trees, none of considerable size.

Fortune had been acquainted with this tree for some years previously as a dwarf plant⁴ in pots, contrived, though only $1\frac{1}{2}$ to 2 ft. high, to look like an aged Cedar of Lebanon. It appears to be known to the Chinese, as either *chin-sung*, "golden pine," or *chin-lo-sung*, "golden deciduous pine," names applied on account of the beautiful yellow colour of the foliage for a short time before it falls in autumn.

Fortune sent seeds from Chekiang in 1853, and again in 1855 to Glendinning's nursery, Chiswick; but he states⁵ that of all the packages of seed, which he sent for several years in succession, only one batch ever germinated; and that the only plants living in England in 1860 were natural seedlings which had been dug up in the woods of China and sent⁶ home in Wardian cases in 1854.

The tree is perfectly hardy, as it withstood the severe winter of 1859-1860 at Ambleside⁷ and at Hafodunos⁷; and possibly its rarity in collections is due to the small number of plants actually introduced; but it appears to be extremely slow in growth in England. It will not endure lime in the soil, as the seedlings raised and planted at Colesborne soon die. (A. H.)

REMARKABLE TREES

The finest tree that we know of is in a sheltered situation at Carclew, which, when I saw it in 1902, was 35 ft. by 5 ft. In 1910 it was 40 ft. by 5 ft. 2 in. I am told by Mr. Simmons, the head-gardener at Carclew, that he has never found fertile seed on it. There is a healthy tree in the grounds at Hutley Towers near Ryde, which in 1906 was 30 ft. by 2 ft., but it produced no cones either in 1905 or 1906. At Joldwynds, near Dorking, the seat of Sir W. Paget Bowman, Bt., there is a tree, planted about 1879, which is now $27\frac{1}{2}$ ft. by $2\frac{1}{2}$ ft. Though perfectly healthy and branching to the ground it has never produced any seed.

There are several trees at Kew, the largest of which near the main gate is probably one of the original seedlings.⁸ It flowered profusely in June 1907, producing fully developed cones with imperfect seed, no embryo being formed.⁹ It bore cones freely again in 1910; and measured 31 ft. by 2 ft. 4 in. in 1912.

At Tortworth, a tree measured in 1910, 37 ft. by 4 ft. 1 in. Lord Ducie informs me that it was planted on 3rd November 1858, in a bed of sand overlying carboniferous limestone, deep enough, however, to sustain a heavy growth of

¹ Referred by Hance to *Larix dahurica*, but evidently, from the Chinese name "*chin-sung*," used by Moule, he was speaking of *Pseudolarix*.

² Cf. Bretschneider, *op. cit.* 741 (1898).

³ *Var. nana*, Masters, in *Journ. Linn. Soc. (Bot.)* xviii. 523 (1881).

⁴ Fortune, in *Gard. Chron.* 1855, p. 644. Kent says that until the tree coned at Pallanza, plants were obtained by layering.

⁵ In *Gard. Chron.* xlii. 344 (1907).

⁶ In *Gard. Chron.* 1860, p. 170.

⁷ *Gard. Chron.* 1860, pp. 74 and 386.

⁸ It is apparently the tree mentioned by J. Smith, *Records of Kew Gardens*, 290 (1888), as 5 ft. high in 1864.

⁹ According to Masters, in *Gard. Chron.* ii. 440 (1887) and *Journ. Roy. Hort. Soc.* xiv. 68 (1892), this species first produced fruit in England in 1887 at Lucombe and Pince's nursery, Exeter, but this tree is no longer living.

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Rhododendron. The tree is very brittle, and has lost many branches, and is somewhat ragged in look although it is in a very sheltered position. It produced cones on four or five occasions; but in no case did they contain fertile seed.

The Rev. Hon. W. Ellis informs me that at Bothelhaugh, near Morpeth, Northumberland, a tree planted over thirty years ago is under 6 ft. high. At Coombe Wood, the largest specimen measured 35 ft. by 3 ft. 8 in. in 1910. At Scorrier, near Truro, a healthy tree was 30 ft. by 3 ft. in 1911.

We have seen no trees in either Scotland or Ireland.

The finest specimen in Europe is growing in Rovelli's nursery at Pallanza; and measured 64 ft. by 6 ft. 10 in. in 1909. This tree produced staminate flowers in 1884; and since then has coned regularly every two or three years. Large numbers of natural seedlings appear in prepared soil under the tree; and the seed is said to germinate better where it falls, than when collected and sown in pans under glass. As the seeds and scales fall together and close to the parent tree, young seedlings probably succeed best with considerable shade.

In Belgium it is said¹ to have attained no less than 46 ft. in height by 3 ft. in girth at the nursery of the Horticultural Society of Calmpthout, near Antwerp, where seedlings grew as fast as those of the common larch; and Dr. Masters mentioned,² in 1883, a fine tree in Linden's nursery at Ghent.

At Verrières, near Paris, one of the original trees³ is about 35 ft. high and 3 ft. in girth. It produces fruit and fertile seed, but in no great quantity. There is a good specimen⁴ at Karlsruhe, about 35 ft. high, which bore cones for the first time in 1896; the seed, however, was unfertile.

In the United States this tree thrives well, as it delights in hot summers; and Sargent states that he never saw a plant which appeared to suffer from heat or cold, fungoid diseases, or the attacks of insects. The largest specimen⁵ is growing in Parson's nursery at Flushing, Long Island, which was imported from London in 1859 when it was 3 ft. high. It measured in 1895 55 ft. high, with a stem 2 ft. in diameter, and branches 50 ft. across, and has borne seed frequently. Another specimen in Mr. Hunnewell's pinetum at Wellesley, Mass., measured⁶ in 1905 35 ft. in height and 4 ft. in girth, with a spread of branches of 37 ft. This tree has borne seed since 1887, and many seedlings have been raised from it. Sargent reports⁶ another large specimen on Mr. Probasco's estate at Cincinnati. (H. J. E.)

¹ Bull. Soc. Dendr. France, No. 18, p. 162 (1910).

² In Gard. Chron. xix. 88 (1883).

³ Cf. P. L. de Vilmorin, Hortus Vilmorinianus, 66, fig. ix. (1906).

⁴ Cf. Mitt. Deut. Dend. Ges. 1896, pp. 71, fig., and 113.

⁵ Garden and Forest, 1895, p. 415.

⁶ Sargent, Pinetum at Wellesley in 1905, p. 10, and in Garden and Forest, 1897, p. 317.

CATALPA

Catalpa,¹ Scopoli, *Introd. Hist. Nat.* 170 (1777); Bentham et Hooker, *Gen. Pl.* ii. 1041 (1876); Bureau, in *Nouv. Arch. Mus. Hist. Nat.* vi. 169 (1894); Dode, in *Bull. Soc. Dendr. France*, i. 194 (1907).

DECIDUOUS trees, belonging to the order Bignoniaceæ. Branchlets stout, with thick pith; leaf-scars elevated, orbicular, marked with a circle of dots, which are the tiny scars left by the fibro-vascular bundles of the fallen petiole. Buds minute, globose, immersed in the bark, with two to four external scales; all axillary, no true terminal bud being formed, the top of the branchlet dying in summer, and leaving an elevated circular scar close to the upper axillary bud. Leaves simple, opposite or in whorls of threes, entire or lobed, long-stalked, pinnately-nerved, without stipules.

Flowers perfect, in terminal panicles or corymbs.² Calyx gamosepalous, membranous, splitting when the flower opens into two broad ovate entire lobes. Corolla gamopetalous, inserted on a nearly obsolete disc; tube broad, campanulate, oblique, enlarged above into a spreading bilabiate limb, the posterior lip two-partite, the anterior three-lobed. Stamens inserted near the base of the corolla, two, anterior, filaments flattened, anthers bilocular and opening longitudinally. Staminodes similarly inserted, three, posterior, filiform, minute or rudimentary. Ovary sessile, two-celled; style elongated, divided at the apex into two stigmatic lobes³; ovules numerous in several series on a central placenta. Fruit, a long nearly cylindrical capsule, tapering from the middle to each end, persistent on the branches during winter, and ultimately splitting into two valves. Seeds numerous, small, oblong, compressed, inserted in two or four ranks near the margin of the woody septum, with broad lateral wings, notched at the base of the seed, and ending in tufts of long coarse hairs.

The leaves of *Catalpa* show on their lower surface in the axils of the nerves clusters of circular glands which secrete nectar, and are visited by numerous insects, especially ants and bees, the latter getting honey from them as well as from the

¹ *Catalpa* is a corruption of *Catawba*, the name of an Indian tribe that formerly occupied Georgia and the Carolinas.

² Bureau divides the temperate species into two sections:—

(a) *Thyrsoideæ*, comprising *C. bignonioides*, *C. speciosa*, and *C. Kaempferi*; inflorescence a narrow panicle, the secondary axes being branched.

(b) *Corymbosæ*, including *C. Bungei* and *C. Fargesii*; inflorescence a corymb, with simple secondary axes.

³ The stigmatic lobes exhibit sensitive movements, opening and shutting like the leaves of a book, with the visits of bees and other insects. Cf. Masters in *Gard. Chron.* xiii. 651 (1880), and Kerner, *Nat. Hist. Plants*, Eng. Trans. ii. 281 (1898). This phenomenon in *C. bignonioides* has been studied by Meehan, in *Proc. Amer. Assoc. Adv. Sc.* 1873, pp. 72, 73, and in *Bot. Gaz.* viii. 191 (1883); and in the case of *C. speciosa* by Antisdale, in *Bot. Gaz.* viii. 171 (1883).

flowers. These glandular areas, which are large and conspicuous near the base of the leaf, bear no pubescence.¹

The seedlings² of *Catalpa* have stalked deeply bifid obovate cotyledons raised above ground, and followed on the stem by opposite decussate or ternately verticillate ovate leaves.

Catalpas may be propagated³ by both stem and root cuttings.

Eight species of *Catalpa* are known, of which three are natives of the West Indies and not hardy. The West Indian species constitute a distinct section, characterised by lanceolate or elliptic leaves. The remaining five species, with ovate leaves, inhabit the United States and China; and have all been introduced into cultivation in Europe. They may be arranged as follows:—

I. *Leaves glabrous.*

1. *Catalpa Bungei*, Meyer. China. See p. 1489.

Leaves, with a disagreeable peculiar odour, entire with a long slender acuminate apex, or with one or two long-pointed lateral lobes, or coarsely serrate in margin.

II. *Leaves pubescent with simple hairs.*

* *Branchlets glabrous.*

2. *Catalpa bignonioides*, Walter. United States. See p. 1485.

Leaves, with a disagreeable peculiar odour, usually entire with a short apex, glabrous above, pubescent beneath, the pubescence not covering the whole surface of the midrib.

3. *Catalpa speciosa*, Warder. United States. See p. 1483.

Leaves inodorous, usually entire with a long acuminate apex, glabrous above, pubescent beneath, the pubescence covering the midrib entirely.

** *Branchlets with stiff glandular hairs.*

4. *Catalpa Kaempferi*, Siebold and Zuccarini. Wild in Central China, long cultivated in Japan. See p. 1487.

Leaves inodorous, usually three-lobed; pubescent on the upper surface throughout, and on the lower surface on the midrib and nerves.

III. *Leaves tomentose with branched hairs.*

5. *Catalpa Fargesii*, Bureau. Central China. See p. 1490.

Leaves entire or with one or two acute lateral lobes; tomentose on the lower surface throughout, and on the upper surface mainly on the nerves.

(A. H.)

¹ Cf. Ryder in *Proc. Philad. Acad.* 1879, p. 161, and *Amer. Nat.* xiii. 648 (1879). The glandular areas are greenish in the two species from the United States, and purplish in the three Chinese species. They are almost entirely confined to the base of the leaf in *C. Fargesii* and *C. Bungei*; but are also present in the upper axils of the leaf in *C. Kaempferi*, *C. speciosa*, and *C. bignonioides*.

² Described by Lubbock, *Seedlings*, ii. 335, 339, fig. 571 (1892).

³ Cf. J. Clarke in *Gard. Chron.* xlvii. 100 (1910).

CATALPA SPECIOSA, WESTERN CATALPA

Catalpa speciosa,¹ Warder, *ex Engelmann*, in *Bot. Gaz.* v. 1 (1880); Sargent, *Silva N. Amer.* vi. 89, tt. 290, 291 (1894), and *Trees N. Amer.* 795 (1905); Bureau, in *Novv. Arch. Mus. Hist. Nat.* vi. 184 (1894); André, in *Rev. Hort.* lxxvii. 136, fig. (1895); Hall and Schrenk, *U.S. Dep. Agric. Bur. Forestry, Bull.* No. 37 (1902); Roberts and Dickens, *Kansas State Agric. College, Bull.* No. 108 (1902); Dode, in *Bull. Soc. Dendr. France*, i. 195 (1907).
Catalpa cordifolia, Jaume, in Duhamel, *Traité des Arb.* ii. t. 5 (1802) (excl. text) (not Moench).

A tree, rarely attaining in America 120 feet in height and 14 feet in girth, usually smaller. Bark thick, deeply furrowed, and roughened with scales. Young branchlets glabrous. Leaves similar to those of *C. bignonioides*, but without their peculiar odour, often larger, up to 10 in. long and 7 in. wide, with longer acuminate points; glabrescent above; lower surface with the pubescence of simple hairs more marked than in *C. bignonioides*, spreading over the whole of the midrib and extending to the petioles.

Flowers appearing two weeks earlier than those of *C. bignonioides*, few in open panicles, which are about 6 in. long and broad; calyx purplish, glandular-pubescent; corolla white, 2 in. long, 2½ in. wide, often spotted externally with purple near the base; marked internally on the lower side with two bands of yellow blotches following two lateral ridges, and a few purple spots on the lobes of the lower lip of the limb. Fruit, 8 in. to 20 in. long, ½ in. to ¾ in. in diameter in the middle, with a thick wall, splitting into two concave valves. Seeds 1 in. long, ½ in. wide, light brown, with wings rounded at the ends and ending in a fringe of short hairs.

C. speciosa under favourable conditions differs from *C. bignonioides* in habit, forming a narrow tree with ascending branches; but in the arboretum at Segrez, where there are old trees of both species, they are nearly alike in appearance. They are readily distinguished by their flowers, fruits, and seeds; but when these are absent, the main distinctive character is the odour of the leaves.²

This species in its natural range is confined to a limited region, extending from the valley of the Vermilion river, Illinois, through southern Illinois and Indiana, western Kentucky and Tennessee, south-eastern Missouri, and north-eastern Arkansas. It comes in contact with *C. bignonioides* in south-eastern Missouri; and is abundant and of its largest size in southern Illinois and Indiana. It has become naturalised through cultivation in southern Arkansas, western Louisiana, and eastern Texas.

It has been planted in the United States as far north as South Dakota, southern Michigan, and Minnesota, and southern Massachusetts; and westward to eastern

¹ Warder, in *Western Hort. Review*, iii. 533 (1853), was the first to distinguish *C. speciosa*, but did not then publish this specific name. It appears to have been first used by Sargent, who, in *Gard. Chron.* xii. 784 (1879), points out that the western *Catalpa* differs from *C. bignonioides*; and says that if distinct, it should be known as *C. speciosa*.

² W. H. Lamb, in *Proc. Soc. Amer. Foresters*, vii. 80, figs. 1, 2 (1912), points out that the septum of the pod (the long wrinkled partition along which the seeds are arranged) is nearly circular in section in *C. speciosa*, and lenticular or narrowly elliptic in *C. bignonioides*.

Nebraska, Kansas, and Oklahoma. It has succeeded on irrigated lands in New Mexico, Utah, and Colorado, at low altitudes and where the soil is free from alkali. The range for economic planting appears to be on the fertile alluvial lands of the middle west, south of lat. 41° .

This species, though only distinguished by Warder as late as 1853, appears to have been introduced early into France, as it was figured in *Nouveau Duhamel* in 1802; but no trees so old as this are now known in Europe. Prof. Sargent sent seeds to Kew in 1880, and probably about the same time to Segrez and Les Barres in France. At Kew *C. speciosa*, though forming a better tree than *C. bignonioides*, is very slow in growth, the tallest example, now thirty years old, from seed, being about 25 feet high. It is perfectly hardy, as it has borne at Kew 0° Fahr. without injury, and does not suffer in the severe winters of New England. Bureau states that on M. André's property in Touraine it did not suffer from a temperature of -26° Cent.

It came into vogue in America as a tree for planting to produce timber quickly about 1879 to 1883, when large plantations were made by R. Douglas, near Farlington in Kansas, which are now owned by the railway company. One forty-acre tract of these plantations is, however, *C. bignonioides*. (A. H.)

CULTIVATION

An immense quantity of literature on this species has appeared in America, mainly by Mr. John P. Brown of Connersville, Indiana, who devoted a great part of his magazine, *Arboriculture*, to advocating the economic value of this tree. Though this publication contains many illustrations and details on the growth of the Catalpa in many localities and under varied conditions, it has more interest for American than for British readers, and our space will not allow me to refer to them in detail. There seems to be little doubt that in the rich alluvial valleys of the Ohio, Tennessee, Arkansas, and other tributaries of the Mississippi, its growth is very rapid when young, and it is one of the most valuable trees for fencing, lumber, railway sleepers, and other purposes,¹ on account of the durability of its timber; but it requires a much longer and hotter summer than any part of our islands afford. The latest account of this species is by Oman,² who studied the results obtained by four plantations in Kansas, which were cut in 1902-1906. He gives valuable hints regarding the proper mode of planting, and states that the financial returns on deep fertile porous soil are remarkable. This tree endures inundation, one plantation having been completely submerged for a week without injury. It coppices freely, and can even be propagated by cuttings; but suckers from the roots have not been observed.

Large quantities of seedlings have been raised and distributed in this country on several occasions,³ but we cannot hear of a single place in which they show any

¹ It is also a suitable timber for furniture, as shown by an arm-chair given me by Mr. Brown at Louis in 1904, which has handsome grain, takes a good polish, and has worn well.

² *Proc. Soc. Amer. Foresters*, vi. 42-52 (1911).

³ About 150 trees of this species, which were raised from seed in the Royal Horticultural Society's garden at Chiswick in 1880, were distributed widely to the members; but we have not seen any of these (*Gard. Chron.* xlvii. 245 (1910)).

signs of becoming a timber tree. I agree entirely with the opinion that Mr. Bean has expressed in *Kew Bulletin*, 1907, p. 43, that it is improbable that this tree can be grown anywhere in England with any hope of profit, though as an ornamental tree of small size it may have considerable value in favourable situations.

A plantation of it was made near Tottenham House, Marlborough, by the Marquess of Ailesbury, where the young trees in 1907 were 3 to 6 ft. high, but so far as we can learn they grow slowly and do not ripen their wood in autumn, which is the case with those I have raised myself. (H. J. E.)

CATALPA BIGNONIOIDES, COMMON CATALPA

Catalpa bignonioides, Walter, *Fl. Car.* 64 (1788); Bureau, in *Nouv. Archiv. Mus. Hist. Nat.* vi. 175 (1894); Dode, in *Bull. Soc. Dendr. France*, i. 194 (1907); Sargent, in *Bot. Gaz.* xlv. 226 (1907).

Catalpa cordifolia, Moench, *Meth.* 464 (1794); Nuttall, *Gen. N. Amer. Pl.* i. 10 (1818).

Catalpa communis, Dumont de Courset, *Bot. Cult.* ii. 189 (1802).

Catalpa syringifolia, Sims, in *Bot. Mag.*¹ t. 1094 (1808); Loudon, *Arb. et Frut. Brit.* iii. 1261 (1838).

Catalpa Catalpa, Karsten, *Pharm. Med. Bot.* 927 (1882); Sargent, *Silva N. Amer.* vi. 86, tt. 288, 289 (1894), and *Trees N. Amer.* 793 (1905).

Bignonia Catalpa, Linnæus, *Sp. Pl.* 622 (1753) (in part).

A tree, rarely attaining in America 60 ft. in height and 10 ft. in girth, usually smaller. Bark separating on the surface into large thin irregular scales. Young branchlets glabrous. Leaves (Vol. III., Plate 204, Fig. 5) emitting when bruised a disagreeable odour, ovate, about 5 to 6 in. long, and 4 to 5 in. wide; cordate, truncate, or cuneate at the base, contracted into a slender acuminate point or rounded at the apex, usually entire or occasionally with one or two slight lateral lobes, glabrous above, pubescent with simple hairs on the nerves and veinlets beneath, the pubescence on the midrib being confined to its edges close to the surface of the blade; glandular areas pale; petioles glabrous.

Flowers numerous in a compact panicle, about 8 to 10 in. long and broad; calyx glabrous, green or light purple; corolla white, $1\frac{1}{2}$ in. long and wide, marked on the inner surface on the lower side by two rows of yellow blotches along two parallel ridges or folds, and on the throat and lower lobes of the limb by numerous conspicuous purple spots. Fruit, 6 to 20 in. long, $\frac{1}{4}$ to $\frac{1}{3}$ in. thick in the middle, with a thin wall, splitting into two flat valves. Seeds about 1 in. long, $\frac{1}{4}$ in. wide, silvery grey, with pointed wings, ending in long pencil-like tufts of white hairs.

The following varieties have arisen in cultivation:—

1. Var. *aurea*, Lavallée, *Arbor. Segrez.* 175 (1877).

Leaves pale yellow, retaining their colour throughout the season. One of the best golden-leaved small trees² in cultivation. Its origin is unknown to me.

2. Var. *purpurea*, Rehder, in Bailey, *Cycl. Amer. Hort.* i. 258 (1900).

Leaves purplish, with dark purple glandular spots. It is said by Nicholson to

¹ The plate was drawn from a branch of a tree growing in Mr. Granger's garden at Exeter in 1808.

² A specimen at Kew is figured in *Gard. Mag.* 1910, p. 709.

have originated in the United States, and is possibly a hybrid. It is cultivated by Simon-Louis at Metz.

3. Var. *variegata*, Bureau, *op. cit.* 183.

Variiegated with white or yellow. In var. *Koehnei*, Dode, *op. cit.* 206, the leaves are pale yellow, with irregular angular green patches. Cultivated by Simon-Louis.

4. Var. *erubescens*, Nicholson, in *Woods and Forests*, 1885, p. 52.

Catalpa erubescens, Carrière, in *Rev. Hort.* l. 460 (1869).

This form, which I have not seen, is said to have purplish petioles and glandular spots, with a more compact inflorescence, and a more highly coloured corolla with a less deeply divided limb than the type. It is possibly, as Dode suggests, a hybrid.

5. Var. *nana*, Bureau, *op. cit.* 183.

A low spreading bush, with crowded branches, occasionally grafted high. The leaves are identical in odour and in all other respects with *C. bignonioides*; and there are no grounds for supposing it to be a form of *C. Bungei*, under which name it is commonly known in nurseries and gardens. It has not yet flowered anywhere, and appears to have been first cultivated at Segrez¹ in 1877, where it may possibly have arisen as a sport.

C. bignonioides is a native of the eastern part of the United States; but the exact localities where it is truly native cannot be determined with certainty. It is usually supposed to be indigenous on the banks of rivers in south-western Georgia, western Florida, and central Albania and Mississippi, and to be naturalised throughout the south Atlantic States. On account of its handsome flowers it was extensively planted for ornament; and its dissemination has been aided by its winged seeds, which are borne to a considerable distance by the wind and float on water without injury for a long period. As it bears moderately severe winters it may possibly have been a native of the more northern parts of the Alleghany range, where it is not now met with in the existing forests. It thrives as far north as Philadelphia, but is killed during the winter at Rochester on Lake Ontario, and often succumbs at St. Louis.²

(A. H.)

The first account of this species was published in *The Natural History of Carolina* by Catesby, who introduced³ it into England in 1726.

The largest tree mentioned by Loudon was one at Syon, 52 ft. high and 3 ft. in diameter, of which only the dead stump remains, but there is a spreading tree grown from one of its layered branches on the north side of the lake which was in flower in July 1912 when I saw it last. A tree at Kew, which died in 1907, when it was about sixty years old, was 30 ft. high and 6 ft. 1 in. in girth. A tree in the Terrace Gardens, Richmond, was 35 ft. by 8 ft. 1 in. in 1912. A fine specimen⁴ in Mr. Denne Dunn's garden at Canterbury was 32 ft. high in 1876. At Caldrees, Ickleton, near Cambridge, there is a fine tree, which flowers freely every year; it is about 35 ft. high and 7 ft. in girth.

¹ Lavallée, *Arb. Segrez.* 176 (1877), where it is named *C. Bungei*, var. *nana (pumila)*. Cf. also Lavallée, *Icon. Arb. Segrez.* ii. 35 (1880).

² R. Douglas, in *Woods and Forests*, 1884, p. 566.

³ Aiton, *Hort. Kew.* ii. 346 (1789).

⁴ Figured in *Gard. Chron.* v. 13, fig. 2 (1876). In *Gard. Chron.* xxvi. 257 (1897) mention is made of a large tree at Rosslyn, Stamford Hill.

There are many trees of considerable age, but of no great height, in parks and places¹ in and around London, the best known of which was one at Gray's Inn, which died a few years ago. This *Catalpa* was reported by tradition to have been brought from America by Sir W. Raleigh, and to have been planted by Bacon; but there is no good authority for this, and the tree is not long-lived in England.

At Ham Manor, near Arundel, I saw a very well-shaped tree (Plate 350) in 1907 which measured 52 ft. by 7 ft. with a clean bole 15 ft. high. There is a tree at Heywood, Wilts, which, in 1906, was about 30 ft. high and 15 ft. in girth below the branches. A photograph sent me by the then gardener, Mr. Robinson, showed it in full flower as a very beautiful tree. Another at Elbridge, as measured by Mr. Furze in 1904, was 41 ft. high, 14 ft. in girth, and had a spread of 61 ft. A fine old tree at Wilton House, Wilts, was, when I saw it in 1906, showing signs of decay, but measured 53 ft. by 6½ ft. (H. J. E.)

CATALPA KAEMPFERI

Catalpa Kaempferi, Siebold and Zuccarini, in *Abhand. Akad. München*, iv. pt. ii. p. 142 (1846); J. D. Hooker, *Bot. Mag.* t. 6611 (1882); Lavallée, *Icon. Arb. Hort. Segrez.* 33, t. 10 (1885); Hemsley, in *Journ. Linn. Soc. (Bot.)* xxvi. 235 (1890); Bureau, in *Nouv. Arch. Mus. Nat. Hist.* vi. 190 (1894).

Catalpa ovata,² G. Don, *Gen. Syst.* iv. 230 (1837); Sargent, *Silva N. Amer.* vi. 84, note (1894).

Catalpa Bungei, Decaisne, in *Rev. Hort.* v. 406 (1851) (not C. A. Meyer); Carrière, in *Flore des Serres*, viii. 8 (1852); Jacques, in *Flore des Serres*, x. 188 (1855).

Catalpa Henryi, Dode, in *Bull. Soc. Dend. France*, i. 199 (1907).

Bignonia Catalpa, Thunberg, *Fl. Jap.* 251 (1784) (not Linnæus).

A tree, attaining 70 ft. in height; bark brown, slightly fissured. Young branchlets with numerous sessile glands and scattered stiff glandular hairs.³ Leaves (Vol. III. Plate 204, Fig. 6) without a disagreeable or peculiar odour, ovate, variable in size, averaging 5 to 6 in. in width and length, cordate at the base, shortly acuminate at the apex; rarely entire, usually with one or two (occasionally three or four) triangular sharp-pointed lateral lobes; upper surface covered with a minute pubescence, the nerves often purple and with scattered long hairs; lower surface pubescent on the nerves and veinlets; petiole with glands and glandular hairs, as on the branchlets.

Flowers numerous in much-branched panicles, which are 4 to 9 in. long; calyx glabrous; corolla pale yellow, about ¾ in. long and broad, marked externally with two orange bands and numerous purple spots. Fruit, 7 to 12 in. long, cylindrical, ½ in. in diameter, with a thin wall, splitting into two concave valves. Seeds, ⅓ in.

¹ Mr. Hugh Boyd Watt, in an article on *Catalpas* in London and neighbourhood, which appeared in *The Field*, Feb. 17, 1912, states that there was abundance of fruit in the autumn of 1911 on the trees in Victoria Embankment gardens, Brunswick Square, Hampstead, Richmond, Kew, and Syon House. Six large trees in Palace Yard, Westminster, bore no fruit, though they flowered in the preceding summer. There was no fruit formed in 1909 and 1910; but there was a good crop in 1906.

² This is the oldest name of the species; but it has never been in use.

³ These peculiar hairs, which are characteristic of this species, are deciduous in the course of the season.

long, $\frac{1}{8}$ in. wide, greyish brown, with pointed wings ending in long pencil-like tufts of white hairs.

This species is much planted in gardens and around temples in Japan; but is not a native of that country, according to the Japanese botanists, who state that it was introduced at an early period by the Buddhist monks. It was found wild¹ in central China by myself and by Wilson in western Hupeh, and by Giraldi² in Shensi.

It was first made known to Europeans by Kaempfer, who visited Japan in 1690, and published³ in 1712 a good description and figure of the tree. It is usually known in Japan as the *Ki-sasage*, or "bean-tree" on account of its peculiar pods. Dupont, in a letter to Lavallée, mentions that he never saw this tree in the forest in Japan, but always planted, and records one 75 ft. in height and 5 ft. in girth growing near a temple.

It was introduced into Europe from Japan by Siebold in 1849, and has probably thriven best at Segrez, where Lavallée mentions a tree, which covered an area over 40 yards in circumference. It appears to be much hardier both in France and at Boston⁴ (U.S.) than *C. bignonioides*.

Plants raised from seed⁵ sent from central China by Wilson to Coombe Wood, and by Père Farges to Les Barres, appear to be identical in all respects⁶ with trees of Japanese origin.

The finest specimen of *C. Kaempferi* known to us in England is a tree at Syon, which measured, when Elwes saw it in July 1912, 62 ft. by 5 ft. 1 in. It was then in full flower, with capsules of the previous year containing ripe seeds. The oldest tree at Kew, about 20 ft. high, was procured from Volxem in 1879.

A remarkable hybrid has arisen between *C. Kaempferi* and *C. bignonioides*:—*Catalpa hybrida*,⁷ Späth, in *Gartenflora*, lvii. 481, t. 1454 (1898).

Catalpa × J. C. Teas, Sargent, in *Garden and Forest*, ii. 303, fig. (1889); *Catalpa Teasiana*, Dode, in *Bull. Soc. Dend. France*, i. 205 (1907).

A tree, said to be of remarkably vigorous growth, resembling *C. Kaempferi* in foliage, but intermediate in flowers and fruit between that species and *C. bignonioides*. It produces extremely large panicles, 18 to 20 in. long and 10 in. wide, of 200 to 300 fragrant flowers, about 1 in. long; corolla tinged with yellow in the throat and marked with broad purple stripes. Fruit 12 to 15 in. long, $\frac{1}{4}$ in. wide.

This hybrid was raised about 1880 in J. C. Teas' nursery at Baysville, Indiana, from seed out of a peculiar single pod which was observed on a tree of *C. Kaempferi*. The latter grew near trees of both *C. bignonioides* and *C. speciosa*, but the pollen

¹ It is figured in the *Chih Wu Ming*, xxxiii. pl. 48 (1848).

² Cf. Diels, in Engler, *Jahrb.* xxxvi. heft 4, p. 98 (1905).

³ *Aman. Exot.* 842 (1712).

⁴ Sargent, in *Gard. Chron.* xii. 784 (1879).

⁵ Sargent, in a letter to Kew, dated 2nd February 1900, states that seeds received from Shanghai in 1892 of reputed *C. Bungei*, produced plants of *C. Kaempferi*.

⁶ A young tree at Kew, 10 ft. high, of Chinese origin, bears leaves identical in odour, shape, pubescence, and colour, with an older tree of Japanese origin. Specimens sent from Les Barres show no differences.

⁷ Dode, *op. cit.* 204, identifies *C. hybrida*, Späth, with *C. erubescens*, Carrière, described above, p. 1486. Rehder, however, in Bailey, *Cycl. Am. Hort.* i. 258 (1900), considers Späth's description to refer to Teas' hybrid; and this appears to be correct. Späth does not say, as Dode asserts, that the hybrid originated in his nursery.

appears to have come from the former. As Sargent points out, *C. bignonioides* and *C. Kaempferi* flower at the same time, whereas *C. speciosa* is two to three weeks earlier than *C. Kaempferi*. Moreover, Penhallow,¹ by an examination of the wood of the different species of *Catalpa* and of the hybrid, has shown conclusively that the latter is a cross between *C. bignonioides* and *C. Kaempferi*, in which the characters of the latter are dominant; and that *C. speciosa* was in no way concerned in its production. Penhallow adds, that some of the seedlings of the hybrid, but not all, revert to *C. Kaempferi*.

"Teas' Japan hybrid," as it is commonly called, was introduced into Kew gardens in 1891, and flowered in 1900 and succeeding years, but has not produced fruit. At Kew it shows no excessive vigour.

C. japonica, Dode, in *Bull. Soc. Dend. France*, i. 200 (1907), said to have been introduced from Japan in 1886 by Simon-Louis, is unknown to me; but from the description appears to be another hybrid between *C. bignonioides* and *C. Kaempferi*. (A. H.)

CATALPA BUNGEI

Catalpa Bungei, C. A. Meyer, in *Bull. Acad. Sc. St. Pétersb.* ii. 51 (1837); Maximowicz, *Prim. Fl. Amur.* 475 (1859); Kurz, in *Journ. Bot.* ii. 193 (1873); Lavallée, *Arbor. Segrez.* 176 (1877); Hance, in *Journ. Bot.* xi. 37 (1882); Franchet, *Pl. David.* i. 229 (1884); Hemsley, in *Journ. Linn. Soc. (Bot.)* xxvi. 234 (1890); Bureau, in *Nouv. Arch. Mus. Hist. Nat.* vi. 197, pl. 4 (1894); Bean, in *Kew Bull.* 1907, p. 102.

Catalpa syringifolia, Bunge, *Enum. Pl. China Bor.* 45 (1835) (not Sims).

Catalpa heterophylla, Dode, in *Bull. Soc. Dend. France*, i. 203 (1907).

Catalpa Duclouxii, Dode, in *Bull. Soc. Dend. France*, 1907, p. 201, and 1909, p. 154.

A tree, attaining in China 40 feet in height. Young branchlets glabrous, covered with minute glands. Leaves with a disagreeable odour, variable in size and shape, about 5 in. long and 4 in. wide, ovate or deltoid, cuneate or truncate at the base, ending in a long slender acuminate apex; entire, or with two lateral long-pointed lobes, or with several irregular acute teeth on each side; upper surface dark green, shining, glabrous; lower surface pale green, glabrous; petiole glabrous.

Flowers, three to nine, in a loose corymb; axis and pedicels glabrous or with a few simple hairs; calyx glabrous, green below, pink above; corolla, $1\frac{1}{4}$ in. long, with a wide campanulate tube, which is tinged with yellow along two projecting ridges and is elsewhere spotted purple, and a white five-lobed limb, with numerous purple dots, which give the whole flower a decidedly pinkish tint. Fruit, described as very long and slender, 25 to 40 in. in length and $\frac{1}{8}$ in. in diameter. Seeds greyish brown, $\frac{3}{8}$ in. long, with narrow pointed wings, ending in pencil-like tufts of pale yellow hairs.

The foliage of this tree is very variable—entire or two- to three-lobed leaves occurring on old trees; whilst those with a dentate margin are characteristic of

¹ In *Amer. Naturalist*, xxxix. 113, figs. 1-8 (1905).

branches ending in an inflorescence, and are normally developed on the ordinary branches of young trees. As both forms occur on the same individual, var. *heterophylla*, Meyer, cannot be maintained as a distinct variety.¹ In northern China, the leaves are quite glabrous; but in the mountains of central China, there are traces of pubescence (simple hairs) on the upper surface of the leaves and on the petioles. Specimens with more numerous flowers in the corymb, which has one or two of the lateral axes branched, have been considered to be a distinct species, *C. Duclouxii*, Dode; but these are probably trees of greater vigour and not even a distinct variety.

C. Bungei is readily distinguishable by its glabrous shining leaves, with longer and more slender points to the lobes than is the case in the other species.

This tree is widely spread throughout the mountains of China, from Peking in the north to Yunnan in the south-west, and is also recorded from the coast provinces of Shantung and Chekiang. Wilson found it in Szechwan at 8850 feet altitude, as a "tree 40 ft. in height, with white flowers suffused and spotted with pink." In Hupeh, it grows at about 4000 to 5000 feet elevation in the mixed forests of deciduous trees, and, my notes state, "40 feet high, 4 feet in girth, with pinkish flowers, which, together with the leaves, are of a disagreeable odour." It is much planted in temple grounds, at Peking, Shanghai, and elsewhere, and is usually known as the *chiu* tree.² It flowers at Peking in May.

This species is very rare in cultivation, the plants generally sold under this name by nurserymen being either the dwarf form of *C. bignonioides* or *C. Kaempferi*. Bureau knew of only one living specimen in France, a small tree at Segrez, which had not produced flowers.

It was introduced³ about 1904 into the Arnold Arboretum by seed procured from Peking; and a tree sent by Sargent to Kew in 1905 is now about 8 feet high.

(A. H.)

CATALPA FARGESI

Catalpa Fargesii, Bureau, in *Novv. Archiv. Mus. Hist. Nat.* vi. 195, pl. 3 (1894); Dode, in *Bull. Soc. Dend. France*, i. 204 (1907).

Catalpa vestita, Diels, in *Engler, Jahrb.* xxix. 577 (1900).

A small tree, distinct from the other species, in the presence of stellate tomentum or branched hairs on the young branchlets, leaves, axes of the inflorescence, pedicels, bracts, and calyx. Leaves about 5 in. long and 4 in. broad, entire or with one or two acute lateral lobes, subcordate at the base, acuminate at the apex; tomentose on the lower surface throughout, on the upper surface mainly on the nerves.

¹ Cf. Bretschneider, *Bot. Sincium*, in *Journ. N. China Branch, R. Asiat. Soc.* xvi. 112 (1882), who states that "the leaves on the same tree are very variable, cordate, entire, lobed, lacinate, triangular, sinuate, etc."

² Bretschneider gives an account of the Chinese literature of this tree in *Bot. Sin.* ii. 339 (1882) and iii. 478 (1895). The classical name *tze*, with which he identifies the *Catalpa*, possibly indicated *Sassafras Tsumu*. Cf. vol. iii. p. 515.

³ Cf. Rehder, in *Mitt. Deut. Dend. Ges.* 1907, p. 76.

Flowers few, seven to ten in a compact corymb; calyx covered externally with stellate tomentum; corolla, similar in size to that of *C. Bungei*, white, spotted with reddish brown dots. Fruit 18 to 20 in. long, $\frac{1}{5}$ in. in diameter. Seeds yellowish grey, about $\frac{2}{5}$ in. long, with sharp-pointed wings, ending in long silky hairs.

C. Fargesii is a native of western China, where it has been found in the mountains of Szechwan and Shensi by Farges, Giraldi, and Wilson. The latter introduced¹ it in 1901. Young plants show merely slight traces of the branched hairs on the branchlets and leaves, which are so characteristic of wild specimens; but as they grow older this peculiar pubescence may increase in quantity. Plants of this species, raised from seed sent by Wilson (Nos. 636 and 640) in 1905, are growing freely at Colesborne, where they have endured 30° of frost without injury, though the wood does not ripen well in autumn. These are now 4 to 6 ft. high. There are also young plants at Kew and Aldenham. (A. H.)

¹ *Journ. Roy. Hort. Soc.* xxviii. 50 (1902).

PAULOWNIA

Paulownia,¹ Siebold and Zuccarini, *Fl. Jap.* i. 25 (1835); Bentham et Hooker, *Gen. Pl.* ii. 939 (1876); Dode, in *Bull. Soc. Dend. France*, 1908, p. 159; Schneider, *Laubholzkunde*, ii. 618 (1911).

DECIDUOUS trees belonging to the order Scrophulariaceæ. Branchlets with chambered pith, showing in winter large oval raised opposite leaf-scars. Buds axillary, no true terminal bud being formed, minute, covered with two or four pubescent scales. Leaves simple, opposite in decussate pairs, stalked, ovate, cordate.

Flowers in large terminal erect panicles, opening in spring before the leaves; calyx five-cleft, campanulate, persistent at the base of the fruit; corolla gamopetalous, inserted on the base of the calyx, with a long slightly curved tube, and five spreading lobes, the three lower lobes longer than the two upper lobes; stamens four, affixed to the tube of the corolla, didynamous, included, with divaricate anthers; ovary superior, two-celled, with numerous ovules; style one, slender, slightly thickened towards the summit, stigmatic on the inner side. Fruit, ripening in one year, a two-celled woody or coriaceous capsule, ovoid, loculicidally dehiscent by two valves; placentæ two, ovate, compressed; seeds numerous, minute, oblong, surrounded by a broad translucent striated wing.

Two species of *Paulownia*² have been clearly distinguished, one of which, little known and not in cultivation in England, may be here briefly described.

I. *Paulownia Fortunei*, Hemsley, in *Journ. Linn. Soc. (Bot.)* xxvi. 180 (1890).

Leaves narrowly oval, longer and more acuminate than in *P. tomentosa*, covered beneath with a dense whitish tomentum. Flowers longer and relatively narrower than in *P. tomentosa*; calyx-lobes deltoid, obtuse, usually brown tomentose throughout, occasionally glabrescent except on the borders. Fruit, 3 to 3½ in. long, narrowly ovoid; seeds ¼ in. long, much larger than those of *P. tomentosa*.

¹ Named after Anna Paulowna, Queen of the Netherlands.

² Hayata, in *Bull. Congrès Internat. Bot. Bruxelles*, 41, pl. 24 (1910), and in *Journ. Coll. Sci. Tokyo*, xxx. 209 (1911), mentions a possible new species in Formosa. Elwes saw this in 1912 at a village near Horisha in Central Formosa; but it was not in leaf. There is also a supposed new species from Western China, raised at the Arnold Arboretum from seed sent by E. H. Wilson. It is in cultivation at Kew and Aldenham; but the young plants cannot at present be distinguished from *P. tomentosa*. Cf. *Gard. Chron.* xlvi. 275, fig. 116 (1910).—A. H.

I raised seedlings from Mr. Wilson's seeds, No. 769, collected in his journey of 1908 in Western China, which appear at three years old to be hardier and more rapid in growth than those which I have raised from the common species. The seedlings of the latter were killed to the ground for three years after planting out; whilst the West China form is now, at three years old, 14 ft. high, of which 10 ft. is the growth of 1911. This form seems likely to be a most ornamental tree even in cold parts of England; but must be planted in warm sheltered places where its immense juvenile leaves, measuring 21 in. by 23 in., will not be torn by wind.—H. J. E.

This species, which is probably smaller in size than *P. tomentosa*, occurs both in the north of China, where it has been collected at Chefoo, and in the south, where it has been found in the province of Kwangtung.

P. Duclouxii,¹ Dode, in *Bull. Soc. Dend. France*, 1908, p. 162, is apparently a variety with white flowers, tinged with pink, and not spotted as in the type. This is said to have been raised by C. Sprenger² of Corfu from seed, which he received from Dr. Dode.

PAULOWNIA TOMENTOSA

Paulownia tomentosa, Koch, *Dendrologie*, ii. pt. 1, p. 299 (1872); Shirasawa, *Icon. Ess. Forest. Japon*, i. text 129, t. 85 (1900).

Paulownia imperialis, Siebold and Zuccarini, *Fl. Jap.* i. 27 (1835); Loudon, *Trees and Shrubs*, 671 (1842); W. J. Hooker, *Bot. Mag.*³ t. 4666 (1852); Hemsley, in *Journ. Linn. Soc. (Bot.)* xxvi. 180 (1890).

Bignonia tomentosa, Thunberg, *Fl. Jap.* 252 (1784).

A tree, attaining 80 ft. in height and 12 ft. in girth. Young branchlets green, glandular, and pubescent. Leaves broadly ovate, about 7 to 8 in. long, and 6 to 7 in. wide, cordate at the base, shortly acuminate at the apex, undivided or with one or two short lateral deltoid lobes, entire in margin; upper surface dark green, pubescent with short erect hairs; lower surface greyish green, covered with a thin tomentum; petiole 3 to 5 in. long, glandular, pubescent.

Flowers violet, the lower lip marked with dark coloured spots and two yellow bands; calyx with five ovate erect lobes, covered with a dense rusty brown tomentum. Capsules ovoid, about 1½ in. long, and 1 in. broad; seeds minute, about ⅓ in. long.

1. Var. *Fargesii*, Henry (var. *nova*).

Paulownia Fargesii, Franchet, in *Bull. Mus. Hist. Nat. Paris*, 1896, p. 280.

Flowers paler in colour. Adult leaves more glabrous than in the type. This was described by Franchet from a specimen sent by Père Farges from the mountains of north-eastern Szechwan; and appears to be identical with a tree found by me growing on cliffs in the mountains of Hupeh (No. 5346 A). The pentagonal ribbed calyx, noticed by Franchet, appears to be due to drying of the specimen, and not to be specially characteristic of this form, as a similar calyx occurs in some specimens of typical *P. tomentosa*. Var. *Fargesii* was introduced into cultivation in France by M. M. de Vilmorin, who raised it from seed received from Père Farges; and it flowered⁴ in M. Boucher's nursery at Paris in 1905.

P. tomentosa is a native of the mountains of central and western China, where it has been found growing wild at altitudes of about 4000 feet by Père Farges in Szechwan, and by myself in Hupeh and Yunnan. It is the *fung* tree of the Chinese

¹ *P. meridionalis*, Dode, *loc. cit.*, described from a tree growing in Laos in Indo-China, is allied to or perhaps a form of *P. Fortunei*. ² Cf. *Mitt. Deut. Dend. Ges.* 1910, p. 246.

³ Figured from a tree in the garden at Bishopstowe, near Torquay, the first which flowered in the open air in England.

⁴ Cf. *Journ. Soc. Nat. Hort.* vi. 324 (1905). C. Sprenger of Corfu, states in *Mitt. Deut. Dend. Ges.* 1910, p. 247, that he has raised *P. Fargesii* from seeds received from the mountains of north-west Hupeh in central China.

classics,¹ the wood of which was used in ancient times for making lutes. It is largely planted as an ornamental tree throughout China, Korea, and Japan; and was probably introduced into the latter country at an early period by the Buddhist monks.²

This species often produces root-suckers at a considerable distance from the parent tree; and when cut down, sprouts vigorously from the stool. The seedling, which has an herbaceous stem, usually dies down at the end of the first year; but in the following spring a permanent and more woody stem arises from a bud close to the ground. The leaves on young plants (which are very large), on root-suckers, and on coppice shoots differ from the foliage of the adult tree, their margin being furnished with numerous short teeth, while their upper surface is velvety to the touch and very viscid, owing to the presence of numerous glandular hairs and sessile glands.

The Paulownia may be raised from seed sown in spring, or from root-cuttings; and may also be propagated by stem-cuttings under glass, or even from leaf-cuttings. At Kew this species is very effective as a foliage plant in beds out of doors. The plants, when about three years old, are cut down in early spring to within 6 inches of the ground; and when they start to grow, all the buds except one on each stem are removed. Watered in dry weather and mulched with manure, stems are produced about 6 ft. high, which bear enormous leaves, 12 to 18 in. in diameter.

This tree was introduced³ into Europe in 1834, by seeds sent from Japan to Paris by M. de Cussy; and one of the original trees in the Jardin des Plantes measured in 1904 about 60 ft. in height, and 12 ft. in girth. It succeeds well in France and Italy, where it attains a considerable size, and regularly produces flowers and fruit.

It was introduced⁴ into England by seeds from Japan in 1838, and was cultivated in the Horticultural Society's garden at Chiswick; but it has never attained large dimensions in this country, and probably many of the older trees were killed in the severe winters of 1860 and 1866. It flowers frequently in the south of England, but rarely produces fruit, and very seldom fertile seed. (A. H.)

The largest tree I know of in England is one standing near the entrance lodge at Westonbirt, Gloucestershire, which as measured in August 1911, by Mr. A. Chapman, was 56 ft. by 7 ft. at 3 ft. from the ground.

The next is at Wilton House, which in 1906 measured 53 ft. by 6 ft. 8 in., but being in a damp situation it has only flowered twice in fifty years, and Mr. Challis informed me that it suffered much in the hard winters of 1860-61, and 1879-80. A fine tree at Linton Park, Maidstone, in 1911 measured 45 ft. high and 9 ft. in girth at 6 ft. from the ground. At Caldrees, Ickleton, Cambridgeshire, there is a tree about 25 ft. high and 3½ ft. in girth, which produces flowers and fruit nearly every year. From its seeds, plants were raised in 1902, one of which was planted at Ickleton Grange, and is now 12 ft. high.

¹ Cf. Bretschneider, *Bot. Sinic.* ii. 348 (1892). It is colloquially known in China as the *pao-t'ung*, in order to distinguish it from the *wu-t'ung* (*Sterculia platanifolia*), and the *t'ung-yu* (*Alcurites cordata*).

² It is figured by Kaempfer, *Amen. Exot.* 860 (1712).

³ *Actes Premier Congrès Internat. Bot., Paris*, 536 (1900). Cf. also *Gard. Chron.* 1841, pp. 349, 701, where it is stated that a single plant was raised in the Royal Garden in Paris, from Japanese seed, in 1834.

⁴ Loudon, *Gard. Mag.* xvi. 635 (1840). It flowered in a greenhouse at Oakfield near Cheltenham in 1843, according to Loudon, *Gard. Mag.* 1843, p. 649.

At Swanmore Cottage, Hants, Mr. Molyneux showed me a well-shaped tree, 35 ft. by 7½ ft., in 1906, which flowers occasionally but never ripens seed. At Ashstead Park, Surrey, the seat of Mr. P. Ralli, there was in 1892 a fine tree, 45 ft. by 7½ ft., which flowers freely in warm seasons.¹ At Whitbourn Court, near Worcester, Sir R. Harrington has a tree which he raised from seed gathered in the Vatican gardens at Rome in 1888, which in 1905 was 23 ft. by 4 ft., and with a head 25 ft. in diameter. In Cornwall, where the climate does not suit it so well, the largest I have seen, at Scorrier, was about 25 ft. high in 1911.

There are specimens 20 to 30 ft. high in the Kew and Cambridge Botanic Gardens; at Grayswood, Haslemere; in several gardens in Kent; at East Cowes Castle in the Isle of Wight; at Hursley Park, Winchester; at Abbotsbury²; at Bicton³; at Trevarno,⁴ Cornwall; and at Singleton Abbey, Swansea.

In Scotland, the only places where I have seen it are at Castle Kennedy, where in 1906 I saw a poor-looking tree about 25 ft. high, which evidently does not like the climate; and at Tynninghame, East Lothian, where Mr. Brotherston measured a tree 3 ft. 9 in. in girth at 3 ft. from the ground, which has been in bad health for years, so we may conclude that the summers of Scotland are too short and cold for it.

In Ireland, there are two old but not very thriving trees at Glasnevin; but at Mount Usher, there is a fine tree nearly 40 ft. high, and over 6 ft. in girth.

In America,⁵ it does not flower regularly north of New York; but is fairly hardy in sheltered positions as far north as Massachusetts, where the flower-buds are killed every winter; and it can be cultivated as a foliage plant even in Montreal.

TIMBER

In Japan, it is known as *kiri*; and produces a very light, dull white, shining wood, which is used for making boxes, musical instruments, linings of safes, clogs, doors, and in cabinet work. As large planks are not usually obtainable, Paulownia boards are made by joining small pieces together with paste and bamboo pegs, as shown at the Anglo-Japanese Exhibition at Shepherd's Bush, London. On my last visit to Japan I saw well-made wardrobes of this wood, which is preferred to all others for this purpose on account of its resistance to damp. Clothes kept in drawers of this wood are said to remain free from mould during the rainy season. These wardrobes are sometimes framed in the wood of *Diospyros Kaki*, the heart-wood of which is black mottled with grey, and very handsome. The large braziers, called *Hibashi* in Japan, are often made of sections of the trunk of Paulownia turned in such a way as to show its beautiful grain. (H. J. E.)

¹ *Gard. Chron.* xii. 440 (1892).

² Fruit was sent to Kew from Abbotsbury in January 1902.

³ *Quart. Journ. Forestry*, i. 54 (1907).

⁴ Cf. *Gard. Chron.* xxvi. 211 (1899). In *The Field*, 1908, p. 233, the tree at Trevarno, said to be twenty years old and 30 ft. high, is reported to have produced a few years previously a good crop of fruit.

⁵ Rehder, in Bailey, *Cycl. Amer. Hort.* 1223 (1901). Britton and Brown, *Illustrated Flora Northern U.S.* iii. 157 (1898), state that it has escaped from cultivation in southern New York, in New Jersey, and in the Southern States.

ROBINIA

Robinia, Linnæus, *Gen. Pl.* 220 (1737) and *Sp. Pl.* 722 (1753); Bentham et Hooker, *Gen. Pl.* i. 499 (1865); Schneider, *Laubholzkunde*, ii. 79 (1907).
Pseudacacia, Moench, *Meth.* 145 (1794).

DECIDUOUS trees and shrubs belonging to the division Papilionaceæ of the order Leguminosæ. Leaves unequally pinnate, alternate, stalked: leaflets opposite, rarely sub-opposite or alternate, stipellate, stalked, entire, penninerved. Stipules in pairs, at first setaceous, ultimately either deciduous or developing into persistent spines. No true terminal bud is formed, the tip of the branchlet falling off early in summer and leaving a scar at the apex of the twig. Buds minute, multiple, three to five superposed vertically, not apparent¹ in summer and autumn, being concealed by the enlarged base of the petiole; in winter, embedded in a projection on the branchlet between the stipules, and covered by three scales, which are united together and form the leaf-scar. Usually only the uppermost bud develops—the scales, which are very tomentose within, bursting open, and afterwards persisting at the base of the new branchlet during the following season.

Flowers in pendulous racemes, arising from the axils of the leaves, with long pedicels and caducous bracts and bracteoles. Calyx campanulate, unequally five-toothed. Corolla papilionaceous; petals with short claws, inserted on a tubular glandular disc, connate with the base of the calyx-tube; standard large, reflexed, obcordate; wings oblong, curved, free; keel-petals incurved, obtuse, united below. Stamens ten, inserted with the petals; nine inferior united into a tube; upper stamen free at the base. Ovary stalked; style subulate, inflexed, pubescent, ending in a small stigma; ovules numerous, hanging in two rows from the ventral suture. Pods in pendulous racemes, linear-oblong, compressed; valves two, thin, membranous; seed-bearing suture with a narrow wing. Seeds numerous, reniform, oblique, with a persistent incurved stalk.

About eight species of *Robinia* are known, confined to the United States and Mexico. Four, all natives of the United States, occur in cultivation:—

I. *Branchlets without glands.*

1. *Robinia Pseudacacia*, Linnæus. See p. 1497.

Branchlets at first slightly pubescent, soon becoming glabrous. Leaflets

¹ Occasionally a supra-axillary bud is formed, visible above the insertion of the leaf; it develops into a short-lived feeble branch.

Robinia

1497

pubescent, minutely apiculate. Stipules persisting as glabrous hard woody spines.

2. *Robinia neomexicana*, Gray. See p. 1506.

Branchlets densely pubescent. Leaflets pubescent, tipped at the acute apex with a long mucro; stipels mostly persistent. Stipules persistent as slightly pubescent hard woody spines.

II. *Branchlets glandular.*

3. *Robinia viscosa*, Ventenat. See p. 1507.

Branchlets with short-stalked glands, exuding a viscid matter. Leaflets pubescent, shortly apiculate. Stipules usually deciduous, occasionally persistent as slender short spines.

4. *Robinia hispida*, Linnæus. See p. 1508.

Branchlets with glandular bristles and dense pubescence. Leaflets glabrous, except for slight pubescence on the midrib beneath. Stipules usually deciduous, occasionally persistent as minute blunt spines. (A. H.)

ROBINIA PSEUDACACIA, FALSE ACACIA, LOCUST

Robinia Pseudacacia, Linnæus, *Sp. Pl.* 722 (1753); Cobbett, *Woodlands*, Nos. 322-398 (1825); Loudon, *Arb. et Frut. Brit.* ii. 609 (1838); Withers, *The Acacia Tree* (1842); Wilkomm, *Forstliche Flora*, 930 (1887); Sargent, *Silva N. Amer.* iii. 39, tt. 112, 113 (1892), and *Trees N. Amer.* 572 (1905); Mathieu, *Flore Forestière*, 119 (1897); Schneider, *Laubholzkunde*, ii. 82 (1907).

Robinia fragilis, Salisbury, *Prod.* 336 (1796).

Pseudacacia odorata, Moench, *Meth.* 145 (1794).

A tree, attaining about 80 feet in height and 15 feet in girth. Bark thick, brownish, with broad and deep longitudinal fissures, separated by scaly ridges. Young branchlets, at first slightly pubescent, soon becoming glabrous. Leaf-rachis slightly pubescent. Leaflets, nine to nineteen, elliptic or oval, rounded at the base; rounded, truncate or emarginate at the apex, which terminates in a minute mucro; upper surface covered with minute appressed pubescence, lower surface paler with scattered hairs; petiolule, $\frac{1}{8}$ in., slightly pubescent; stipels linear, $\frac{1}{16}$ in., early deciduous.

Flowers in loose pubescent non-glandular racemes; pedicels slender, $\frac{1}{2}$ in. long, pubescent; calyx gibbous, pubescent, the lowest lobe acuminate and longer than the others; petals white, with a greenish yellow patch on the middle of the inner surface of the standard. Pod, 2 to 4 in. long, glabrous, persistent on the leafless branches late in winter; seeds usually four to eight.

The stipules,¹ at first linear, subulate, membranous, pubescent, and about $\frac{1}{2}$ in. long, are either deciduous or develop into spines, which persist for several years and occasionally attain $\frac{3}{4}$ in. in length. These spines are glabrous, triangular, com-

¹ Cf. Colomb, in *Ann. Sc. Nat.* vi. 65 (1887).

pressed, straight or turned up at their sharp points; and in winter, together with the concealed buds and the stout glabrous angled twigs, serve to identify this species.

The flowers are fragrant,¹ and are visited by bees, as they contain much honey. In southern Italy,² the flowers are developed before the leaves; but north of the Alps the leaves unfold earlier or at the same time as the flowers. The leaves droop at night.

Seedling:³—The cotyledons, raised above ground on a glabrous caulicle, are oblong-oval, obtuse, entire, shortly stalked, light green, thick in texture, obscurely veined, and about $\frac{1}{2}$ in. long. The slightly pubescent stem bears alternate leaves; first leaf always unifoliolate, rounded, obtuse, and broader than long; second leaf with three leaflets, the terminal orbicular one larger than the two lateral elliptic leaflets; succeeding leaves with three to five leaflets.

This species produces numerous root-suckers,⁴ arising singly or in groups of two or three at a considerable distance from the tree. Leaves on root-suckers smaller than on adult trees, but with the usual number of leaflets, which are cordate at the base; stipules usually aborted or very short.

The tree, when cut down, produces coppice shoots freely; and on this account, and because of its facility of reproduction from root-suckers, it is much cultivated in the warmer parts of Europe as coppice with a short rotation.

VARIETIES

A large number of varieties have arisen in cultivation in Europe. Some have been successfully raised from cuttings; but they are usually propagated by grafting.

1. *Leaves as in the type; habit peculiar.*

1. Var. *pyramidalis*, Pépin, in *Rev. Hort.* iv. 240 (1845) (var. *fastigiata*, Nicholson).

Narrowly pyramidal, resembling the Lombardy Poplar in shape; branches directed vertically upwards. This was introduced by M. Leroy of Angers, and a fine specimen in the Jardin des Plantes at Paris was planted by Pépin in 1843. The best example of this we know is in the public gardens at Le Mans, in France, where Elwes measured one in 1908 nearly 60 ft. high. There are four specimens in the public garden at Genoa, one about 40 ft. in height, which are more broadly pyramidal in habit, the branches not being so upright. These correspond to the description of var. *stricta*, Link, *ex Loudon, Arb. et Frut. Brit.* ii. 610 (1838). Both these varieties are suitable for planting in streets; but seem to be scarcely known in England, except at Kew, where there is a good example of var. *pyramidalis* about 35 ft. high.

2. Var. *Ultriciana*, Reuter, *ex Dippel, Laubholzkunde*, iii. 702 (1893). Branches pendulous.

¹ Cf. Mesnard, in *Ann. Sc. Nat.* xviii. 341 (1893).

² Kerner, *Nat. Hist. Plants*, Eng. Transl. i. 562 (1898).

³ Cf. Lubbock, *Seedlings*, i. 422, fig. 275 (1892), and Ledoux, in *Ann. Sc. Nat.* xviii. 369, fig. 39 (1903).

⁴ Cf. Dubard, in *Ann. Sc. Nat.* xvii. 167 (1903).

A tree at Kew, called var. *pendula nova*, has slightly pendulous branches with small leaflets.

3. Var. *tortuosa*, De Candolle, *Cat. Pl. Monspel.* 136 (1813).

A tree, with wide-spreading twisted branches.¹ The habit is well figured by Schneider, *Dendrol. Winterstudien*, 89, fig. 90 (1903).

4. Var. *umbraculifera*, De Candolle, *Cat. Pl. Monspel.* 137 (1813).

A compact, rounded bush, giving dense shade; branches without spines; seldom if ever flowering.² Suitable for rock gardens, and often called Parasol Acacia. It is said³ to have originated from a burr on a tree of the typical form. There are two good specimens at Kew, about 15 ft. high, grafted at about 10 ft. from the ground.

5. Var. *Bessoniana*, Nicholson.

A compact, dense, round-headed tree, without spines. This resists wind, and is much used for avenues and street planting. It is readily propagated by cuttings.

6. Var. *inermis*, De Candolle, *Cat. Pl. Monspel.* 136 (1813).

Branches without spines; otherwise as in the type.

II. *Leaves different from those of the type.*

7. Numerous varieties with differently coloured foliage are known, the peculiarities of which are indicated by their names, as var. *aurea*, Kirchner; var. *aureo-variegata*, Schneider; var. *argenteo-variegata*, Kirchner; and var. *purpurea*, Dippel.

8. Var. *crispa*, De Candolle, *Prod.* ii. 261 (1825).

Leaflets curled; branches without spines. On a tree of this variety in the Jardin des Plantes at Paris, only the upper leaflets were abnormal, the lower three or four pairs of each leaf being of the ordinary form.

9. Var. *bullata*, Koch, *Dendrologie*, i. 56 (1869).

Leaflets crowded and puckered with swellings.

10. A series of forms, with remarkably small leaflets, have arisen in cultivation, as var. *amorphaeifolia*, Link; var. *myrtifolia*, Koch; var. *tragacanthoides*, Kirchner; var. *sophoraefolia*, Kirchner (*R. coluteoides*, Koch). In var. *linearis*, Kirchner, and var. *dissecta*, Koch, the leaves are remarkably narrow.

11. Var. *monophylla*, Kirchner, *Arb. Musc.* 377 (1864).

Leaves with only one leaflet, which is much enlarged, or with, in addition, three to five leaflets, all larger than in the type. This appeared in 1855 as a single plant in a bed of seedlings in M. Deniaux's nursery at Brain-sur-Authion (Maine-et-Loire). The original plant was transplanted into the Jardin des Plantes at Paris, where it flowered and gave seeds in 1865. The seeds when sown were said to have yielded about one-quarter of the variety, the remainder being normal. The one-leaved Robinia is also said to be liable to a petaloid alteration of the stamens, which impairs fertility.⁴

A tall, slender tree of var. *monophylla* at Brocklesby Park, 57 ft. high and

¹ This variety occasionally develops remarkably thick corky bark. Cf. *Mitt. Deut. Dend. Ges.* 1911, p. 404, fig.

² Koch, *Dendrologie*, i. 57 (1869) states that he saw a flowering branch, which had been produced by an unclipped bush of this variety. The flowers were white, and not yellow, as stated by Dumont de Courset, *Bot. Cult.* vi. 140 (1811).

³ Carrière, *Prod. et Fixat. Vars.* 54 (1865).

⁴ De Vries, *Plant Breeding*, 617, 664 (1906).

2 ft. 8 in. in girth in 1908, showed no sign of having been grafted, and had produced three suckers with normal leaves, one being 36 ft. distant from the parent tree and 8 ft. in height. There are two trees about 30 ft. high at Kew, differing in habit—one, narrow with ascending branches; the other wider, with pendulous branches.

III. Flowers differing from those of the type.

12. Var. *Decaisneana*, Carrière, in *Rev. Hort.* 1863, p. 151, with coloured plate.

Flowers pale pink, and larger than in the type; otherwise similar. This originated in the nursery of M. Villevielle at Manosque (Basses-Alpes), and flowered for the first time in 1862. This variety is said to come fairly true from seed. It is well known in English nurseries, and seems to be a very vigorous grower.

13. Var. *lutea*, Schneider, *Laubholzkunde*, ii. 83 (1907).

Flowers pale yellow. This variety is mentioned by Dumont de Courset, *Bot. Cult.* vi. 140 (1811) as var. *flore luteo*, but it is doubtful if it is now in cultivation.

14. Var. *semperflorens*, Carrière, in *Rev. Hort.* xlii. 502 (1871) and xlvii. 191, with coloured plate (1875).

A tree of great vigour, producing annual shoots of abnormal length (up to 6 ft. long), which bear flowers continually from June to September. This originated as a single seedling in M. Durousset's nursery at Genouilly (Seine et Loire), and has been in commerce since 1875. The original tree was transplanted in 1874 into the Jardin des Plantes at Paris, and was remarkable for its constant production of numerous flowers. Carrière counted on one branch no less than 145 racemes.

HYBRIDS

1. *Robinia dubia*, Foucault, in Desvaux, *Journ. de Bot.* ii. 204 (1813); Loudon, *Arb. et Frut. Brit.* ii. 627 (1838).

Robinia ambigua, Poiret, in Lamarck, *Encyc. Suppl.* iv. 690 (1816).

Robinia intermedia, Soulange-Bodin, in *Ann. Soc. Hort. Paris*, ii. 43 (1828).

This hybrid between *R. Pseudacacia* and *R. viscosa* is a small tree, differing mainly from the first named species in the young branchlets and flowering peduncles being slightly viscid-glandular and in the flowers being pale pink. It has been in cultivation about 150 years.¹

2. *Robinia bella-rosea*, Nicholson, *Dict. Garden.* iii. 310 (1887).

This is similar to the last, but the branchlets are more plainly viscid-glandular, whilst the flowers are larger and deep pink in colour.

3. *Robinia Holdtii*, Beissner, in *Mitt. Deut. Dend. Ges.* xi. 117 (1902); Koehne in *Gartenflora*, lii. 272 (1903).

A hybrid between *R. Pseudacacia* and *R. neomexicana*, which originated² about 1890 in Mr. Von Holdt's garden at Alcott in Colorado. Leaflets larger than those of *R. neomexicana*, darker green than those of *R. Pseudacacia*. Flowers varying in colour, white flushed with pink or deep pink. A few stalked glands occur on the flowering peduncle and on the pod.

¹ It is possibly *R. echinata*, Miller, *Dict.* ed. 8, No. 2 (1768).

² Beissner, *op. cit.* 118, states that a similar plant also originated in Späth's nursery.

4. *Robinia coloradensis*, Dode, in *Bull. Soc. Bot. France*, lv. 650 (1908).

A peculiar tree¹ raised at Les Barres from seed, sent by M. Berthoud from Golden in Colorado. It is probably a seedling of *R. Holdtii*.

5. *Robinia Holdtii britzensis*, Späth, in *Gartenflora*, lii. 557 (1903).

This is a vigorous plant which was raised in Späth's nursery from a seed produced by a tree of *R. neomexicana* in 1893. It, however, closely resembles *R. Pseudacacia*, only differing from this species in having traces of purple on the standard of the flower.

DISTRIBUTION

R. Pseudacacia is considered by American botanists to be indigenous in the Alleghany Mountains from Pennsylvania to Georgia, but it is now widely naturalised throughout most of the United States east of the Rocky Mountains and in Nova Scotia and Ontario. Dame and Brooks say² that it is thoroughly at home in Maine, forming wooded banks along streams, and fairly abundant in thickets and along roadsides and fences in the New England States generally. Plate 353, reproduced from a photograph sent by Miss Cummings, shows a tree at Boston (Mass.). A shrubby form, which occurs in Kansas, Arkansas, and Indian Territory, is perhaps a true native and not an escape from cultivation. The tree attains its largest size³ in West Virginia. It is found in the forest in mixture with other trees, growing on the slopes with oaks, chestnut, hickories, and maples, while along the streams it is associated with ash and black walnut. It often spreads by its root-suckers, forming thickets of small trees. In the mountains of Pennsylvania and West Virginia, burnt and cut-over forest lands are speedily covered with seedlings,⁴ which often grow up into pure stands of considerable extent.

On account of the excellence of its timber for fence posts and for all uses requiring contact with the soil, and also for fuel, the Robinia was much planted⁵ formerly throughout the United States, and succeeded well south of the 38th parallel; but at the present time planting is restricted or rendered useless on account of the ravages of the locust-borer⁶ (*Cyllene Robiniae*, Forster). The grubs of this beetle bore holes through the bark deep into the wood, which becomes completely honey-combed with galleries. Young plantations are often attacked, especially in the States east of the Rocky Mountains. The Robinia thrives in the dry prairie regions, and has been planted with success on alkaline soil in the San Joaquin valley in California.⁷

INTRODUCTION

This species was introduced into France by Jean Robin, who received seeds from America in 1601; and the oldest tree known was planted in 1636 by Vespasian

¹ Cf. Vilmorin, *Frut. Vilmor.* 54, fig. (1994), whose description does not agree with that of Dode. The individuals that were raised may have differed considerably.

² *Trees of New England*, 131 (1902).

³ Ridgway measured a cultivated tree in Illinois, 95 ft. high and 11½ ft. in girth.

⁴ The seed is retained in the pods on the trees till late in the year, and is distributed to great distances by the strong winter winds.

⁵ Directions for planting in the United States are given in the *United States Forest Circular*, No. 64 (1907).

⁶ Cf. *United States Entom. Comm., Fifth Report*, 355 (1890).

⁷ Hilyard, *Sails*, 480 (1906).

Robin in the Jardin des Plantes at Paris, where the stump, largely made up by cement, still remains, and produces a few shoots and flowering branches every year.¹

The date of introduction² into England is uncertain; but Parkinson, in his *Theatre of Plants*, published in 1640, mentions the tree as having been grown by Tradescant "to an exceeding height." During the seventeenth and eighteenth centuries the Robinia was occasionally planted; but it only came prominently into vogue by the vigorous advocacy of Cobbett, who began to write about it in 1823.

(A. H.)

CULTIVATION

No tree except the oak has probably been so much written on in England as the Robinia or Locust, as William Cobbett, its great advocate, always called it, though now it is more commonly, though incorrectly, called Acacia. That great Englishman was, during his exile in America, so much impressed with the valuable qualities of its wood, that, though suffering under a grievous and unjust political persecution, "nevertheless I did not forget my country and the duty I still owed to her"; and when he returned to England in 1819 brought with him a parcel of seed, which he had no means of sowing till 1823. He then began sowing it on a very small scale at first, but later he raised it in large quantities, and sold more than a million plants. In *Woodlands*, Cobbett devoted many pages to an account of this species, which he considered was going to supplant all other trees in England; but Cobbett's enthusiasm in arboriculture, as in politics, often outran his discretion, and though many of his trees still remain, mostly long past their prime and in a more or less decayed condition, the Robinia has never realised his predictions. It has always been obnoxious to the British woodman, partly on account of its thorns which tore his clothes and hands, partly on account of the hardness of its wood which blunted his tools, and partly because of its liability to be broken by the wind, and to reproduce from suckers when cut.

Cobbett had many admirers, one of whom, Lord Folkestone, afterwards Earl of Radnor, bought 13,600 locust trees, which were one-year seedlings one year transplanted; and carried them in a large waggon from Sussex to Coleshill, Berkshire, in the latter part of March 1824. These were planted in clumps of one to several hundreds in a large plantation in Coleshill Park; and when Cobbett saw them in 1826 they averaged more than 12 ft. high, and, as he says, "looked like clumps of trees which had been planted many years previous to the planting of the trees of the rest of the plantation." He calculated the cost of trees, trenching, and planting, at £134, and thought that, at six or seven years old, they would be fit to cut for hop-poles, and then be worth 1s. each, leaving a profit of £529 on the five acres which he supposed them to cover. Of course if this profit or anything like it had been realised here or elsewhere, the tree would not have been neglected as it has been

¹ Cf. *Actes Premier Congrès Internat. Bot. Paris*, 536 (1900). This old tree is figured by Sargent in *Garden and Forest*, iii. 305, fig. (1890). When Elwes saw it in 1905 it had a branch about 40 ft. high producing good foliage.

² Dr. Yule, in *Mem. Caled. Hort. Soc.* ii. 413 (1819), states that it was first planted in Scotland by Mr. Cockburn at Ormiston Hall, Haddingtonshire.

almost everywhere in England. When I visited Coleshill in June 1905, I could find no one who remembered them, and the late Mr. Pleydell-Bouverie, uncle of the present Lord Radnor, who then lived at Coleshill, thought that they had all disappeared with the exception of a few near the house, which measured 60 ft. by 8 ft. 3 in. and 65 ft. by 9 ft. 3 in., and two or three in the park.

Neither at Botley, where Cobbett lived for some years and planted American trees, nor in the surrounding district, where the soil and climate suit this tree as well as any in England, could I find any trace of locust plantations.

The only plantation which we have seen and of which any exact details are on record, is the Brickhills plantation on the estate of Sir Hugh Beevor at Hargham, Norfolk. This has been described¹ by its owner in the *Quarterly Journal of Forestry*, ii. 301-303 (1908), and the results are so favourable that they should be read by everyone. Sir Hugh sums up by saying, "For its own sake I shall continue to grow it for estate use, having always utilised and refused to sell any. The chief use I put it to now is as stakes for rabbit-proof fencing; and these when taken up at the end of ten years will be used again for a similar term. To supply stakes no tree is so well fitted, and it would be worth planting for this purpose only."

In 1842 W. Withers of Holt, Norfolk, compiled a work² of over 400 pages on this tree, in which he prints a great many communications, among which one written by F. Blaikie from Holkham in 1828 states, "I found great difficulty in protecting young locust trees from hares and rabbits. These animals prefer it to any forest tree. They could not have been so plentiful as they are now, at the time Mr. Coke reared the innumerable locust trees growing at this place. Those trees thrive on our most inferior sandy soils where other forest trees barely exist. We do not succeed in raising plants from home-grown seed, though it appears sound and well grown." Here also I failed to find any evidence that this species was now valued; and it may be said generally that though in almost every southern county large trees may be found, which are often decayed at the heart, yet Robinia is no longer looked on as useful for general planting; and that unless pruning of the branches is carefully attended to, this tree is more likely to suffer from wind when young than other trees.

All my observations go to show that Robinia is essentially a lover of a hot, dry, and sandy soil, though it only attains a large size and age on a good sandy loam; and while it tolerates lime, grows much better without it. It is easy to raise from seed and grows rapidly from the first; but the shoots often fail to ripen and are liable to freeze when young. It should be transplanted in the spring when a year old, as its root system is not naturally fibrous, and be planted out when two or three years old in a sunny position. Though Robinia trees may be seen drawn up to a great height in mixed plantations,³ where their rapid growth has given

¹ Sir Hugh Beevor gives me the following notes on this plantation, which was made in 1829 and measured in 1901:—"Where pure the trees cover not quite an acre; on the best half-acre there are 40 trees per acre with a volume of 1000 cubic ft.; canopy incomplete on account of windfalls; largest tree with a volume of 80 cubic ft."

² *The Acacia Tree* (1842).

³ Paeske of Brunswick, in *Mitt. Deut. Dend. Ges.* 1911, p. 77, recommends the planting of Robinia as scattered solitary trees in hirsch woods, which will provide shelter against the wind, and yet give enough sunlight for it to develop well. Amidst birch, the Robinia cleans its stem perfectly, being often free from branches up to 40 ft. in fairly good soil.

them the lead, this species will not bear much shade; and if grown for economic purposes it ought to be cut when twenty to thirty years old, or as soon as it is fit to make a good gate-post. On any suitable soil the wood is then at its best; whereas if left to grow into larger timber, the trunk becomes deeply furrowed or burry, and usually begins to decay inside at fifty to sixty years old. It would perhaps make a good mixture if planted in alternate lines five feet apart with sweet chestnut and cut out as soon as large enough; leaving the chestnuts to form a clean crop dense enough to suppress the stool shoots of the Robinia by its shade, and in their turn to be clean felled at fifty to sixty years old. This opinion is shared by Mr. Braid, forester to the Earl of Dudley, who finds Robinia a valuable tree when properly treated, on dry sandy land near Kidderminster.

REMARKABLE TREES

Perhaps the finest tree in England is the one growing in front of Frogmore House, near Windsor (Plate 351), which, when I measured it in 1908, was 88 ft. high by 14 ft. 7 in. in girth. President Roosevelt told me in 1904 that he hardly thought that such a tree could be now found in the United States. It is probably over a hundred years old, as I am told by Mr. Nutt, Clerk of Works at Windsor Castle, that Frogmore was bought in 1748 by Sir E. Walpole; and leased to Queen Charlotte in 1809. Another fine tree at The Mote, Maidstone (Plate 352), which I saw in 1902 measured about 80 ft. high.

At Kew a very old tree was probably planted by Aiton about 1760.

At Pains Hill there are some very large trees, one of which in 1904 was about 60 ft. high by 17 ft. 3 in. in girth; another was 70 ft. by 12½ ft. These were probably planted about 1750.

At Burwood House, Surrey, Col. Thynne in 1900 measured a tree 86 ft. by 13 ft. 3 in., which I have not seen. At Bowood, Wilts, I found, in 1908, a tree nearly 90 ft. high by 8½ ft. in girth. At Arley Castle there is a tree 85 ft. by 9 ft. in 1905 which was planted in 1820. At Stanway, Gloucestershire, there is a very old tree whose top is dying, and has been taller; in 1911 I made it 65 ft. by 11 ft. 10 in. At Audley End, in 1908, there was a healthy tree close to the house 80 ft. by 11 ft. 2 in. At Hatfield, Herts, there are several good trees, the largest, near the conservatory, measuring, in 1911, 67 ft. high by 12 ft. 8 in. in girth at three feet from the ground. In Tree Court of Caius College, Cambridge, there is an old tree about 60 ft. high, and 11 ft. 7 in. in girth, dividing at 10 ft. from the ground into two main stems. At Kenwood, near London, a very old tree, split nearly to the ground, with a decayed top, measured 45 ft. by 16 ft. in 1909. In an old gravel pit at Hitchin, Herts, drawn up in a thick wood among elms, I saw in 1905 a tall slender tree 80 to 90 ft. high, with a clean bole over 50 ft. high. At Holly Dale, near Keston, Kent, Mr. Webster records¹ a tree 78 ft. by 11 ft. 7 in., containing 110 ft. of timber and with a spread of 54 ft. At Chilham Castle, Kent, there is a fine tree, 75 to 80 ft. high and of moderate girth, on the lawn.

¹ *Trans. Roy. Scot. Arb. Soc.* xii. 312 (1890).

Sometimes the trunks of old trees are covered with burrs, the most remarkable that I have seen being a tree at Coolhurst, Sussex, which had a short trunk 14½ feet round; and another at Henley Park, Surrey, the seat of Sir J. Roberts, which was 65 ft. by 12½ ft.

In the north-west of England the tree rarely attains any great size; but Clark¹ records one at Dovenby Hall, Cumberland, 55 ft. by 9 ft. in 1887, which was planted in 1795.

In Wales the best I have seen is at Golden Grove, which in 1906 was 65 ft. by 8½ ft.

In Scotland it only thrives in the drier climate of the east, the best I know of being at Gordon Castle, a sound healthy tree which in 1904 was 56 ft. by 9 ft. At Murthly Castle a tree, forked near the ground, was in 1906 about 50 ft. by 6 ft. The largest trees measured by Mr. Renwick are two at Cordale House, Dumbartonshire, 64 ft. by 7 ft. and 53 ft. by 6 ft. 7 in., and one at Mauldslie Castle, 60 ft. by 6 ft. 1 in., all taken in 1911.

In Ireland, Henry has seen very few large trees, the finest being probably one at Doneraile, Co. Cork, which is about 12 ft. in girth, with a *Pyrus Aucuparia* arising from the stem at 9 ft. from the ground. At Glenomera, Co. Clare, a young healthy tree in a wood measured, in 1907, 59 ft. by 5 ft. 9 in. At Woodstock, Kilkenny, I saw in 1909 a tree near the Lodge, about 60 ft. by 6 ft. 9 in.

TIMBER

Such a mass of details are found in the writings of Loudon, Cobbett, and Withers as to the durable properties of this timber, that I need not repeat them at length; but I can say, from personal experience that for gate- and fencing-posts it is unrivalled for strength and durability by any native timber except that of the yew. Mr. H. Clinton-Baker² showed me the hanging-post of his lodge gate, which is now absolutely sound at the ground level, with the date 1849 cut on it. I was told that the spurs put up to support the oak posts of a fence at Pains Hill had remained sound for eighty years. I have myself proved that a tree planted on fair loam will in twenty-five years produce three good gate-posts, whilst oak at the same age would not make one.

On the Continent it is considered by wheelwrights to be superior to all other timber for spokes, and is now used extensively for wheel spokes of motor cars. For such purposes it must be cut before the wood has become old and lost its elasticity; and I believe that it is best when 9 to 12 inches in diameter. From one short log of this size, for which I paid 5s., the spokes of a heavy timber carriage wheel were made. Notwithstanding these good qualities the timber has no recognised value among English timber merchants, and "Acorn," in *English Timber*, says that it is so little known in home timber yards that there are no specific outlets for its disposal. Therefore I should advise that it be kept for home use only.

¹ *Trans. Eng. Arb. Soc.* 1887, p. 143.

² Two fencing stakes made of Robinia, which had been put down in 1848 in the pinetum at Bayfordbury, were perfectly sound in October 1911, when they were presented by Mr. H. Clinton-Baker to the Cambridge Forestry Museum.

The Robinia has proved very useful in the afforestation of the steppes of Russia and Hungary. The plantations in Hungary,¹ mostly pure and growing on light dry soil, covered an area of 70,000 hectares in 1899. These plantations are usually treated as coppice with a rotation of twenty years. Illes² states that in Hungary, a plantation, fifty years old, produced 8800 cubic feet of timber per acre, the trees averaging 90 ft. in height and 10 in. in diameter. In Roumania, the tree has been used with great success in fixing the moving sands on the Danube, and 5000 to 6000 hectares have been planted.

(H. J. E.)

ROBINIA NEOMEXICANA, WESTERN LOCUST

Robinia neomexicana, Gray, in *Mem. Amer. Acad.* v. 315 (1853); Sargent, *Silva N. Amer.* iii. 43, t. 114 (1892), and *Trees N. Amer.* 573 (1905); Wittmack and Bretschneider, in *Gartenflora*, li. 649, t. 1385 (1892); Robinson, *Flora and Sylva*, 1904, p. 57, with coloured plate.

A small tree, attaining 25 ft. in height and 2 ft. in girth, with thin scaly slightly furrowed bark. Young branchlets densely covered with appressed pubescence, some of which is retained in the second year. Leaflets nine to twenty-three, elliptical, rounded at the base, acute or rounded at the apex, which ends in a long slender mucro; pubescence as in *R. Pseudacacia*; stipels, $\frac{1}{10}$ in. long, often persistent; petiolules $\frac{1}{8}$ in. long, pubescent. The leaflets are somewhat smaller and bluer in tint than those of *R. Pseudacacia*.

Flowers³ in short compact glandular long-peduncled racemes; calyx-lobes all acuminate, appressed pubescent; corolla pink or white tinged with pink; standard narrow with a yellow blotch on the inner surface. Pod about 3 in. long, glandular pubescent.

This species differs little in appearance from the common Robinia, but is readily distinguished by the densely pubescent branchlets and the persistent stipels at the base of the leaflets. In winter the branchlets retain some of the pubescence, and are often covered with a glaucous bloom. The stipules become spinescent, as in *R. Pseudacacia*, but retain traces of pubescence, and are not quite glabrous as in that species.

This species forms hybrids with *R. Pseudacacia*, which are described on p. 1500.

R. neomexicana grows on the banks of mountain streams, and is distributed from the valley of the Purgatory river in southern Colorado through northern New Mexico to the Santa Catalina and Santa Rita Mountains in Arizona, whence it extends northward to southern Utah. It ascends to 7000 feet altitude.

It was introduced⁴ into cultivation in the Harvard Botanic Garden, U.S.A., in

¹ Cf. Booth, *Einführ. Ausländ. Holzarten*, 65 (1903).

² Quoted by Unwin, *Future Forest Trees*, 45 (1905). A plantation in France, fifty years old, yielded about 4300 cubic ft. per acre. Cf. *Bull. Soc. Forest. Franche-Comté*, x. 18 (1911).

³ A form with white flowers is said to have been found wild in Arizona. Cf. *Mitt. Deut. Dend. Ges.* 1911, p. 423.

⁴ Cf. W. J. Bean, in *Gard. Chron.* xxxv. 229 (1904). It appears to have been introduced on the Continent by Dieck, who states in his catalogue, *Neuheiten Offerte Nat. Arb. Zöschel*, 1889-1890, p. 13, that he received it from Prof. Sargent. It was soon afterwards obtained from the same source by Späth.

1882, and was sent from there to Kew in 1887. It is perfectly hardy at Kew, ripening seed, and has already attained a height of 25 feet. It is an ornamental small tree, producing beautiful pale pink flowers in June, and occasionally a second time in autumn. It flowers best in hot dry summers. (A. H.)

In my trial ground at Colesborne a seedling procured from Kew has endured winter frosts below zero without injury, and ripens its wood in a young state better than the common Robinia. At Aldenham House a young tree 15 ft. high bore fruit in 1911, and evidently liked the hot dry summer. Mr. Vicary Gibbs considers its flowers more ornamental than those of any variety, except *R. Pseudacacia* var. *Decaisneana*. (H. J. E.)

ROBINIA VISCOSA, CLAMMY LOCUST

Robinia viscosa, Ventenat, *Hort. Cels.* 4, t. 4 (1800); Loudon, *Arb. et Frut. Brit.* ii. 626 (1838); Sargent, *Silva N. Amer.* iii. 45, t. 115 (1892), and *Trees N. Amer.* 574 (1905).
Robinia glutinosa, Sims, in *Bot. Mag.* xvi. t. 560 (1803).

A tree, attaining 40 ft. in height and 3 ft. in girth, with thin smooth dark brown bark. Young branchlets covered with sessile and short-stalked glands, exuding a viscid matter. Leaflets nine to twenty-five, ovate or oval, rounded at the base, acute or rounded at the apex, which ends in a short mucro; pubescence similar to that of *R. Pseudacacia*; stipels slender, mostly deciduous; petiolules $\frac{1}{8}$ in. long, pubescent.

Flowers, about ten to fifteen, inodorous, in pubescent glandular short racemes; pedicels pubescent; calyx-lobes all subulately pointed, pubescent; corolla pale pink, with a narrow standard marked on the inner surface with a pale yellow blotch. Pod about 3 in. long, glandular-hispid.

This species is readily distinguished in winter by the viscid glandular twigs, which look as if oiled. The stipules are subulate, ultimately either deciduous or developing into slender short spines.

No varieties¹ of this species are known; but it forms hybrids with *R. Pseudacacia*, which are described on p. 1500.

The Clammy Locust, as it is called in America, is confined in the wild state to the mountains of North and South Carolina, where it occurs as a small tree or large shrub, often spreading by root-suckers and forming considerable thickets. It has been widely planted in the eastern United States, and is now naturalised in many places east of the Mississippi and as far north as the Canadian frontier.

It was introduced into England in 1797, and first flowered, according to Sims, in Mr. Whiteley's garden at Old Brompton in 1800. It is occasionally seen in botanic gardens, as at Kew, where there are several old specimens 25 to 35 ft. in height, which are probably the finest in Europe. This species is much slower in growth than *R. Pseudacacia*, but is ornamental on account of its pink flowers, which are produced in June and July. (A. H.)

¹ In Loudon, *Gard. Mag.* xvii. 391 (1841), it is stated that Vilmorin found at Verrières seedlings of this species with branchlets, which were not viscid.

ROBINIA HISPIDA, ROSE ACACIA

Robinia hispida, Linnæus, *Mantissa*, 101 (1767); Curtis, *Bot. Mag.* t. 311 (1795); Loudon, *Arb. et Frut. Brit.* ii. 627 (1838); Sargent, *Silva N. Amer.* iii. 37 (1892).
Robinia hispida-rosea, Loiseleur, in *Nouv. Duham.* ii. 64 (1804).
Robinia rosea, Loiseleur, *op. cit.* t. 18 (1804).
Pseudacacia hispida, Moench, *Meth.* 145 (1794).

A shrub, attaining about 10 ft. in height. Young branchlets covered with dense pubescence, interspersed with glandular bristles, which persist in the second year. Leaf-rachis with similar pubescence and bristles. Leaflets, seven to eleven, larger than in the other species, 1 to 2 in. long, oval, rounded at the base, rounded or occasionally slightly cuspidate at the apex, which is tipped with a long pubescent mucro; glabrous, except for slight pubescence on the midrib beneath; stipels persistent; petiolule, $\frac{1}{2}$ to $\frac{1}{4}$ in. long, pubescent and glandular-hispid.

Flowers few, five to nine, in loose pendulous racemes, pink, without odour; calyx-lobes all ending in long subulate teeth; peduncles, axis, pedicels, and calyx covered with white pubescence interspersed with glandular bristles. Fruit,¹ about 2 in. long, slightly constricted between the seeds, covered with glandular bristles. The stipules are usually deciduous, but occasionally develop on the older branchlets as minute blunt spines.

Two forms of this species and a probable hybrid are known:—

1. Var. *typica*, Schneider, *Laubholzkunde*, ii. 81 (1907), described above. This is characterised by numerous glandular bristles on the branchlets and leaf-rachis.

2. Var. *macrophylla*, De Candolle, *Prod.* ii. 262 (1825).

Var. *inermis*, Kirchner, *Arb. Musc.* 373 (1864).
Robinia macrophylla, Schrader, *ex De Candolle, loc. cit.*

Glandular bristles few or none on the branchlets and leaf-rachis, but present on the peduncles and calyx of the flower and on the pod. Leaves and flowers larger than in the typical form. Var. *macrophylla* appears to have arisen in cultivation in Europe.²

3. *Robinia Kelseyi*, Cowell, in Bailey, *Cycl. Amer. Hort.* 1538 (1902); Hutchinson and Bean, in *Bot. Mag.* t. 8213 (1908).

A small shrub, which originated³ in H. P. Kelsey's nursery at Boston, U.S.A.

¹ Mr. T. Meehan, who studied this plant in the wild state in Tennessee, says that it produces fruit very rarely, and is usually reproduced in the forests by root-suckers. He procured two pods in 1894, one of which he sent to the Kew herbarium. Cf. *Kew Bulletin*, 1893, p. 341, and Nicholson, in *Gardeners' Magazine*, 1894, p. 118. Carrière, in *Rev. Hort.* xxxix. 431, fig. 38 (1867), describes imperfect fruits which were produced on a tree at Paris.

² Cf. Carrière, *Prod. et Fixat. Vars.* 54 (1865), and in *Rev. Hort.* liv. 109 (1972).

³ Mr. Kelsey in a letter to Kew says that it came up spontaneously in his nursery; but supposes that it may have come into his collection with seed of other plants from the southern Alleghany Mountains.

With *R. Kelseyi* should be compared *R. Boyntoni*, Ashe, in *Journ. Elis. Mitch. Soc.* xiv. part ii. p. 53 (1897), which I have not seen. This is identified by Schneider, *Laubholzkunde*, ii. 82, note (1907) with *R. hispida*, var. *rosea*, Pursh, *Fl. Amer. Sept.* ii. 488 (1814); and is said to occur in North Carolina, Tennessee, Georgia, and Alabama. *R. Boyntoni*, according to Ashe's description, is very similar to *R. Kelseyi*, but with glabrous fruit. Small, *Flora South-eastern U.S.* 613 (1903), however, says that the pod is hispid.

It is probably a hybrid between *R. hispida* and *R. Pseudacacia*, resembling the latter in the slightly pubescent and usually non-glandular¹ branchlets, and in the small size of the leaflets, which are seven to eleven in number, $\frac{1}{2}$ to $1\frac{1}{2}$ in. long, glabrous, lanceolate, and tipped with a conspicuous mucro. The flowers are similar to those of *R. hispida*, but smaller; and are pink in colour, few (about five to eight) in the raceme,—with the peduncle, axis, pedicels, and calyx more or less covered with stalked glands, all the calyx-lobes being subulately pointed. Fruit reddish, $1\frac{1}{2}$ to 2 in. long, densely covered with glandular hairs; seeds three to four. Stipular spines are present on the branchlets, but are feebly developed.

This was introduced into commerce about 1901, and shrubs planted at Kew in 1903 have flowered and produced fruit.² It is not so rank in growth as *R. hispida*, and is less liable on this account to be injured by the wind. According to Mr. Bean, it can be readily propagated by grafting on the roots of *R. Pseudacacia*.

R. hispida, commonly known as the rose acacia, occurs in the mountains of Virginia, Kentucky, Tennessee, North and South Carolina, Alabama and Georgia.

It was introduced³ into cultivation in England by Sir John Colliton at Exmouth, in 1741. It is a handsome shrub with beautiful flowers, produced in June and July. It is usually grafted on the common Robinia; but Nicholson says that as it is readily propagated by root-cuttings, this mode of reproduction is preferable.

(A. H.)

¹ The branchlets bear occasionally one or two stalked glands.

² Cf. *Gard. Chron.* xlvii. 391, fig. 177 (1910), where the plant is figured. It obtained an award of merit at the Royal Horticultural Society on June 7, 1910.

³ Loudon, *Gard. Mag.* 1841, p. 637.

GLEDITSCHIA

Gleditschia, Clayton, ex Linnæus, *Gen. Pl.* 480 (1742); Willdenow, *Berl. Baumz.* 132 (1796); Spach, *Hist. Veg.* i. 90 (1834); Bentham et Hooker, *Gen. Pl.* i. 568 (1865); Maximowicz, *Mél. Biol.* xii. 450 (1886); Rehder, in Bailey, *Cycl. Amer. Hort.* 650 (1900).
Gleditsia, Linnæus, *Sp. Pl.* 1056 (1753); Schneider, *Laubholzkunde*, ii. 8 (1907).

DECIDUOUS trees belonging to the division Cæsalpinea of the order Leguminosæ. Stem and branches often armed with stout rigid sharp long-pointed spines, which are simple or branched. These spines are abortive branches, which arise above the axils of the leaves, being developed from buds embedded in the bark. Buds of the leafy branches, axillary, no true terminal bud being formed, concealed in the tissue of the twig, multiple, three or four superposed in a vertical line, the two or three lower without scales and covered by the base of the petiole in summer and by the leaf-scar in winter; the uppermost bud, larger than the others, covered with minute scales.

Leaves alternate or fascicled, long-stalked, equally pinnate or bipinnate, some of the pinnæ in the latter often reduced¹ to simple leaflets. Leaflets membranous, opposite or alternate, crenulate in margin, without stipels. Stipules leafy, early deciduous.

Flowers polygamous, dioecious, or perfect; regular, minute, greenish white, in axillary simple or spicate racemes, with scale-like caducous bracts. Calyx campanulate, lined with a disc, three- to five-lobed. Petals as many as the lobes of the calyx. Stamens, six to ten, inserted with the petals on the margin of the disc, exerted; filaments free, erect; anthers abortive in the pistillate flowers; ovary usually one-celled, rudimentary or absent in the staminate flowers; style short, with a dilated terminal stigma; ovules two or many.

Pod coriaceous, compressed; either elongated, containing pulp, many-seeded, and indehiscent; or short, without pulp, one- or two-seeded, and ultimately dehiscent. Seed oval or orbicular, more or less compressed, attached by a long slender funicle.

About a dozen species of *Gleditschia* are known, natives of North America, Caucasus, North Persia, Japan, China, Formosa, the Philippines, Celebes, Tropical Africa, and Argentina.

The following key comprises the species cultivated in Europe, which I have been able to identify. The leaflets described are those of the simply pinnate leaves on adult trees.

¹ Leavitt, in *Bot. Gaz.* xvii. 49, fig. 14 (1909), describes and figures these peculiar leaves, occurring in *G. triacanthos*.

Gleditschia

1511

I. Pods elongated, many-seeded, indehiscent.

* Leaflets, eight to twelve, prominently reticulate beneath.

(a) Branchlets pubescent.

1. *Gleditschia Delavayi*, Franchet. South-western China. See p. 1513.

Leaflets ovate-oblong, 2 to 2½ in. long, ¾ to 1½ in. wide, almost entire in margin. Pod, 16 to 20 in. long, flattened, twisted, not dotted with pits.

(b) Branchlets glabrous.

2. *Gleditschia sinensis*, Lamarck. North China. See p. 1513.

Leaflets ovate-lanceolate, 1¼ to 2½ in. long, ⅝ to 1 in. wide, crenulate. Pod, 6 to 10 in. long, convex on both surfaces, dotted with minute pits.

3. *Gleditschia macracantha*, Desfontaines. Central China. See p. 1514.

Leaflets ovate-oblong, 2 to 3 in. long, 1 to 1½ in. wide, crenulate. Pod, 6 to 12 in. long, slightly convex on both surfaces, dotted with minute pits.

** Leaflets twelve to twenty-eight, not prominently reticulate beneath. Branchlets glabrous.¹ Pods flattened, averaging 12 in. long, not dotted with pits.

4. *Gleditschia triacanthos*, Linnæus. North America. See p. 1517.

Leaf-rachis pubescent on all sides. Leaflets lanceolate, 1 to 1½ in. long, ⅜ to ⅝ in. wide, with dense conspicuous pubescence on the midrib beneath.

5. *Gleditschia caspica*, Desfontaines. South-west coast of the Caspian Sea. See p. 1512.

Leaf-rachis pubescent only on the outer edge of the groove. Leaflets narrowly elliptical or lanceolate, 1¼ to 1½ in. long, ⅝ to ¾ in. wide; glandular on the midrib above; shining and quite glabrous beneath. Young branchlets green.

6. *Gleditschia japonica*, Miquel. Japan, Manchuria, North China. See p. 1516.

Leaf-rachis as in *G. caspica*. Leaflets similar, but narrower and not glandular on the midrib above. Young branchlets purplish.

II. Pods short, one- to two-seeded, dehiscent.

7. *Gleditschia aquatica*, Marshall. North America. See p. 1520.

Leaf-rachis pubescent only on the outer edge of the groove. Leaflets, ten to twenty, lanceolate, about 1 in. long and ⅓ in. wide, distinguishable from the other species by their small size, and by being quite glabrous on both surfaces and only slightly ciliate on the margin. Young branchlets glabrous.

In addition to the species enumerated in the key, mention may be made here of a peculiar *Gleditschia*, growing in the nursery of Messrs. Simon-Louis at Plantières, which has been identified by Schneider, *Laubholzkunde*, ii. 10 (1907), with *Gleditschia ferox*, Desfontaines, *Hist. Arb.* ii. 247 (1809). This tree has remarkably stout, compressed, reddish brown spines, which attain on the trunk 10 in. in length, with branches 3 to 5 in. long; on the branchlets, the spines are about 1½ in. long, bearing two short lateral opposite smaller spines. The foliage on the specimen which I have seen, is mostly bipinnate, with six to ten pinnæ, each bearing twenty or more

¹ The branchlets of *G. triacanthos* are usually pubescent close to the base; but are glabrous elsewhere.

small leaflets. This tree has never borne fruit, and cannot be identified with any species known in the wild state. Whether it is a hybrid, which originated at an early period in France, or an unknown species, is uncertain.¹ A specimen is growing at Colesborne, where it is quite hardy, but does not seem likely to attain a tree-like habit.

(A. H.)

GLEDITSCHIA CASPICA

Gleditschia caspica, Desfontaines, *Hist. Arb.* ii. 247 (1809); Spach, *Hist. Vég.* i. 97 (1834); Loudon, *Arb. et Frut. Brit.* ii. 655 (1838); Boissier, *Fl. Orient.* ii. 631 (1872).
Gleditschia horrida, Makino, var. *caspica*, Schneider, *Laubholzkunde*, ii. 12 (1907).

A tree, attaining about 35 ft. in height. Young branchlets glabrous. Leaves simply pinnate or bipinnate with six to eight pairs of pinnæ; leaflets of the pinnate leaves, fourteen to twenty, narrowly elliptical or lanceolate, about $1\frac{1}{4}$ to $1\frac{1}{2}$ in. long, and $\frac{5}{8}$ to $\frac{3}{4}$ in. wide, rounded at the base, truncate or emarginate with a short mucro at the apex; upper surface with scattered short hairs on the midrib and nerves, and numerous minute glands on the midrib; lower surface glabrous, shining; margin crenulate, ciliate; stalklet very short, broad, pubescent above, glabrous beneath; rachis pubescent on the outer edge of the broad glandular often winged groove, elsewhere glabrous.

Flowers sub-sessile in slightly pubescent racemes or spikes; ovary glabrous. Pod thin and flattened, indehiscent, 9 to 12 in. long, 1 to $1\frac{1}{4}$ in. broad, with a sweet edible pulp,² straight or falcate, dark chestnut brown, smooth without dotted pits, slightly pubescent. Seeds numerous, close to the upper suture of the pod, oval, compressed, about $\frac{1}{2}$ in. long, shining, dark brown, marked on the surface with transverse raised lines.

The thorns on the branches in this species are chestnut brown, flattened or compressed in section, usually bipinnately branched, the primary branches coming off in different planes and bearing two or three lateral thorns. The thorns on the stem are much branched, and often very formidable.

G. caspica is limited to the wooded districts along the south-west coast of the Caspian Sea in Ghilan and Talysch. It is a rare tree, never attaining a large size, Medwedew³ giving its height as 30 to 35 ft. It ascends in the valleys to about 500 ft. altitude. The wood is used in the construction of mills, as it is durable under water. Cattle and wild pigs are fond of the sweetish pods.

G. caspica was introduced into England about 1822; and is usually seen as a small tree in botanic gardens,⁴ where its remarkable spiny trunk renders it an object of interest. It flowers, and occasionally produces fruit at Cambridge, where there are two trees of different sexes.

(A. H.)

¹ Rehder, in Bailey, *Cycl. Amer. Hort.* 650 (1900), states that *G. ferox* is often cultivated; but all the specimens which we have received from the Continent with this name, except the one from Simon-Louis, are referable to *G. caspica*.

² Cf. Hohenacker, in *Bull. Soc. Mosc.* iv. 351 (1838).

³ Cf. Köppen, *Holzgewächse Europ. Russlands*, i. 236 (1888), and Radde, *Pflanzenverb. Kaukasusländ.* 185, 189, 198 (1899).

⁴ Bean, in *Kew Bull.* 1908, p. 400, records a handsome tree, 40 ft. high, in the Schönbrunn Botanic Garden near Vienna.

GLEDITSCHIA DELAVAYI

Gleditschia Delavayi, Franchet, *Pl. Delav.* 189 (1889); Schneider, *Laubholzkunde*, ii. 11 (1907).

A tree, attaining in Yunnan 40 ft. in height. Young branchlets covered with a dense minute pubescence. Leaves on adult trees simply pinnate; leaflets ten to fourteen, oblong-ovate, 2 to $2\frac{1}{2}$ in. long, and $\frac{3}{4}$ to $1\frac{1}{2}$ in. broad; rounded or emarginate, and minutely apiculate at the apex; almost entire in margin, the crenations being few and indistinct; upper surface slightly pubescent on the midrib and veins; lower surface prominently reticulate, slightly pubescent on the midrib, elsewhere glabrous; stalklets short, stout, pubescent; rachis covered on all sides with a dense minute pubescence.

Flowers with short pedicels, perfect, in simple loose pubescent racemes; ovary glabrous. Pod indchiscent, 16 to 20 in. long, and 2 to $2\frac{1}{2}$ in. wide, flattened, twisted, glaucous, dark brown, slightly pubescent, not dotted with pits on the surface; seeds numerous, close to the upper suture.

The spines on the branchlets are terete, pubescent, simple or two- to three-forked.

G. Delavayi is readily distinguishable from all the other species by its pubescent branchlets and very large pods. It is a native of south-western China, where it was found in Yunnan by Delavay and myself at elevations of 4000 to 6000 ft. It was introduced into England by E. H. Wilson, who sent seeds in 1900 from Yunnan to Messrs. Veitch; but the plants raised from this consignment in the Coombe Wood nursery died in the winter of 1905-1906. Other plants raised two or three years afterwards from seed sent by Wilson from the Min valley in Szechwan still survive at Coombe Wood, as well as small plants at Kew and Cambridge.

This species is also in cultivation at Verrières near Paris. (A. H.)

GLEDITSCHIA SINENSIS

Gleditschia sinensis,¹ Lamarck, *Encycl.* ii. 465 (1786); Bunge, *Enum. Pl. Chin. Bor.* 21 (1831); Loudon, *Arb. et Frut. Brit.* ii. 654 (1838); Hemsley, in *Journ. Linn. Soc. (Bot.)* xxiii. 209 (1887); Schneider, *Laubholzkunde*, ii. 9 (1907).
Gleditschia horrida, Willdenow, *Sp. Pl.* iv. 2, p. 1098 (1806) (not Makino).
Gleditschia xylocarpa, Hance, in *Journ. Bot.* xxii. 366 (1884).
Gymnocladus Williamsii, Hance, *loc. cit.*

A tree, attaining in China 40 feet in height. Young branchlets glabrous. Leaves usually simply pinnate; leaflets eight to twelve, ovate-lanceolate, $1\frac{1}{4}$ to $2\frac{1}{2}$ in. long, $\frac{5}{8}$ to 1 in. broad; tapering to a rounded or truncate apiculate apex; upper surface minutely pubescent, but usually becoming glabrescent except on the midrib;

¹ *G. sinensis*, Bentham, *Fl. Hongk.* 100 (1861), and Maximowicz, in *Mé. Biol.* xii. 453 (1886), is not Lamarck's species; and is referable to *G. australis*, Hemsley.

lower surface, with scattered minute pubescence, which usually soon disappears, and with prominent reticulate venation; margin crenulate and ciliate; rachis pubescent on the edges of the groove; petiolule pubescent.

Flowers, on pedicels about $\frac{1}{8}$ in. long, in loose pubescent racemes; ovary pubescent on the borders. Pod indehiscent, 6 to 10 in. long, $\frac{3}{4}$ to $1\frac{1}{4}$ in. broad, swollen and convex on both surfaces, glaucous, glabrous, dark purplish brown, marked on the surface with dot-like pits. Seeds numerous, placed in the centre of the pod, oval, about $\frac{2}{5}$ in. long, convex on both surfaces, pointed at the apex, smooth, shining, brown, marked with transverse lines.

The spines on the branchlets are terete, usually with one or two lateral smaller spines. A variety¹ without spines is said to have arisen in Camuzet's nursery in 1823.

G. sinensis was described in 1786 by Lamarck from a tree, which had been cultivated for nine years in the Royal Garden at Versailles. It was said to have been raised from seed² received from China; and Lamarck adds that the pods were somewhat cylindrical and contained globose seeds. In Gay's herbarium at Kew, there is a specimen, labelled *G. sinensis*, Lamarck, which was gathered in 1822 from a tree, probably the original one, at the Trianon; and this specimen may be regarded as an undoubted type of Lamarck's species.³ It is identical with a species of *Gleditschia* which occurs wild on the mountains near Peking, and is cultivated farther south, as at Shanghai and Ningpo. The pods, which are called *tsao-chia*, are used as soap for washing clothes by the Chinese.

Loudon reported large trees of this species at Syon and the Mile End Nursery in 1838; but it is doubtful if these were accurately named; and they cannot now be found. We have not seen a single example in Britain. It is not common even in France, though there are large specimens at Verrières⁴ near Paris, and at Montpellier. (A. H.)

GLEDITSCHIA MACRACANTHA

Gleditschia macracantha, Desfontaines, *Hist. Arb.* ii. 246 (1809); Loudon, *Arb. et Frut. Brit.* ii. 654 (1838).

Gleditschia Fontanesii, Spach, *Hist. Vég. i.* 95 (1834).

Gleditschia officinalis,⁵ Hemsley, in *Kew Bulletin*, 1892, p. 82.

A tree, attaining in central China 50 ft. in height. Young branchlets glabrous. Leaves simply pinnate, with six to twelve leaflets, which are variable in size; those

¹ De Vries, *Plant Breeding*, 617 (1906).

² Bretschneider, *Hist. Europ. Bot. Disc. China*, 49, 52, 77 (1898), supposes that the seed was sent from Peking by Père D'Incarville; but the latter died in 1757, and Lamarck's account, though not quite clear, seems to indicate that the seeds were received about 1777.

³ *G. sinensis* has been much confused with other Chinese species by various authors. There are good specimens in the British Museum, gathered by Bretschneider and Williams near Peking.

⁴ Cf. *Hortus Vilmorinianus*, 19 (1906), where a tree of this species, wrongly identified as *G. caspica*, is reported to be 50 ft. high and 5 ft. in girth. It was probably planted in 1825.

⁵ This species was founded on specimens, bearing unripe and aborted pods, which were gathered on 26th July 1888.

towards the base of the shoot, very large, ovate-oblong,¹ 2 to 3 in. long, and 1 to $1\frac{1}{2}$ in. broad; those towards the apex of the shoot, smaller, ovate-lanceolate, $1\frac{1}{2}$ in. long and $\frac{3}{4}$ in. broad; glabrous, except on the midrib above, which is pubescent throughout, and on the midrib beneath, which bears a few scattered hairs; margin crenulate; lower surface prominently reticulate; rachis pubescent on the edges of the groove; petiolules pubescent.

Flowers in loose pubescent simple racemes; pedicels slender, pubescent, $\frac{1}{4}$ to $\frac{1}{2}$ in. long; ovary pubescent. Pod indehiscent, 6 to 12 in. long, 1 to $1\frac{1}{2}$ in. broad, straight or curved, not twisted, slightly convex on both surfaces, not so swollen as in *G. sinensis*, and not so flattened as in *G. triacanthos*, dark purplish brown, glabrous, shining, often glaucous, dotted with minute pits. Seeds numerous, placed towards the centre of the pod, oval, about $\frac{1}{2}$ in. long, convex on both surfaces, shining brown, marked with transverse raised lines, becoming deeply pitted when dried in the immature state.

The spines on the branchlets are terete, conical, reddish brown, simple or with one or two small lateral thorns.

This species is closely allied to *G. sinensis*, but appears to differ in the shape of the leaflets, which are larger, broader, and more prominently reticulate; and has pods, which can be readily distinguished. In the Kew herbarium, there is a branch with a pod, gathered by Gay in 1814 from a tree in M. Morel's garden near Paris. This tree is stated by Gay to have been identical with a tree of *G. macracantha* in the Jardin des Plantes, doubtless the one on which Desfontaines founded this species. Gay's specimen may then be accepted with certainty as a type of *G. macracantha*.

G. macracantha occurs in the wild state in the mountains of central China,² where it was found by Dr. Faber and myself in the provinces of Hupeh and Szechwan. Young unripe and aborted pods are gathered by the Chinese, and used as a drug, known as *ya-tsao*.³

G. macracantha was probably introduced into France by seed sent from China by the missionaries towards the end of the 18th century. A large tree of this species is said by Loudon to have been growing at Syon in 1838; but little reliance can be placed on his identification. It is apparently now unknown in cultivation in England; but it thrives well in the south of France and in Italy, whence we have obtained specimens from Montpellier and La Mortola. (A. H.)

¹ On one of the trees at Montpellier, the large leaflets are occasionally obovate, a shape not seen in any other species.

² A specimen gathered by Ford's collector in 1888 on Lantao Island, near Hong-Kong, is probably this species.

³ Cf. Hanbury, *Science Papers*, 248, 1876. These pods, of which there are specimens from China in the London Pharmaceutical Museum, appear to be aborted and contain no seeds. Similar pods have been produced on a solitary tree at La Mortola, which bears only pistillate flowers, the anthers being absent or sterile.

GLEDITSCHIA JAPONICA

Gleditschia japonica, Miquel, in *Ann. Mus. Bot. Ludg. Bat.* iii. 54 (1867); Franchet et Savatier, *Enum. Pl. Jap.* i. 114 (1875) and ii. 327 (1879); Maximowicz, *Mél. Biol.* xii. 452 (1886); Sargent, in *Garden and Forest*, vi. 163, t. 27 (1893), and *Forest Flora Japan*, 35, t. 11 (1894); Shirasawa, *Icon. Ess. Forest. Japon.* i. text, 87, t. 51, figs. 15 to 30 (1900).
Gleditschia horrida,¹ Makino, in *Tokyo Bot. Mag.* xvii. 12 (1903); Schneider, *Laubholzkunde*, ii. 11 (1907).
Fagara horrida, Thunberg, in *Trans. Linn. Soc.* ii. 329 (1794).

A tree, attaining in Japan 60 to 70 ft. in height, with a trunk occasionally 3 ft. in diameter. Young branchlets glabrous, purplish. Leaves similar to those of *G. caspica*, but with the leaflets apparently narrower, always lanceolate, tapering to a rounded or acute (not emarginate) apiculate apex, and without glands on the midrib of the upper surface; lower surface slightly pubescent on the midrib.

Pods thin, flattened, about 10 to 14 in. long, falcate, often twisted, shining or glaucous, brown, glabrescent, without dot-like pits on the surface. Seeds numerous, situated towards the upper suture of the pod, oval, flattened, about $\frac{1}{3}$ in. long, marked with transverse lines.

This species is closely allied to, if not really identical with *G. caspica*; but the material examined has been insufficient for determination. The purplish colour of the young branchlets in cultivated specimens of *G. japonica* may not be a constant character.

This species is a native of Japan, Manchuria,² and north China. In Japan, it is rare towards the north, where it is occasionally seen on the banks of rivers at no great altitude. It is more abundant and attains its largest size on the banks of the Kisogawa and other streams in the centre of the main island at elevations of about 2000 ft., where it thrives best in rich alluvial soil, though it is often seen on gravelly slopes. The pulp of the pods is much used for washing cloth by the Japanese, who call the tree *Saikachi*.

In Manchuria, it is said by Komarov³ to be wild in the neighbourhood of Mukden; and there are specimens in the Kew herbarium collected by Ross and Webster in other districts. Bretschneider also sent this species to Kew from the neighbourhood of Peking.

The only specimen which we have seen in England is a tree at Kew, about 15 ft. high, obtained from Yokohama in 1894. A young tree at Verrières, raised from Chinese seed, appears to belong to this species. (A. H.)

¹ This name is inadvisable, as *G. horrida*, Willdenow, *Sp. Pl.* iv. 2. p. 1098 (1806), is a synonym of *G. sinensis*, Lamarck.

² Cf. T. Nakai, in *Journ. Sci. Coll. Tokyo*, xxvi. 142 (1910), who records a variety of this species without spines from Korea. His *G. caspica* from the same region is doubtless *G. japonica*.

³ In *Act. Hort. Petrop.* xxii. 566 (1904).

GLEDITSCHIA TRIACANTHOS, HONEY LOCUST

Gleditschia triacanthos, Linnæus, *Sp. Pl.* 1056 (excl. β) (1753); Loudon, *Arb. et Frut. Brit.* ii. 650 (1838); Sargent, *Silva N. Amer.* iii. 75, tt. 125, 126 (1882), and *Trees N. Amer.* 556 (1905); Schneider, *Laubholzkunde*, 12 (1907).
Gleditschia spinosa, Marshall, *Arb. Amer.* 54 (1785).
Gleditschia meliloba, Walter, *Fl. Carol.* 254 (1788).
Gleditschia elegans, Salisbury, *Prod.* 323 (1796).
Gleditschia brachycarpa,¹ Pursh, *Fl. Amer. Sept.* i. 221 (1814).
Gleditschia heterophylla, Rafinesque, *Fl. Ludovic.* 99 (1817).

A tree, attaining in America 70 to 140 ft. in height and 10 to 20 ft. in girth. Bark divided by deep fissures into narrow longitudinal scaly ridges. Young branchlets green, slightly pubescent at the base below the insertions of the lower leaves, elsewhere glabrous; shining brown and glabrous in the second year. Leaves simply pinnate or bipinnate, with four to seven pairs of pinnæ; leaflets of the pinnate leaves, 14 to 28, lanceolate, averaging 1 to $1\frac{1}{2}$ in. long, and $\frac{3}{8}$ to $\frac{5}{8}$ in. wide, minutely apiculate at the rounded or acute apex; margin crenulate and ciliate; both surfaces pubescent with scattered curved hairs, which are dense and conspicuous on the yellowish green midrib beneath, and on the short stout stalklets; rachis with a narrow groove, and densely pubescent on all sides; venation inconspicuous and not prominent on the lower surface.

Flowers with short pedicels; staminate flowers numerous in usually clustered pubescent racemes; pistillate flowers few in solitary racemes. Pod, 12 to 16 in. long, 1 to $1\frac{1}{2}$ in. broad, indehiscent, thin and flattened; straight or falcate, often twisted; shining dark brown without dot-like pits, pubescent; inner coat thin and papery. Seeds numerous, placed close to the upper suture of the pod, separated by a succulent pulp, oval, about $\frac{1}{3}$ in. long, compressed, marked with a few transverse lines, and becoming pitted on drying.

The spines on the branchlets are conical, terete, unbranched or three-forked, the branching being simply pinnate in one plane; their colour is reddish at first, becoming ultimately shining dark brown.

The seedling² has oval-oblong sessile cotyledons, and bears in the first year pinnate leaves with about 20 very small leaflets.

VARIETIES AND HYBRID

1. Var. *inermis*, Pursh, *Fl. Amer. Sept.* i. 221 (1814).

Spines entirely absent or feebly developed.³ According to Loudon, abundance

¹ Said to differ from the type in bearing short pods. The pods, however, are variable in size on individual trees; and this cannot be maintained even as a distinct variety.

² Cf. Tübenf, *Samen, Früchte u. Keimlinge*, 127 (1891).

³ Sargent, *Silva N. Amer.* iii. 75, note 3 (1882), states that trees growing under conditions where they have been freely exposed to light most frequently develop spines; while those growing in the forest, shaded by other trees, are often unarmed.

of plants without spines may be selected from beds of seedlings of the ordinary form.

2. Var. *Bujoti*, Rehder, in Bailey, *Cycl. Amer. Hort.* 650 (1900).

Gleditsia Bujoti, Neumann, in *Rev. Hort.* iv. 205 (1845).

Branches pendulous; leaflets narrower than in the typical form.

3. Var. *nana*, Hort. Kew. A small round-headed tree of compact habit, with dark green foliage, and leaflets shorter and broader than in the type. This, of which there is a living example at Kew, appears to be identical with *G. ferox*, var. *nana*, Rehder, in Bailey, *Cycl. Amer. Hort.* 650 (1900); and is possibly *G. sinensis*, var. *nana*, Loudon, *Arb. et Frut. Brit.* ii. 654 (1838).

4. This species probably hybridizes with *G. aquatica*. Schneck, in *Plant World*, vii. 252 (1904), states that he found several trees of evidently hybrid origin growing on the edge of a swamp on Mt. Carmel, Illinois. These bore pods about 5 in. long and 1½ in. broad which were entirely destitute of pulp.

G. texana, Sargent, in *Bot. Gaz.* xxxi. 1 (1901), *Silva N. Amer.* xiii. 13, t. 627 (1902), and *Trees N. Amer.* 557 (1905), bears similar pods, and is said to be only found as a single grove of large trees, growing in alluvial soil along the Brazos river, near Brazoria in Texas. As both *G. triacanthos* and *G. aquatica* are found in the valley of the Brazos river, it is probable that *G. texana* is a hybrid between these two species. There are similar pods, without foliage, in the Kew Herbarium, which are labelled "*Gleditschia brachyloba*,¹ Mississippi Banks, Nuttall."

A small plant of *G. texana*, obtained from the Arnold Arboretum in 1900, is now growing at Kew. It differs from native specimens in having spines on the branchlets. (A. H.)

DISTRIBUTION AND CULTIVATION

G. triacanthos is a native of North America, extending from the western slope of the Alleghany Mountains in Pennsylvania westward through Ontario and Michigan to Minnesota, Nebraska, Kansas, and Indian Territory, and southward to Alabama, Mississippi, and the valley of the Brazos river in Texas. It usually grows on the borders of streams or in valleys in moist fertile land, either singly or in rare cases covering considerable areas almost exclusively, and occasionally occurs on dry gravelly hills. Sargent states that it is now often found naturalised in the region east of the Alleghany Mountains. It attains its largest size in Indiana and Illinois, where Ridgway² states that it was formerly one of the most majestic trees of the forest. Many were 120 to 140 ft. high, with straight trunks clear of branches to 50 or 70 ft., and 4 to 6 ft. in diameter. No trees except the Cypress and Catalpa had a more characteristic appearance, its tall straight but usually inclined trunk, of a dark grey or nearly black colour, being conspicuous at a distance, while the delicate foliage made its top contrast with other species. He³ gives 156 ft. as its maximum height, on the authority of Dr. Schneck, who showed me the remains of

these wonderful woods in 1904, when I could find no tree of this species larger than about 110 ft. by 9 ft.

G. triacanthos is a very ornamental tree, with fine foliage, which turns a bright golden yellow colour in autumn. It was first cultivated in England at Fulham, where a tree planted by Bishop Compton about 1700 bore fruit¹ in 1729. Though the seeds rarely if ever ripen in England, I have easily raised seedlings from French seed by soaking them in water before sowing. The seedlings do not ripen their wood in the open, and should be kept in a frame for two or three years. This species does not appear to be long lived in our climate, as most of the old trees mentioned by Loudon in 1838 cannot now be found. He figures one at Syon 57 ft. high, with a trunk 3 ft. in diameter; but the largest tree² there now was only 46 ft. by 2 ft. in girth in 1910.

In England one of the finest trees is growing near the Palm House at Kew. It measures 54 ft. by 6 ft. 10 in., and bears fruit occasionally. At Fawley Court a fine tree with flaky bark, like that of a tree at Verrières, and with very few spines, was 74 ft. by 5 ft. 10 in. in 1905. An old tree at Arley Castle³ measured 51 ft. by 5 ft. 5 in. in 1904. At Belton, Grantham, Miss Woolward reports a tree 47 ft. by 4 ft. in 1907.

Other large trees measured by me are at Bisterne Park, Hants, 62 ft. by 8 ft., with a bole of 30 ft., decaying in 1906; at Ham Manor, Sussex, 60 ft. by 4 ft. 7 in. in 1907; at Stowe, Bucks, 53 ft. by 4 ft. 10 in. in 1905; in the grounds of Wadham College, Oxford, 53 ft. by 4½ ft. in 1907; and one of the same size at Bibury Rectory, Gloucestershire, in 1908.

In Wales the only large tree I have seen is a very fine one at Golden Grove, 65 ft. by 4½ ft., a healthy tree with very few spines.

In Scotland and Ireland we have not seen any trees of note.

This species attains a large size, and produces fruit with good seed regularly in the south of France and in Italy. In the neighbourhood of Parma it is used for making formidable hedges. At Montpellier there is a fine specimen, narrowly pyramidal in habit, very different in aspect from the usual form seen in cultivation. In the Bishop's garden at Beauvais I measured in 1908 a tree 80 ft. by 7 ft.; and at the Château de Geneste, near Bordeaux, in 1909, one 80 ft. by 8 ft. At Schloss Dyck, in Germany, an even larger tree is reported,⁴ measuring about 90 ft. by 7 ft.

TIMBER

The wood is heavy, hard, and strong, with a coarse open grain, reddish brown at the heart with yellowish white sapwood. Being durable in the soil, it is used in the United States for posts and rails and to a small extent for wheel hubs; but I have never seen or heard of it in the English timber market, and it is not likely to have

¹ Cf. *London Catalogue of Trees*, 87, plate 21 (1730).

² A. B. Jackson, *Cat. Trees Syon House*, 15 (1910).

³ R. Woodward, jun., *Cat. Trees Arley Castle*, 15 (1907).

⁴ *Mitt. D. D. Ges.* 1904, p. 18.

¹ *G. brachycarpa*, Pursh, is probably meant, the specimens being collected by Nuttall.

² *Proc. U.S. Nat. Mus.* 1882, p. 64.

³ Ridgway, *Additional Notes*, 419.

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any special commercial value. The best specimen of it which I have seen was cut down at Wretham Rectory, Norfolk, in 1884, when it produced a log 30 ft. long, containing 69 cubic feet of timber. From it a bookcase of very nice appearance was made.
(H. J. E.)

GLEDITSCHIA AQUATICA

Gleditschia aquatica, Marshall, *Arb. Amer.* 95 (1785); Sargent, *Silva N. Amer.* iii. 79, t. 127 (1892), and *Trees N. Amer.* 558 (1905).
Gleditschia inermis, Miller, *Dict.* ed. 8, No. 2 (1768); Schneider, *Laubholzkunde*, ii. 13 (1907).
Gleditschia caroliniensis, Lamarck, *Encyc.* ii. 465 (1786).
Gleditschia monosperma, Walter, *Fl. Carol.* 254 (1788); Loudon, *Arb. et Frut. Brit.* ii. 653 (1838).

A tree, attaining in America 50 to 60 ft. in height, with a short trunk occasionally 8 ft. in girth. Young branchlets glabrous. Leaves simply pinnate, or bipinnate with three or four pairs of pinnæ; leaflets of the simple pinnate leaves, ten to twenty, lanceolate, about 1 in. long and $\frac{1}{3}$ in. wide, gradually narrowing to an obtuse apex, which is usually without any distinct mucro; margin crenulate, slightly ciliate; both surfaces shining, glabrous; stalklet slender, slightly pubescent; rachis pubescent on the edge of the narrow groove, elsewhere glabrous.

Pod thin and flattened, without pulp, dehiscent; either one-seeded, rhomboid, 1 to $1\frac{1}{2}$ in. long, or two-seeded, with the edges nearly parallel, about $2\frac{1}{4}$ in. long; reddish brown, glabrous, and without dotted pits on the surface. Seed orbicular, flattened, about $\frac{1}{3}$ in. in diameter, orange-brown, marked on the surface with transverse wavy lines.

The spines in this species are shining dark reddish brown, compressed and not terete in section, usually unbranched, or rarely with short branches arising pinnately in one plane.

G. aquatica is a native of the coast region of the United States from South Carolina, Georgia, and Florida westward through the Gulf States to the Brazos river in Texas; and extends northward in the Mississippi basin, through Louisiana, Arkansas, Kentucky, and Tennessee to southern Illinois and Indiana. East of the Mississippi river, it is rare and only found in river swamps; but westward it is very abundant on rich alluvial land, occupying in Louisiana and Arkansas extensive tracts, which are inundated for a considerable period every year.

It is said by Loudon to have been introduced into England in 1723 by Catesby; but it is extremely doubtful if the large trees considered to be this species by Loudon were correctly named, as in all probability they were simply *G. triacanthos*.

The only specimen which we have seen in this country, is a small tree at Kew, about 10 ft. high.
(A. H.)

LABURNUM

Laburnum, Linnæus, *Syst. Nat.* 4 (1735); Medicus in *Vorl. Churfürstl. Ges.* ii. 363 (1787); Grisebach, *Spicil. Fl. Rum.* i. 7 (1843); Bentham et Hooker, *Gen. Pl.* i. 481 (1865); Schneider, *Laubholzkunde*, ii. 37 (1907).
Cytisus, Linnæus, section *Laburnum*, Wettstein, in *Oesterr. Bot. Zeitschr.* xl. 435, t. iv. (1890), and xli. 127, 261 (1891).

DECIDUOUS small trees or shrubs, belonging to the division Papilionaceæ of the order Leguminosæ. Leaves alternate, compound, with three stalked leaflets, and more or less persistent stipules. Flowers yellow, in terminal racemes; calyx campanulate, two-lipped, the upper lip with two short teeth, the lower lip with three short teeth; standard ovate or orbicular, erect; wings obovate; keel incurved, shorter than the wings; stamens monadelphous, five short versatile anthers alternating with five basifixed anthers; ovary stalked, ovules numerous; style glabrous, incurved, with a terminal stigma. Pod linear, flattened, stalked. Seeds without an excrescence at the hilum.

This genus comprises three species, one of which *L. caramanicum*, Bentham and Hooker, a native of Greece and Asia Minor, is a low shrub, which need not be further alluded to.
(A. H.)

LABURNUM ALPINUM, ALPINE LABURNUM

Laburnum alpinum, Berchtold and Presl, *Opir. Rost.* iii. 99 (1830-1835); Grisebach, *Spicil. Fl. Rum.* i. 7 (1843); Schneider, *Laubholzkunde*, ii. 39 (1907).
Cytisus alpinus, Miller, *Dict.* ed. 8, No. 2 (1768); Loudon, *Arb. et Frut. Brit.* ii. 591 (1838).
Cytisus angustifolius, Moench, *Meth.* 145 (1794).

A tree similar in size, bark, and mode of branching, to *L. vulgare*. Young branchlets glabrous. Leaves similar to those of *L. vulgare*, but with glabrous petioles; leaflets more variable in shape, oval, oblong, or even obovate, acute and mucronate at the apex, entire in margin; dark green and glabrous above; light green and glabrous beneath, except for a few long hairs on the base of the midrib.

Flowers in long and slender racemes,—smaller, paler yellow, and opening later than those of *L. vulgare*; calyx and pedicels glabrous. Pod, about $1\frac{1}{2}$ to 2 in. long, glabrous, with the upper suture winged; seeds brown.

This species is variable in the wild state:—

1. Var. *pilosum*, Koehne, *Deut. Dendr.* 326 (1893), has leaflets with a few scattered hairs on the under surface.

2. Var. *microstachys*, Koehne, *loc. cit.* Racemes shorter and less pendulous than in the type. This occurs in sunny arid localities.

3. Loudon mentions a pendulous form in Loddiges' nursery, which, from the description, appears to have been a hybrid between this species and *L. vulgare*.

This species has much the same distribution as *L. vulgare*, but is found at a higher elevation in the mountains of central Europe, being common in the Jura, the Alps, and the Carpathians.

The two species were confused; but *L. alpinum*¹ appears to have been as early introduced as the other. It is more hardy, and is cultivated 5° of latitude farther north in Norway and Sweden. It thrives in the Highlands of Scotland,² and hence is often, but erroneously, called Scotch Laburnum. The largest specimens, which we have seen of this species in Britain, are the fine old trees in the Edinburgh Botanic Garden, which were planted about 1820 and are now showing signs of old age. One of these in 1911 was over 40 ft. high and nearly 5 ft. in girth.

(A. H.)

LABURNUM VULGARE, LABURNUM

Laburnum vulgare, Berchtold and Presl, *Opir. Rost.* iii. 99 (1830-1835); Grisebach, *Spicil. Fl. Rum.* i. 7 (1843).

Laburnum anagyroides, Medicus, in *Vorl. Churfürstl. Ges.* ii. 363 (1787); Schneider, *Laubholzkunde*, ii. 37 (1907).

Cytisus Laburnum, Linnæus, *Sp. Pl.* 739 (1753); Loudon, *Arb. et Frut. Brit.* ii. 590 (1838).

A small tree, seldom exceeding 30 ft. in height, with smooth greenish bark, and few long shoots, most of the lateral buds developing only short shoots, on which the leaves are borne in fascicles. Young branchlets covered with appressed silky pubescence. Leaves on long pubescent stalks. Leaflets three, elliptic, the terminal one larger than the two lateral; tapering at both ends, mucronate at the apex; upper surface dark green, glabrous; lower surface pale, more or less covered with appressed silky pubescence; margin entire; venation pinnate; stalklets silky pubescent. Buds with two to three silky external scales, a true terminal bud being present, which is surrounded in winter by acuminate silky stipular leaf bases.

Flowers in long pendulous racemes; the axis, long slender pedicels, and calyx being covered with silky appressed hairs. Corolla large, yellow; standard veined with dark purple lines. Pods about 2 in. long, often contracted in the middle, at first silky, then becoming glabrescent, thickened on both sutures, dehiscent. Seeds reniform-orbicular, depressed, black.

¹ Loudon, *Arb. et Frut. Brit.* ii. 917 (1838) says that the Alpine Laburnum, though actually a much lower tree than the mountain ash, will, when drawn up in woods, attain twice the height of the latter tree. This species was called Tree Laburnum by Sang, Nicol's *Planter's Kalendar*, 91 (1812) to distinguish it from the common Laburnum, which was said to be more shrubby in growth in Scotland.

² See Plate 370, where in the accompanying letterpress are given further particulars.

This species is variable in the wild state, three sub-species having been established by Wettstein; but Schneider only recognises the typical form and the following variety:—

1. Var. *Alschingeri*, Reichenbach, *Icon. Flor. Germ.* xxii. 30 (1869).

Cytisus Alschingeri, Visiani, *Fl. Dalmat.* iii. 262 (1852).

Lower lip of the calyx much longer than the upper lip, not approximately equal in length as in the type. Leaflets greyer and more pubescent beneath.

A considerable number of varieties have arisen in cultivation, the most important of which are:—

2. Var. *quercifolium*, Loudon. Leaflets, three or five, deeply lobed.

3. Var. *bullatum*, Koch, *Dendrologie*, i. 17 (1869). Leaflets curled, and puckered with swellings.

4. Var. *sessilifolium*, Kirchner, *Arb. Musc.* 399 (1864). Leaflets crowded, sessile.

5. Var. *aureum*, Simon-Louis, *Cat.* 1880, p. 51; Van Houtte, *Flore des Serres*, xxi. 2242, 2243 (1875). Foliage yellow.

6. Var. *pendulum*, Koch, *loc. cit.* Branchlets pendulous.

7. Var. *Carlievi*,¹ Kirchner, *Arb. Musc.* 398 (1864). Leaflets smaller than in the type. Flowers small, in short, more or less erect racemes.

HYBRIDS

L. vulgare is one of the parents in each of the following hybrids:—

I. *Laburnum Watereri*, Dippel, *Laubholzkunde*, iii. 673 (1893).

Laburnum vulgare, vars. *Watereri*, *intermedium*, and *Parksii*, Kirchner, *Arb. Musc.* 399, 400 (1864). *Cytisus Watereri*, Wettstein, in *Oesterr. Bot. Zeitschr.* xli. 129 (1891).

This is intermediate between *L. vulgare* and *L. alpinum* in the characters of the branchlets, foliage, and pods, and in the time of flowering; but it approaches the former species in the colour of the flowers, and exceeds it in the length of the racemes, which bear numerous flowers on long pedicels. The young branchlets, petiole, and under surface of the leaflets, have a few scattered appressed hairs.

This hybrid has been noticed in the wild state,² as at Bozen in the Tyrol, where Hausmann gathered it in 1856. It appears to have originated several times in cultivation; and was first noticed in 1842, when it was offered for sale by T. D. Parkes,³ a nurseryman at Dartford. He states that it was raised from seed, and had flowers of a deeper colour than *L. vulgare*, borne in racemes 15 in. long.

It afterwards appeared in a bed of seedlings in Waterer's nursery. Darwin⁴ found that 20 per cent of the pollen grains were ill-formed and useless, and that in most seasons it yielded no fruit.⁵ In 1865 his tree produced a few pods, some of

¹ Several plants appear to be known under this name, and possibly may be different forms, arising from the hybrid in the second generation.

² Wettstein, in *Oesterr. Bot. Zeitschr.* xli. 170 (1891).

³ Cf. *Gard. Chron.* 1842, pp. 365 and 705.

⁴ *Variation of Animals and Plants*, i. 416 (1890). A shrub at Aldenham, named *L. Alschingeri*, agrees in foliage and long racemes with *L. Watereri*; but produces every year abundance of pods, which apparently contain good seed. Mr. Vicary Gibbs raised seedlings from it some years ago.

⁵ Wettstein states that 42 per cent of the pollen grains are useless; and in 1890 made the following observations on three trees of similar age in the Vienna Botanic Garden:—*L. vulgare* bore 654 pods, with about 3000 seeds; *L. alpinum* produced 562 pods, with about 2500 seeds; while *L. Watereri* bore only 7 pods, with 21 seeds, of which only 5 were fertile.

which contained one or two apparently good seeds. Some of these germinated; and he raised two trees, one of which resembled the parent, but the other was remarkably dwarf in habit with small leaves.

This hybrid, which is usually sold as *L. Watereri* or *L. Parksii*, is very ornamental, occasionally bearing racemes 16 or 18 in. long, and is said to be very rapid in growth.¹

II. *Laburnum Adami*, Kirchner, *Arb. Musc.* 397 (1864).

Cytisus Adami, Poiteau, in *Ann. Soc. Hort. Paris*, vii. 501 (1830), and in Loudon, *Gard. Mag.* xvii. 59 (1841).

Cytisus Laburnum, Linnæus, var. *coccineum*, Lindley, in *Bot. Reg.* xxxiii. t. 1965 (1837).

Cytisus Laburnum, Linnæus, var. *purpurascens*, Loudon, *Arb. et Frut. Brit.* ii. 590 (1838).

This remarkable hybrid, between *Laburnum vulgare* and *Cytisus purpureus*, Scopoli, has normally glabrous branchlets, petioles, and leaves, with leaflets smaller than those of *L. vulgare*; and bears dingy red small flowers, in short pendulous racemes, which never set seed. It is usually reproduced by grafting on the common Laburnum, and is remarkable in often producing stray branches which revert back to one or both of the parents. A single tree is thus often seen bearing three kinds of foliage and flowers: (a) the hybrid foliage and flowers; (b) branches with the yellow flowers and leaves of *L. vulgare*; and (c) branches with the leaves and small purple flowers of *Cytisus purpureus*.² The yellow flowers produce pods which yield fertile seed, from which Darwin³ raised seedlings resembling in most respects the common Laburnum. The branches with purple flowers are said by Darwin to be not quite the same as those of *Cytisus purpureus*, and are not perfectly fertile; but he raised seedlings from their seed which differed in no respect from pure *Cytisus purpureus*.

This hybrid is said to have originated in 1825 in the nursery of M. Adam at Vitry, near Paris. He inserted on a stock of *L. vulgare* a shield of the bark of *Cytisus purpureus*, which produced in the following year several shoots, one of which was more vigorous and had larger leaves than the others. This shoot was propagated, and as soon as it bore the peculiar flowers intermediate between the two species, was recognised as a hybrid which had been produced by grafting. This account has been disputed by some botanists; and De Vries,⁴ who has made a study of the plant, states that Camuzet, a contemporary of M. Adam, maintained that he had seen the tree from which the latter had taken his graft, and that it was not *Cytisus purpureus*, but *L. Adami* itself, so that the latter must have originated earlier and been an ordinary chance hybrid from seed. Camuzet's statement seems very improbable; and against this view may be stated the fact that Reisseck, Caspary, and Darwin tried in vain to cross the flowers of *C. purpureus* with those of *L. vulgare*.

¹ Cf. Harrison Weir, in *Gard. Chron.* xxvi. 83 (1899).

² Mixed flowers also occur. Braun, *Rejuvenescence* (Ray Soc.), 317, plate v. (1853), gives an instance of a raceme which bore 21 flowers of *L. Adami*, 3 flowers of *L. vulgare*, and 8 mixed flowers. In the latter, half of the corolla was reddish like *L. Adami*, the other half yellow like *L. vulgare*; similarly, half of the calyx was reddish brown and glabrous, as in *L. Adami*, the other half green and pubescent, as in *L. vulgare*.

³ *Variation of Animals and Plants*, i. 414 (1890).

⁴ *Mutation Theory*, ii. 622, figs. 139, 140 (1911). Cf. also Bateson, in *Nature*, lxxxviii. 37 (1912).

The literature concerning *L. Adami* is very extensive, and need not be cited¹ here; but the reader may refer to an article by R. P. Gregory in *Gard. Chron.* l. 162, 185 (1911) on graft-hybrids, in which is given the anatomical evidence that *L. Adami* resembles *Cytisus purpureus* in the structure of the epidermis, whilst its internal structure is that of *L. vulgare*.

There are good specimens² at Kew, and in several private gardens.

DISTRIBUTION

L. vulgare is a native of Central Europe, occurring in the east of France from Lorraine, through the Jura to the Dauphiné, where it is common in woods on calcareous soil. It is rare in Switzerland, but is widely spread through Lower Austria, Styria, Carinthia, Carniola, and Hungary south of the Danube, attaining its southerly limit in northern Italy, Dalmatia, Servia, and Bulgaria.

All parts of the plant are said to be poisonous; but this is doubtful, as we have heard no case of animals³ being affected from browsing on the leaves alone. The seeds, however, contain a highly poisonous alkaloid,⁴ *cytisine*, discovered by Husemann and Marmé in 1865; and ten seeds have proved fatal to a child.

The flowers are produced regularly in May; but in some seasons, as in 1908, a few trees flower a second time⁵ in October.

In old trees of Laburnum, decayed at the base, adventitious roots are occasionally thrown out at some distance above the ground, and act as props to the stem. An instance of this in the Edinburgh Botanic Garden was described and photographed by Dr. Borthwick.⁶ (A. H.)

CULTIVATION

It was cultivated⁷ by Tradescant in England in 1596, and is largely planted everywhere as a small ornamental tree.

The common Laburnum is very hardy. It was not hurt in Suffolk by the severe winter of 1860-1861, and flowered well in the following May. The blossoms,

¹ The early history is given by Loudon, *Gard. Mag.* xii. 225 (1836), and xv. 122 (1839); and by Dillwyn, in *Gard. Chron.* 1841, pp. 325, 366, and 1842, p. 397. Cf. also Kerner, *Nat. Hist. Plants*, Eng. Trans. ii. 570 (1898).

² Cf. Bean, in *Gard. Chron.* xxxv. 371 (1904). Cf. also *The Garden*, lxxix. 333 (1906), and *Gard. Chron.* xxxvi. 217 (1904), where an illustration is given of a tree of *L. Adami* in Pennick's nursery at Delgany, Co. Wicklow.

³ In the case reported by Dr. Stark in *Gard. Chron.* xvi. 666 (1881), where cattle died at Huntfield, Lanarkshire, after browsing on Laburnum, the pods were eaten as well as the leaves and branches. In *Gard. Chron.* l. 310 (1911) a case is recorded of two cows which died after eating the tops of a felled Laburnum tree; but these bore seed-pods as well as foliage. The flowers are poisonous, according to Taylor, *Med. Jurisp.* 730-733 (1905), who considers a recorded case of poisoning by the bark at Inverness to be doubtful.

⁴ Flückiger and Hanbury, *Pharmacographia*, 172 (1879). The alkaloid *laburnine* here mentioned proved to be only impure *cytisine*. Cf. Kunkel, *Toxicologie*, ii. 847 (1901).

⁵ Cf. *Gard. Chron.* xxxii. 253, 271, 290 (1902), and xlii. 313, 363 (1908). Autumnal flowers, seen in October at Kingston-on-Thames, and on 1st November at Antwerp, were noticed as borne in short racemes.

⁶ *Notes R. Bot. Garden, Edinburgh*, xviii. 121, plate 24 (1907).

⁷ By Act V, Ed. IV. cap. 4 (Ireland), every Englishman was required to have a bow of his own height made of yew, wych hazel, ash, or awburne. The *awburne* was possibly the Laburnum, as it is identical with the Scottish name for this tree, *hoburn saugh*, which is given in Jamieson's *Dictionary*. Cotgrave's *Dictionary* (1611) gives the French word, "*Aubourt*, a kind of tree, Latin *alburnus*; it bears long yellow blossoms which no bee will touch." The flowers of the Laburnum are visited by bees; but Cotgrave here repeats an erroneous statement of Pliny. Cf. the correspondence on this subject in *The Phytologist*, iv. 191, 255 (1860). Matthiolus mentions that in his time the wood of the Laburnum was considered to make the best bows.

however, are sometimes completely killed by late frosts in April, as in 1859 at Mildenhall.¹ It is planted in Norway as far north as Trondhjem, and in Sweden as far as Stockholm.²

No tree is more easily raised from seed, or more easily transplanted than the Laburnum; and its rapid growth when young, and ability to thrive on the poorest, driest, and most chalky soils, makes it a valuable addition not only to pleasure grounds, where it is most generally seen, but also for plantations.

Boutcher³ recommends planting it in plantations where hares are numerous, because as long as they can get Laburnum they will touch no other tree, and though eaten to the ground every winter they will spring up again every summer. I have proved the truth of this to some extent at Colesborne, and planted Laburnums in quantity on the edge of plantations. But as the tree has a tendency to branch freely, and the branches are easily broken by the wind, pruning must be done for some years if a clean bole is desired. There is much variation in the habit; some, having a weeping tendency, should be selected for ornament; whilst for timber, clean stems of 10 to 12 ft. should be aimed at; and on good soils I believe that, though the wood is hardly known to modern cabinetmakers, it will have a considerable value at an age when few other hardwoods have any.

REMARKABLE TREES

One of the finest I have seen in the south, is near the East Lodge at The Mote, near Maidstone, in a sheltered dell. This in 1911 was 38 ft. high, with a bole 8½ ft. in girth and 8 ft. high, but the stem was partly decayed and patched with lead and plaster.

At Ickleton Grange, near Cambridge, Mr. G. W. H. Bowen showed Henry, in June 1912, a remarkable plantation of Laburnum (*L. vulgare*), which is said to have been made about 1790 by Mr. Percy Wyndham. It is four acres in extent, and is situated on the south slope of a hill, the soil being very thin and resting on impermeable chalk. The plantation was coppiced at an early period, most of the trees being bushy, with several wide-spreading limbs, arising from stools of considerable size. The largest specimen has eight great stems, 3 to 5 ft. in girth, and about 30 ft. high. Though close together and almost forming pure canopy, the trees are thinly clad with foliage; and the soil beneath is covered with thick grass. Seedlings, as soon as they appear, are eaten by rabbits; but in the same soil in a garden at some distance, which is surrounded by a Laburnum hedge, seedlings are very numerous. Mr. Bowen has also some thriving Laburnums, which were originally put down as stakes for fencing, but speedily developed roots and grew in this chalky soil.

At Coolhurst, near Horsham, there is a very old tree which leans over the road and has been propped up to keep it from falling. In 1906 it was about 35 ft. high by 3 to 4 ft. in girth. At "The Laburnums," near Stroud, there is a group of three trees, the stems of which are close together at the base, girthing respectively

¹ Bunbury, *Arb. Notes*, 6 (1889).

² Willkomm, *Forstl. Flora*, 918 (1887).

³ *Forest Trees*, 109 (1775).

8 ft. 3 in., 7 ft. 5 in., and 6 ft. near the ground, with a height of about 30 ft., and a spread of foliage of about 18 yards.

In the laundry yard at Alnwick Castle there is an immense spreading tree, dividing at the ground into two main trunks about 43 ft. high and 11 ft. 2 in. round at the ground. This is probably one of three trees mentioned by Loudon,¹ the largest of which in 1835 measured 6 ft. 11 in. in girth, and contained 46 ft. of timber. Mr. Gillanders believes it to be over one hundred years old, and says that it shows signs of decay.

At Inveraray it also grows to a large size, as I saw a log lying in the Duke of Argyll's yard in 1905 which was about 8 ft. in girth, and from which some very handsome furniture was afterwards made. At Dalkeith Palace² there is a remarkable Laburnum, low and spreading in habit, but covering a piece of ground 60 ft. across.

TIMBER

The wood of Laburnum is hard and heavy, weighing about 53 lbs. to the cubic foot when dry, according to Loudon, and is very durable when exposed to wet; and Mr. Vicary Gibbs tells me that a clothes-line prop of laburnum outlasted one of yew.

In colour the heartwood is dark when old, but the wood varies in colour with age, and rapidly becomes darker when exposed to light, becoming dark olive or red brown, and showing small medullary rays. When thoroughly dry it makes remarkably good joints, and is a first-class cabinetmakers' wood, taking a fine surface and good polish. Sang says³ that in his time (1812) it was the most valuable timber grown in Scotland, and that a quantity of it was sold in 1809 at Brechin Castle and Panmure at 10s. 6d. per foot. It was then used for cabinetmaking, musical instruments, handles, and chairs;⁴ and I can say from personal experience that it is a most excellent wood for furniture. I have seen old cabinets made in Scotland in which this wood was used in transverse sections, like the so-called oyster-shell cabinets made from slices of walnut wood. I believe it would also be well adapted for parquet.

(H. J. E.)

¹ *Arb. et Frut. Brit.* iv., Suppl. 2551 (1883).

² Bean, in *Gard. Chron.* li. 168 (1907).

³ Nicol, *Planter's Kalendar*, 91 (1812).

⁴ Cf. *Gard. Chron.* xxxvii. 397 (1905), where Mr. Coomber mentions a beautiful set of chairs made by Mr. Ross from trees which grew near Peterhead.

CASTANOPSIS

Castanopsis, Spach, *Hist. Vég.* xi. 185 (1842); Bentham et Hooker, *Gen. Pl.* iii. 409 (1880).

Castanea, Endlicher, *Gen. Pl.* 275 (in part) (1836); Prantl, in Engler and Prantl, *Nat. Pflanzenfam.* iii. pt. 1, p. 55 (1894).

Callaeocarpus, Miquel, *Pl. Jungh.* i. 13 (1851).

TREES or shrubs belonging to the order Fagaceæ, differing mainly from *Castanea* in the leaves being evergreen, and the buds covered with numerous imbricated scales; moreover, a true terminal bud is formed. Leaves coriaceous, five-ranked, entire or dentate. Catkins erect. Staminate flowers usually in clusters of threes, in simple or branched catkins; calyx, five- or six-partite; stamens six to twenty. Pistillate flowers, one to three, in an involucre, in simple or branched catkins or scattered at the base of the staminate catkin; calyx six-cleft, with abortive stamens; ovary three-celled, with two ovules in each cell; styles three, each ending in a minute stigma. Fruit, ripening in the second year, the spiny involucre enclosing one to three nuts. Nuts ovoid or globose, angled, usually containing one seed, which bears at its apex the aborted ovules.

About thirty species of *Castanopsis* have been described, one of which is a native of California and is the only species in cultivation. The others occur in south-eastern Asia and the Malay Archipelago, extending as far north as the eastern Himalayas, southern China, and Formosa.

CASTANOPSIS CHRYSOPHYLLA

Castanopsis chrysophylla, A. de Candolle, in *Journ. Bot.* i. 182 (1862), and *Prod.* xvi. 2, p. 109 (1864); Sargent, *Silva N. Amer.* ix. 3, t. 439 (1896), and *Trees N. Amer.* 223 (1905); Earl of Ducie, in *Gard. Chron.* xxii. 411, fig. 120 (1897); Masters, in *Gard. Chron.* xxxvi. 152, fig. 59 (1904); Jepson, *Silva of California*, 239, plate 74 (1910).

Castanea chrysophylla, Douglas, ex W. J. Hooker, *Comp. Bot. Mag.* ii. 127 (1836), *Fl. Bor. Amer.* ii. 159 (1839), *London Journ. Bot.* ii. 496, t. 16 (1843), and *Bot. Mag.* t. 4953 (1856); Jepson, *Fl. W. Mid. Calif.* 145 (1901).

A tree, rarely attaining in America 120 ft. in height and 20 ft. in girth, but usually smaller. Bark, 1 to 3 in. thick, and deeply divided by longitudinal fissures into rounded scaly ridges. Young branchlets covered with yellow scurfy scales. Leaves (Vol. III, Plate 202, Fig. 10), persistent two or three years, oblong, averaging 3 to 4 in. in length, and 1 to 1½ in. in breadth, tapering at the base and

apex, often contracted at the apex into a short broad point; thick, coriaceous, entire in margin; dark green, shining and glabrous above; under surface bright yellow, coated with minute scales; lateral nerves pinnate, twelve to sixteen pairs, looping just before they reach the margin; petiole ¼ to ½ in. long.

Staminate catkins simple or branched; stamens six to ten. Pistillate flowers borne on short separate catkins or scattered at the base of the staminate catkin. Fruit-involucre spiny, like that of the common chestnut, irregularly four-valved, containing one or occasionally two nuts; nuts ½ in. long, angled, with a hard shell and a sweet kernel.

The typical form described above is a tree, with large leaves, which gradually passes at high elevations into a shrub, distinguished as follows:—

1. Var. *minor*, A. de Candolle, *Prod.* xvi. 2, p. 110 (1864).

Var. *pumila*, Vasey, in *Rept. Comm. Agric.* 1875, p. 176 (1876).

Castanea chrysophylla, var. *minor*, Bentham, *Pl. Hartweg.* 337 (1857).

A shrub 2 to 15 ft. high. Leaves similar to those of the type in shape, but smaller, 1 to 2 in. long, very golden beneath.

This variety occurs in the Santa Cruz mountains and northwards as far as the south fork of the Salmon river. It is often gregarious on chaparral slopes and on the pine barrens of the Mendocino coast.

2. Var. *sempervirens*, Henry.

Castanopsis sempervirens, Dudley, in Merriam, *Biol. Survey Mt. Shasta*, 142 (1899).

Castanea sempervirens, Kellogg, in *Proc. Calif. Acad.* i. 71 (1855).

A shrub, 1 to 8 ft. high. Leaves elliptical, 1 to 2½ in. long, variable at the base, rounded or obtuse at the apex, pale yellow beneath. This is retained by Jepson, *Silva of California*, 241 (1910), as a distinct species, on account of the usually more numerous (ten to seventeen) stamens; but he acknowledges that there is no difference in the fruits. It grows on arid mountain slopes from Mt. Jacinto northwards through the Sierra Nevada and coast ranges to Mt. Shasta at 3000 to 8000 ft. elevation.

This species, in its typical form as a large tree, occurs in the Redwood belt of Mendocino and Humboldt counties of California, and northwards in the Siskiyou, Coast Range and Cascades of Oregon, as far as the valley of the Columbia river. Southward and eastward in California, only the shrubby forms occur. As a tree it appears to be rare, fruiting very sparingly, so that good seed can scarcely ever be procured. Jepson states that the largest trees now existing scarcely exceed 115 ft. in height; but are occasionally 4 to 6 ft. in diameter.

C. chrysophylla was discovered in 1830 by David Douglas on the Grand Rapids of the river Columbia in Oregon, at Cape Orford, and near Mt. Hood. Seeds were sent to Kew, by the collector Burke,¹ in 1845, from which a solitary plant was raised, which produced fruit when only 5 ft. high in 1856. It was reintroduced by William Lobb, who² sent seeds to Messrs. Veitch in 1853; but, so far as I can judge, the

¹ Cf. *Bot. Mag.* t. 4953. A MS. note at Kew states that Burke collected in North America in 1845.

² *Hortus Veitchii*, 393 (1906).

typical form has never been introduced, all the specimens which I have seen being var. *minor*. (A. H.)

The finest specimen in England is probably that at Tortworth,¹ which was procured from Messrs. Veitch about 1854-1856, and had attained 20 ft. by 1 ft. 5 in. in 1879, and 27 ft. by 3 ft. in 1897; and on 1st August 1911 measured 29 ft. by 3 ft. 5 in., with a circumference of branches as much as 75 ft. This tree is growing in a sheltered position on the side of a hill in a sandy loam, resting on the Old Red Sandstone formation. Up to 1882 it bore sterile fruits; but since that date has produced fertile seed, from which many seedlings have been raised. One of these in the late Sir J. D. Hooker's garden at Sunningdale was 10 ft. high in 1897. I have several times endeavoured to grow seedlings from this tree at Colesborne, but in every case they have died before or after turning out of their pots. I attribute this to excess of lime, and it is clear that *Castanopsis* is intolerant of lime in the soil.

At the Heatherside Nursery, Farnborough, there is a fine specimen with a single stem, but with very wide-spreading branches, which was 35 ft. high and bearing fruit in July 1910. There is said to be a good specimen at Pencarrow in Cornwall.

A shrub² only 2 ft. high produced fruit in 1904 at Kaimes Lodge, Murrayfield, Midlothian.

In Ireland the finest specimen, about 30 ft. high, was at Old Connaught House, Bray; but it died a short time before 1905, when Henry saw the dead stump still remaining. (H. J. E.)

¹ Cf. *Gard. Chron.* xiv. 435 (1880), xviii. 716 (1882), and xxii. 411, fig. 120 (1897).

² Cf. *Gard. Chron.* xxxvi. 152 (1904).

UMBELLULARIA

Umbellularia, Nuttall, *Sylva*, i. 87 (1842); Bentham et Hooker, *Gen. Pl.* iii. 162 (1880).

Oreodaphne, sub-genus *Umbellularia*, Nees ab Esenbeck, *Syst. Laurin.* 462 (1836).

Drimophyllum, Nuttall, *Sylva*, i. 85 (1842).

A GENUS belonging to the order Lauraceæ, the characters of which are given in the following description of the only¹ species known.

UMBELLULARIA CALIFORNICA, CALIFORNIAN LAUREL

Umbellularia californica, Nuttall, *Sylva*, i. 87 (1842); Sargent, *Silva N. Amer.* vii. 21, t. 306 (1895), and *Trees N. Amer.* 334 (1905); Jepson, *Flora W. Mid. Calif.* 191 (1901), and *Silva Calif.* 242, plates 10 and 76 (1910); Chesnut, in *Contrib. U.S. Nat. Herb.* vii. 349 (1902); Eastwood, *Trees of California*, 53 (1905); Power and Lees, in *Trans. Chem. Soc. London*, 1904, p. 629.

Tetranthera (?) *californica*, Hooker and Arnott, *Bot. Voy. Beechey*, 159 (1833).

Oreodaphne californica, Nees ab Esenbeck, *Syst. Laurin.* 463 (1836); Hooker, *Bot. Mag.* t. 5320 (1862).

Drimophyllum pauciflorum, Nuttall, *Sylva*, i. 85, t. 22 (1842).

Laurus regalis, Standish and Noble, *Pract. Hints on Planting*, 160 (1852).

An evergreen tree, variable in habit, occasionally attaining 120 ft. in height and 10 to 15 ft. in girth; but oftener a smaller tree or large bush, rarely reduced to a prostrate shrub. Young branchlets green, glabrous. Leaves persistent two to six years, coriaceous, very aromatic, alternate, simple, lanceolate or narrowly elliptical, averaging 3 to 4 in. long and 1 to 1½ in. broad, cuneate or rounded at the base, tapering to an acute or rounded apex, entire in margin; main veins pinnate, eight to twelve pairs, curved, looping before they reach the margin, connected by reticulate veinlets; dark green and shining above, duller and paler beneath, with a minute scattered pubescence when young, ultimately glabrous; petiole ½ to ⅓ in.

Flowers minute in stalked simple umbels, which are solitary and axillary or crowded near the apex of the branchlet; each umbel with four to nine flowers on slender pedicels arising in the axils of deciduous bracts; calyx with six pale yellow obovate lobes; petals absent; perfect stamens nine, in three series, the inner three with a stalked orange gland on each side of the base of the filament, and alternating with three scale-like staminodia; anthers four-celled, four-valved, the three inner

¹ *Umbellularia parvifolia*, Hemsley, *Biol. Centr. Amer.* iii. 77 (1882), a native of Mexico, belongs to another genus, and is correctly named *Litsea parvifolia*, Mez, in *Jahrb. Königl. Bot. Gart. Berlin*, v. 481 (1889).

extrorse, the outer two series introrse; ovary sessile, with a solitary ovule, and one style, crowned by a capitate stigma.

Fruit, an ovoid berry, about 1 in. long, surrounded at the base by the enlarged calyx, greenish or purplish, containing a large seed, with a hard woody outer shell, and a thin papery inner coat, destitute of albumen; embryo with two large thick cotyledons.

The Californian Laurel is a native of California and south-western Oregon, occurring mainly in the coast ranges from the Umpqua river southward. It is less abundant on the high western slopes of the Sierra Nevada, where it ascends to 4000 ft. in the Yosemite Valley and to 5000 ft. in the Kaweah basin. It is also found on the southern slopes of the San Bernardino mountains at 2000 to 2500 ft., and on the west slope of San Jacinto below 5000 ft.; and reaches its most southerly point in the Oriflamme Cañon near Julian.

Prof. Jepson gives a detailed account of the remarkable variation in the habit of this species. As a tree of considerable or very large size, it is found on the banks of streams, usually in rich alluvial soil. It forms tall bushy thickets on the northern walls of cañons; and becomes a low shrub, 3 to 4 ft. high, in the chaparral of the higher parts of the coast range. A curious prostrate form grows here and there on the bluffs facing the ocean in Mendocino county.

The finest trees in California, 70 to 120 ft. in height, and 9 to 20 ft. in girth, occur in groves, unmixed with other species, on the Eel river and other streams to the northward.

I saw this tree in Oregon, where it grows on the alluvial flats of the Coquille¹ river, in mixture with *Acer macrophyllum*, and attains a large size, trees 70 to 80 ft. high and 10 to 14 ft. in girth being common. The tallest which I measured was 121 ft. high and 11 ft. in girth. The tree is most remarkable for the extraordinary density of its foliage, through which rain penetrates with difficulty and sunshine never. It sprouts freely from the stump when cut down; and when isolated, is prone to produce abundant epicormic branches on the stem.

All parts of the tree contain a volatile oil, which is most abundant in the leaves, amounting to 7½ per cent. This oil resembles menthol and camphor in its effects on the tongue and skin; and when inhaled produces dizziness and headache. The dried leaves spread about drive away fleas; and when used as a decoction are a powerful insecticide. The seeds are roasted and eaten by the Indians.

This species was discovered in 1792 by Archibald Menzies, on the shores of San Francisco Bay; and was introduced² into England from Oregon by David Douglas in 1826. One of his original plants, which was living at Kew in 1862, cannot now be found.³ (A. H.)

We have seen no large trees in England, where it apparently only forms a bush. There is a specimen, with fruit, in the Kew herbarium, sent by Canon Ellacombe from Bitton in 1876. At Grayswood, Haslemere, a large bush

bore flowers in May 1907. At Tortworth, a large bush bore ripe fruit on 15th October 1911, the seed of which germinated this spring in my garden at Colesborne. At Kew there is a young tree, 15 ft. high, near the Temperate House; and an older shrub on the wall near the Forestry Museum. The latter flowers sparingly in most years, but has never produced fruit.

I saw a large bushy specimen about 20 ft. high at Drove House, Thornham, Norfolk, which was bearing ripe fruit in November 1910. Major the Hon. G. Legh informed me that this tree might have been much taller, but that it had been topped by a previous tenant several years before. Considering the exposed situation close to the North Sea, it seems probable that if seedlings from the best form of this species were planted in deep shady valleys in the south-west of England, they might attain a considerable size.

The wood is hard, strong, and close-grained, taking a fine polish. It contains numerous small equal pores and many thin medullary rays. The sapwood is whitish; but the heartwood is of a rich yellow or brown colour, often with peculiar black streaks. The wood is used for making furniture, panelling, staves, shoe-lasts, etc., and is suitable for turnery. At North Bend and Myrtle Point, in south-western Oregon, there are factories where this wood is made into furniture and veneers. A figured board of this wood, which I obtained, under the name of myrtle, from the Californian State Exhibit at St. Louis in 1904, is in the collection of timbers at Cambridge University. (H. J. E.)

¹ It is reported to be abundant and of large size also on the Coos and Rogue rivers in Oregon.

² W. J. Hooker, *Comp. Bot. Mag.* ii. 127 (1836), where the tree is referred to as *Laurus regia*, Douglas.

³ *Cf. Bot. Mag.* t. 5320 (1862), where the plant figured was received from Berlin.

PRUNUS

Prunus, Linnæus, *Sp. Pl.* 473 (1753), and *Gen. Pl.* 212 (1754); Bentham et Hooker, *Gen. Pl.* i. 609 (1865).

TREES or shrubs, belonging to the order Rosaceæ. Leaves alternate, simple; usually serrate with or without glandular points to the serrations, rarely entire; petiole often with one or more glands.

Flowers perfect; solitary, or in fascicles, corymbs, or racemes; calyx-tube cup-shaped or tubular; sepals five, imbricated in the bud; petals five, white or pink; stamens ten to thirty, perigynous, inserted with the petals on the mouth of the calyx-tube; ovary one-celled, with a terminal style, and containing two pendulous ovules. Fruit, a fleshy drupe, with an indehiscent, one-seeded, smooth or rugged stone.

This genus comprises over one hundred species, mostly natives of the temperate regions of the northern hemisphere, a few being indigenous in tropical Asia and tropical America.

In the following article, only a few species, mainly of interest to foresters, are dealt with. These may be arranged as follows:—

SECTION I. *Cerasus*. Cherries.

Leaves rolled up in the bud. Flowers large, long-stalked, usually fascicled or in corymbs.

1. *Prunus Avium*, Linnæus. Europe, Asia Minor, Caucasus. See p. 1535.

Large tree. Leaves variable in shape, cuspidate-acuminate, with scattered long hairs on the midrib and nerves beneath. Branchlets glabrous. Inflorescence not leafy at the base.

2. *Prunus Cerasus*, Linnæus. Europe, Asia Minor, Caucasus. See p. 1541.

Small tree or shrub. Leaves smaller than, but similar in shape to *P. Avium*, nearly glabrous beneath. Branchlets glabrous. Inflorescence with leaves at the base.

3. *Prunus Mahaleb*, Linnæus. Europe, Asia Minor, Caucasus, Armenia, Turkestan. See p. 1542.

Small tree. Leaves broadly ovate, pubescent on each side of the midrib beneath. Branchlets densely pubescent.

SECTION II. *Padus*. Bird Cherries.

Deciduous trees or shrubs. Leaves rolled up in the bud. Flowers small in long racemes, which are leafy at the base.

Prunus

4. *Prunus Padus*, Linnæus. Europe, Temperate Asia. See p. 1543.

Small tree or shrub. Leaves slightly cordate at the base; pale beneath with axil-tufts of pubescence.

5. *Prunus serotina*, Ehrhart. North America. See p. 1546.

Large tree. Leaves tapering at the base; pale beneath with a dense band of rusty pubescence on each side of the midrib.

SECTION III. *Laurocerasus*. Cherry Laurels.

Evergreen trees or shrubs. Leaves rolled up in the bud. Flowers small in long leafless racemes.

6. *Prunus Laurocerasus*, Linnæus. Balkan Peninsula, Asia Minor, Caucasus, North Persia. See p. 1551.

Leaves with a few remote serrations on the margin, and with one or two glands on each side of the midrib beneath.

7. *Prunus lusitanica*, Linnæus. Spain, Portugal, Azores, Madeira, and Canary Isles. See p. 1553.

Leaves regularly serrate, without glands beneath. (A. H.)

PRUNUS AVIUM, WILD CHERRY, GEAN

Prunus Avium, Linnæus, *Fl. Suec.* 165 (1755); Willkomm, *Forstliche Flora*, 898 (1887); Ascherson and Graebner, *Syn. Mitteleurop. Flora*, vi. pt. ii. 151 (1906).
Cerasus Avium, Moench, *Meth.* 672 (1794); Mathieu, *Flore Forestière*, 137 (1897).
Cerasus sylvestris, Loudon, *Arb. et Frut. Brit.* ii. 693 (1838).
Prunus Cerasus, var. *Avium*, Linnæus, *Sp. Pl.* 474 (1753).

A tree, attaining 80 to 100 ft. in height. Bark smooth, shining grey, often peeling off on the surface in transverse annular strips; becoming deeply fissured and thick at the base of old trunks. Young branchlets glabrous. Leaves alternate on the long shoots, clustered at the apices of the short shoots or spurs, variable in shape and size, up to 5 in. long and 2 in. broad, ovate or obovate, elliptic or oblong, cuspidate-acuminate at the apex, cuneate or rounded at the base, biserrate or unequally serrate, the serrations tipped with a gland; upper surface dull, glabrescent; lower surface pale green, with scattered long hairs, mainly on the midrib and nerves; lateral nerves, twelve to sixteen pairs, looping before reaching the margin; petiole with a few scattered hairs, and usually with a pair of red prominent glands near its distal end.

Flowers, two to six in a cluster, appearing with the leaves, and usually situated on the short shoots, arising out of a bud, with no internal leafy scales; calyx-tube constricted near the apex, glabrous, with five entire reflexed lobes: petals five, white, obovate-rounded, emarginate. Fruit globose, smooth, reddish, shining; stone light brown, oval, compressed, furrowed on one edge.

This species suckers from the roots, but not so freely as *P. Cerasus*; and when cut down, produces coppice shoots.

VARIETIES AND HYBRID

I. In the wild and typical form of the species, the fruit is small, with little edible flesh. The cultivated cherries¹ with larger and more edible fruit derived from *P. Avium* comprise two main varieties:—

1. Var. *Juliana*. Heart or Gean Cherries. Fruit mostly black, with soft flesh.
2. Var. *duracina*. Bigarreau Cherries. Fruit mostly yellow or red, with firm flesh.

The Duke Cherries, with acid flesh, are referred to *P. Avium* as var. *regalis* by Bailey.²

II. The following varieties, cultivated for ornament, are peculiar in leaves, flowers, or habit.

3. Var. *decumana*, Koch, *Dendrologie*, i. 106 (1869). Leaves very large, occasionally as much as 10 to 12 in. in length, and 4 to 6 in. in breadth.
4. Var. *asplenifolia*, Kirchner, *Arb. Musc.* 254 (1864). Leaves with deeply incised teeth.
5. Var. *salicifolia*, Dippel, *Laubholzkunde*, iii. 615 (1893). Leaves very narrow.
6. Var. *flore pleno*, Kirchner, *loc. cit.* Flowers partially or completely double.
7. Pendulous and pyramidal forms are also known.

III. The following, which is in all probability a hybrid between *P. Avium* and *P. Mahaleb* is occasionally cultivated:—

8. *Prunus Fontanesiana*, Schneider, *Laubholzkunde*, i. 617 (1906).

Prunus græca, Desfontaines, *ex Koch*, *Dendrologie*, i. 109 (1869).

Cerasus Fontanesiana, Spach, *Hist. Vég.* i. 410 (1834).

A tree, resembling *P. Avium* in habit. Young branchlets covered with dense whitish erect pubescence. Leaves about 4 in. long, 2 in. broad, similar in shape and size to those of *P. Avium*, but differing in the more crenate serrations, which are tipped with sharp minute glands, as in *P. Mahaleb*; glabrous above; pale green beneath with long pubescence on each side of the midrib; petiole pubescent, with one or two large glands. Flowers about $\frac{4}{5}$ in. across.

This tree, the origin of which is unknown, is remarkable for never producing fruit. A specimen at Kew is about 25 ft. high.

DISTRIBUTION

P. Avium is widely distributed throughout nearly the whole of Europe, but appears to be rare in Spain and Italy as a wild tree; and in Russia,³ is confined to the south-western provinces and the Crimea. It also occurs in Asia Minor and the Caucasus. It extends as far north as the province of Bergen in Norway, where Schübeler mentions a pure wood of considerable extent at Urnäs; and its remains have been found in peat-mosses in Sweden.⁴

¹ An excellent account of the cultivated cherries was given by R. Thompson in *Trans. Hort. Soc.*, Second Series, i. 248-294 (1835).

² *Cycl. Amer. Hort.* 1453 (1901).

³ Köppen, *Holzgewächse Eur. Russlands*, i. 280 (1888).

⁴ Willkomm, *Forstliche Flora*, 899, note (1887).

It is difficult to state in what parts of the British Isles it is truly wild; but it is certainly a native of the southern counties of England, occurring in many woods as a rare tree; while in beech woods, as in the Chiltern Hills, it is rather common, and attains a great height.

P. Avium has been found¹ in the fossil state in neolithic beds at Crossness, Essex, and at Gayfield, Edinburgh; and in interglacial deposits at West Wittering and Selsey, Sussex. (A. H.)

CULTIVATION

Though much neglected of late years by planters, the cherry is perhaps our most beautiful native tree when in full flower; and as it grows well and to a large size, on soils of only moderate quality, and suffers less than most trees from spring frosts, it should be planted for ornament as well as for timber in all suitable places.

It seems to grow best among beech, and in woods where the stem is drawn up to a good height before its crown expands, though even in exposed situations it makes a fair-sized trunk. It is indifferent to the geological nature of the soil, growing equally well on calcareous, gravelly, or sandy soils, but not on wet or heavy clays.

It is easy to raise from seed, though as a rule the fruit is eaten by birds before it ripens, and the majority of the young trees that one sees in woods are grown from suckers which spring up at a considerable distance from the trunk. I have seen a colony of young cherries, thirty paces across, all of which had sprung from the roots of one tree after felling. When it has attained a few inches in diameter it is rarely attacked by rabbits. The seed, if put in a rot-heap when ripe, will germinate the following spring, though when kept dry for long, a large proportion will lie dormant for a year before coming up. The seedlings transplant without difficulty, and may be planted out with little or no risk of loss when 3 to 4 ft. high.

For an avenue of moderate size, planted about five yards apart, I can think of no more beautiful tree than the cherry. Mr. Foljambe of Osberton told me that his father was so fond of this tree, that after he became blind he used to ask to be led out into the place where they grew at the time when they were in flower, in order that their scent might recall their beauty the better.

REMARKABLE TREES

The largest cherry tree that I have seen in England was pointed out to me by the late Prof. Fisher in Windsor Park, near the Bishopgate, and not far from the house occupied by Lady Southampton. It has probably been drawn up by beech trees round it, and measured in 1904, 93 to 95 ft. high by 9 ft. 3 in. in girth, with a trunk free from branches for nearly forty feet. It is probably past its best, for the cherry is not a long-lived tree and generally begins to decay before reaching 100 years. In Gatton Park, Surrey, on a flinty chalk hill in a wood of beech, there are

¹ Cf. C. Reid, *Origin British Flora*, 114 (1899).

some fine cherries, and the best of those now standing is about 90 ft. by 7 ft. 6 in.¹ A tree cut here contained 78 cubic feet of sound timber, some of the boards being fully 2 ft. across and quite sound. At Walcot, Shropshire, there are some splendid vigorous young cherry trees, one of which that I measured recently being about 90 ft. high and only 4 ft. 9 in. in girth. These may attain 100 ft. in height as they are still growing. Plate 354 shows a wild cherry in Savernake Forest, with a burry trunk, 12 ft. 7 in. in girth at four feet, and 10 ft. 9 in. at five feet from the ground.

In Gloucestershire there was a tree on the Earl of Harrowby's estate near Campden, which, according to Loudon, measured 85 ft. by over 9 ft. I could not find this tree when I visited Norton Court in 1906, but can well believe the correctness of this measurement after seeing the fine development of ash, oak, and chestnut at this place. On my own land, however, though the tree grows well up to fifty or sixty years old, it does not attain these dimensions, one of 8 ft. in girth being the largest I have.

Probably one of the finest in the Chiltern Hills is a tree growing in Burke's Grove, Butler's Court, Beaconsfield, which was accurately measured in 1909 by Lord Grenfell and B. L. Majendie, Esq., R.N., as follows:—total height, 97 ft.; height to the first branch, 67 ft.; girth at five feet from the ground, 4 ft. 10 in. Mr. Leslie Wood has seen a tree in a beech wood near High Wycombe, 95 ft. in height.

At Camp Wood, The Coppice, Henley, where the beautiful whitebeam grows that was figured in Vol. I. Plate 51, there is a fine tree, which measured in 1905, 74 ft. in height, by 9 ft. 10 in. in girth, at two feet from the ground, above which it divides into two stems. In the adjoining Bolney Wood, two trees measured 79 ft. by 5 ft. 2 in., and 76 ft. by 4 ft. with stems clear of branches to forty feet, and rivalling in height the beeches amidst which they are growing.

In a wood near Riverhill, Kent, Mr. A. B. Jackson measured a tree, 70 ft. by 8½ ft. in 1908. At Sidmouth, Devonshire, Miss Woolward measured a tree, 62 ft. by 10 ft. in 1906. At Henham, Suffolk, there is a tree about 50 ft. high and 10½ ft. in girth, with branches which spread over an area eighty-two paces round.

On Ashampstead Common, Berks, Dr. Watney showed me a very fine tree which was in 1901 about 75 ft. by 8 ft., and was surrounded by quite a grove of suckers from the roots.

At Russells, near Watford, there is, in a thick plantation near the house, a tree about 90 ft. by 9 ft. 8 in., of which the bark, standing up in high ridges, makes the girth seem larger than it really is. The bole of this tree is clean for about 20 ft.

At Appleby Hall, the seat of Lady St. Oswald, in north Lincolnshire, there is a tree in the shrubbery which divides into three large stems at about seven feet and measures about 65 ft. by 11 ft. 9 in.

At Alnwick Castle, Northumberland, a very fine cherry growing in a wood in 1907 measured 80 ft. by 6 ft. 10 in. with a bole about 50 ft. high, but judging from the number of dead branches it is near its end.

¹ Mr. J. S. Elliott of Cranleigh informs me that he bought twenty cherry trees out of this wood containing 807 cubic ft.; the best ten of these averaged 57 cubic ft. each.

At Dynevor Castle there are many fine cherry trees in the slopes round the ruins, and I was told by the late Lord Dynevor that one was blown down in 1889 which at three feet from the ground was no less than 12 ft. 9 in. in girth. At Duffryn, near Cardiff, Mr. Coomber¹ measured in 1896 a tree 82 ft. high by 8 ft. 3 in. at five feet from the ground, with a bole 35 ft. high.

In Scotland the cherry is always called gean. The largest that I have seen is on the flat near the Tay at Murthly Castle, a tree 65 ft. by 11 ft. 5 in., with a bole of 9 ft. The main limb of this tree has decayed, and, in 1908, had a mountain ash about 15 ft. high growing out of the decayed stump. At Duns Castle, Berwickshire, there is a remarkably large tree which I am informed by Mr. J. Ferguson measures 42 ft. by 13 ft. 6 in. and still bears fruit, though not so much as it did 60 or 70 years ago, when the fruit of these trees was more valued in Scotland than it is now. At Gribton, near Dumfries, the seat of H. Lamont, Esq., Henry measured a tree, 56 ft. high by no less than 12 ft. 8 in. in girth, whose branches spread to a diameter of 70 ft.

At Gordon Castle there is a very fine old tree near the house 50 to 60 ft. high, which girths at two feet from the ground, where there is a large swelling, 14 ft. 2 in., and 10 ft. 5 in. at five feet. At Ardkinglas I have seen a fine old cherry by the garden wall which had a very large burr on the trunk.

At Mauldslie Castle, Lanarkshire, Mr. Renwick in 1899 measured a tree 52 ft. high and 13 ft. 2 in. in girth. In 1903, it was reported² to be in a state of decay, the trunk splitting, but supported by an iron band.

In Ireland, a most remarkable grove of cherry trees exists at Clonmannon, Co. Wicklow, though only ten survive out of the fifty which originally grew here on about an acre of lawn. The largest measured, in 1907, 70 ft. high by 10 ft. 10 in. in girth. Another was 55 ft. high and 12 ft. in girth at three feet from the ground, above which it divides into five great stems. Hayes³ records at the same place in 1794, a cherry tree of the Upton-mazard kind, no less than 15 ft. in girth at five feet from the ground, being the largest cultivated cherry tree that I have ever heard of. At Mount Usher, a tree dividing into two stems near the ground, 5 ft. 10 in., and 7 ft. 2 in. in girth respectively, was 62 ft. high in 1903. The girth of the main stem at the base was 11 ft. 3 in. in 1908.

At Glenstal, Co. Limerick, a tree in a wood, clear of branches to thirty feet, was 69 ft. by 6 ft. 3 in. in 1903. At Bunratty, Co. Clare, Mr. R. A. Phillips measured a tree on 14th May 1905, when it was in full flower, 70 ft. in height and 11½ ft. in girth, with a spread of branches fifty-seven feet in diameter.

Though the cultivated varieties of cherry never, in England at least, seem to attain the size of the wild cherry, yet in some districts they become very large. In Nash's orchard at George's Green near Slough I saw, on 23rd July 1908, a tree (Plate 355) at least 60 ft. high by 9 ft. 4 in. in girth. The fruit was being gathered with the help of a ladder with 77 rungs, and the men informed me that in this orchard no less than 101 sieves (25 pounds to the sieve) had been gathered

¹ *Gard. Chron.* xx, 664 (1896).

² *Trans. Nat. Hist. Soc. Glasgow*, vii, 83 (1903).

³ *Treatise on Planting*, 127 (1794).

from one tree. This was a late black cherry of moderate size known in the district as "Black bud" or "Croon's" cherry. W. Dumbarton, a resident of the place, further told me that in an orchard belonging to Sir R. Harvey at Iver, he had gathered thirty-five years ago 165½ sieves of cherries from one tree of the Bigarreau variety, which is still alive. This seemed to me incredible, but I was assured by Mr. Ford, steward to Sir R. Harvey, that he had heard this as a fact from natives of the place.

I saw at Golden Grove in Wales a cultivated cherry no less than 50 ft. by 9 ft. with a bole more than 20 feet high. But as a rule the trees in orchards are cut down or decay before they arrive at anything like the size mentioned above.

I have found no account of cherry trees of great size in Europe, except one by the Rev. R. Walsh,¹ who wrote as follows:—"The second variety is an amber-coloured transparent cherry, of a delicious flavour. It grows in the woods in the interior of Asia Minor, particularly on the banks of the Sakari, the ancient Sangarius. The trees attain a gigantic size, they are ascended by perpendicular ladders, suspended from the lowest branches. I measured the trunk of that from which the seeds I send were taken; the circumference was 5 ft., and the height where the first branches issued 40 ft.; from the summit of the highest branches was from 90 to 100 ft., and this immense tree was loaded with fruit."

TIMBER

The wood of this tree, though now little valued in the trade, is one of the best native woods for inside work, being easier to season and less liable to warp than most timbers. It has a fine even grain which takes a good surface and polishes well. Its colour is pale pinkish when fresh, but when oiled or waxed it becomes with age a dark pinkish or brown, and is highly ornamental when cut so as to show the fine medullary rays.

I have used it with very good effect for panelling a small room at Rapsgate Park, near Colesborne. I am informed by Mr. A. C. Forbes that the pews in the church at Gibside, Northumberland, which were made in 1812 of cherry wood, have not warped or shrunk in the least, the joints being as good as when made. Though the sapwood in some places is worm-eaten, the heartwood is almost free from this defect.

As far as my experience goes the wood is best when the trees are felled at about 4 to 5 feet in girth, older trees being often more or less decayed at the heart. It is sold standing at 6d. a foot or less, and may be bought in the form of board at a very reasonable price, and used for furniture and chair-making, as well as for all work where toughness and strength are not specially required. It may be made richer in colour by soaking it in lime water, and when treated in this way is very similar to pale-coloured mahogany. (H. J. E.)

¹ *Trans. Hort. Soc.* vi. 44 (1826).

PRUNUS CERASUS, DWARF CHERRY

Prunus Cerasus, Linnæus, *Sp. Pl.* 474 (1753); Willkomm, *Forstliche Flora*, 897 (1887); Schneider, *Laubholzkunde*, i. 614 (1906); Ascherson and Graebner, *Syn. Mitteleurop. Flora*, vi. pt. ii. 147 (1906).

Prunus acida,¹ Koch, *Dendrologie*, i. 112 (1869).

Cerasus vulgaris, Miller, *Gard. Dict.* ed. 8, No. 1 (1768); Loudon, *Arb. et Frut. Brit.* ii. 693 (1838).

Cerasus acida, Gaertner, *Fl. Wettar.* ii. 185 (1800); Mathieu, *Flore Forestière*, 139 (1897).

A shrub or rarely a small tree, sending up numerous suckers from the root, and distinguishable from *P. Avium* as follows:—Leaves smaller, almost but not quite glabrous on the shining under surface; glands often absent on the petiole. Flowers, two to five in a cluster, generally on the long shoots, and not on short spurs, as in *P. Avium*; arising out of a bud, the inner scales of which are accrescent and leafy; calyx-tube glabrous, scarcely constricted at the apex, with obtuse deflexed crenate lobes. Fruit globose, shining red, smooth; stone smooth, brown.

A considerable number of the orchard cherries have been derived from this species. These constitute two well-marked groups; those with colourless juice, like the Kentish cherry, and those with coloured juice, like the Morellos. Var. *acida* (*Prunus acida*, Koch) is a shrubby form, with small leaves, and dark red sour fruit, with an ovoid stone.

The following varieties² are cultivated for ornament, being peculiar in leaves, flowers, or habit.

1. Var. *semperflorens*, Loudon, *Arb. et Frut. Brit.* ii. 701 (1838).

Prunus semperflorens, Ehrhart, *Beit.* vii. 132 (1792).

Cerasus semperflorens, De Candolle, *Fl. Franc.* iv. 481 (1805).

Flowering and fruiting throughout the whole summer. This, which is usually grafted high, is known as "All Saints' Cherry." Its origin is uncertain. Koch states³ that it comes true from seed. There is a good specimen at Kew; and it is cultivated by Messrs. Veitch.

2. Var. *persiciflora*, Koch, *Dendrologie*, i. 111 (1869). Flowers double, rose-coloured.

3. Var. *Rhexii*, Kirchner, *Arb. Musc.* 252 (1864). Flowers double, white. This is figured as var. *ranunculiflora*, in *Flore des Serres*, xvii. t. 1805 (1867-1868).

4. Var. *cucullata*, Kirchner, *loc. cit.* Leaves puckered with swellings.

5. Var. *aucubæfolia*, Dippel, *Laubholzkunde*, iii. 613 (1893). Leaves spotted with yellow.

6. Var. *globosa*, Späth, *Cat.* 1887-1888, p. 101. A low globose shrub, with small leaves.

P. Cerasus is usually considered to be a true native of south-eastern Europe, Asia Minor, and the Caucasus; but it has escaped from cultivation in many districts

¹ The name *P. acida* has been used by various authors for different forms of the cherry. *P. acida*, Ehrhart, *Beit.* vii. 130 (1792), was applied to the cultivated sour cherries with colourless sap.

² Carrière, *Prod. et Fix. Vars.* 37 (1865), mentions several curious varieties which I have not seen.

³ *Dendrologie*, i. 113 (1869).

of central Europe, and is now found apparently wild in various localities in England, Scotland, and Ireland. There are many records¹ of *P. Cerasus* in the county floras; but in most cases its occurrence is so rare and local, as to suggest that it is possibly only a recent escape² from some neighbouring orchard, from which the fruit has been carried by birds. It is said, however, to be well established in some woods on the Pennine range in Cumberland, and in others in Surrey and Kent. Mr. R. A. Phillips tells me that it is plentiful in old hedgerows in many parts of Ireland; and he has seen it in a wild glen near Lehinch in County Clare. (A. H.)

PRUNUS MAHALEB, ST. LUCIE CHERRY

Prunus Mahaleb, Linnæus, *Sp. Pl.* 472 (1753); Ascherson and Graebner, *Syn. Mitteleurop. Flora*, vi., pt. ii. 156 (1906).

Prunus odorata, Lamarck, *Fl. Franc.* iii. 108 (1778).

Cerasus Mahaleb, Miller, *Gard. Dict.* ed. 8, No. 4 (1768); Loudon, *Arb. et Frut. Brit.* ii. 707 (1838); Mathieu, *Flore Forestière*, 140 (1897).

Padus Mahaleb, Borkhausen, *Handb. Forstbot.* ii. 1434 (1803).

A deciduous shrub or small tree, occasionally attaining 40 ft. in height. Young branchlets pubescent with dense erect short hairs. Leaves broadly ovate, 1½ to 2 in. long, 1 to 1½ in. broad; shortly acuminate at the apex, rounded at the base; dark shining green and glabrous above; lighter green beneath, with dense long pubescence on each side of the midrib; crenately serrate, each serration with a minute sharp gland; petiole slender, glabrous, with one or two large glands.

Flowers, appearing with the leaves, in short simple corymbs, each with two small leaves at the base, and four to eight flowers above; axis, slender pedicels, and wide-mouthed calyx glabrous; sepals ovate, obtuse, entire. Fruit ovoid, ⅓ in. long, blackish when ripe.

I. The following varieties are known in the wild state:—

1. Var. *transilvanica*, Schur, *Enum. Pl. Trans.* 180 (1866). Flowers small, numerous in the corymb; sepals reflexed. This occurs in Transylvania.

2. Var. *Cupaniana*, Fiori and Paoletti, *Fl. Anal. Ital.* i. 561 (1896) (*Prunus Cupaniana*, Gussone, *Flor. Sic. Syn.* i. 553 (1842)). A low shrub, with small coriaceous leaves; flowers few in the corymb. This occurs in mountain woods in Sicily; and a similar, if not identical form, has been found in Dalmatia.

II. Several varieties have arisen in cultivation:—

3. Var. *chrysoarpa*, Nicholson, in *Kew Hand-List Trees*, i. 143 (1894). Fruit yellow.

4. Var. *globosa*, Dieck, ex Dippel, *Laubholzkunde*, iii. 621 (1893). A globose compact bush.

¹ Mr. W. B. Crump has sent me specimens from Elland Park Wood, near Halifax, taken from small trees and bushes which resemble *P. Cerasus* in habit and are apparently wild. The flowers, however, have a calyx with the constricted tube and entire lobes of *P. Avium*; and in all probability these trees are hybrids between the two species.

² Mr. M. R. Pryor sent me a specimen from a shrub about 14 ft. high, growing in a wood at Weston Park, Stevcnage. This shrub, the only one we know of apparently wild in Herts, has not increased appreciably in size during the last twenty years.

5. Var. *monstrosa*, Kirchner, *Arb. Musc.* 258 (1864). Branches and branchlets very short and thick.

6. Var. *variegata*, Nicholson, *loc. cit.* Leaves variegated with white.

7. Var. *albomarginata*, Dippel, *loc. cit.* Leaves with a white edge.

P. Mahaleb is widely distributed in central and southern Europe, the Crimea, Asia Minor, the Caucasus, Armenia, and Turkestan. In France it grows mainly on rocky ground on the limestone formation, and occurs as far north as the departments of Seine Inférieure, where it is rare, and Pas-de-Calais; but in the west is not known wild north of La Rochelle. In Germany, it occurs in Alsace, Baden, and Bavaria; and, further east, is met with in lower Austria, Hungary, and Transylvania; but is more common southwards in the Tyrol, Carniola, Dalmatia, the Balkan States, and Greece. It also occurs in northern Spain, and in a few localities in Switzerland.

The scented kernels are sold in the bazaars of North-western India, and the tree is cultivated in Baluchistan.¹ The young branches are utilised for pipe-stems; and the tree is cultivated in Austria for this purpose.² (A. H.)

This can hardly be considered as a timber tree, as it rarely, if ever, exceeds 40 ft. high, but it produces, under favourable conditions, a trunk of considerable thickness, which produces a wood known in France under the name of *Bois de St. Lucie*,³ formerly much sought after by turners and cabinetmakers. It was introduced into England in 1764. Its principal use in England is as a stock on which to graft cultivated cherries, but it is also sometimes planted as underwood for game covert; and Loudon says, that when grafted on the wild cherry stock it makes a much larger tree than on its own roots. Whether this had been the cause of the large size attained by a tree at Devonhurst, Chiswick,⁴ or not, I cannot say, but I measured this shortly before it was cut down to clear the site, and found it 30 ft. high by 8 ft. 5 in. in girth, the spread of the foliage being 55 ft. in diameter. In the public gardens at Bury St. Edmunds there is a large old tree about 40 ft. by 5 ft. 9 in.

A tree in the Botanic Garden of Trinity College, Dublin, measured 40 ft. by 6 ft. in 1908. (H. J. E.)

PRUNUS PADUS, BIRD CHERRY

Prunus Padus, Linnæus, *Sp. Pl.* 473 (1753); Willkomm, *Forstl. Flora*, 901 (1887); Ascherson and Graebner, *Syn. Mitteleurop. Flora*, vi. pt. ii. 159 (1906).

Prunus racemosa, Lamarck, *Fl. Franc.* iii. 107 (1778).

Cerasus Padus, De Candolle, *Fl. Franc.* iv. 480 (1805); Loudon, *Arb. et Frut. Brit.* ii. 709 (1838); Mathieu, *Flore Forestière*, 141 (1897).

Padus vulgaris, Borkhausen, *Handb. Forstbot.* ii. 1426 (1803).

Padus racemosa, Schneider, *Laubholzkunde*, i. 639 (1906).

A deciduous shrub or small tree, attaining about 30 ft. in height. Young branchlets glabrous. Leaves, disagreeable in odour, averaging 4 in. long and 2 in.

¹ Hooker, *Fl. Brit. India*, ii. 312 (1878).

² Mathieu, *Flore Forestière*, 141 (1897).

³ Named after the monastery of Sainte-Lucie in the Vosges.

⁴ Devonhurst was a house, with pleasure grounds, built on the site of part of the Horticultural Society's Garden at Chiswick, where a considerable number of interesting trees remained till 1904. Cf. *Gard. Chron.* iv. 726 (1888).

broad, obovate-oblong or elliptic, acuminate at the apex, slightly cordate at the base; glabrous above, paler beneath with brown axil-tufts of pubescence; lateral nerves, 10 to 14 pairs, dividing and looping before reaching the margin, which is finely serrate, with close serrations, each ending in a sharp cartilaginous point; petiole glabrous, slender, with 1 to 4 glands near the insertion of the blade.

Flowers, appearing after the leaves, in racemes about 5 in. long, which have usually one or two small leaves near the base; axis, slender pedicels, and calyx glabrous; sepals glandular-fimbriate; petals white. Fruit globose, about $\frac{1}{3}$ in. in diameter, without a persistent calyx, shining, blackish; stone irregularly pitted.

VARIETIES

I. Besides the typical form described above, which has finely serrate leaves and pendulous racemes, and is prevalent in the plains of central Europe, the following geographical varieties are known:—

1. Var. *borealis*, Schneider, *Laubholzkunde*, i. 640 (1906).

Var. *petraea*, Fiek, *Fl. Schles.* 119 (1881).

Prunus borealis, Salisbury, *Prod.* 356 (1796); Schübeler, *Pflanzen-Welt Norw.* 369 (1873).

Prunus petraea, Tausch, in *Flora*, xxi. 719 (1831).

Leaves with coarser serrations. Racemes erect. This is prevalent in the mountains of Silesia, Bohemia, and Transylvania, and in the Alps; and is also the wild form, which occurs in Scandinavia and the British Isles.

2. Var. *pubescens*, Regel, *Fl. Ussur*, No. 149, ex Maximowicz, in *Mel. Biol.* xi. 706 (1883). Young branchlets, under surface of the leaves, and racemes, more or less covered with reddish brown pubescence. This occurs, but mixed with the typical form, in Manchuria, Saghalien, and north China.

3. Var. *cornuta*, Henry.

Prunus cornuta, Steudel, *Nomencl.* ii. 403 (1841).

Padus cornuta, Carrière, in *Rev. Hort.* 1869, p. 275, fig. 64.

Cerasus cornuta, Royle, *Illust. Bot. Himal.* 207 (1839).

Branchlets glabrous. Leaves rounded at the base, bluish green beneath with reddish brown axil-tufts. Racemes long and, like the pedicels, pubescent. Fruit large, $\frac{1}{3}$ to $\frac{1}{2}$ inch in diameter, with a smooth stone. This occurs in the Himalayas, at 6000 to 12,000 feet, and is considered by Hooker¹ to be a form of *P. Padus*; but by Koehne and Schneider to be a distinct species. It is represented at Kew by a tree 15 feet high.

II. The following have appeared in cultivation²:—

4. Var. *leucocarpa*, Koch, *Dendrologie*, i. 120 (1869). Fruit white to yellowish.

5. Var. *commutata*, Dippel, *Laubholzkunde*, iii. 647 (1893). Flowers and leaves appearing very early in the season. Said by Schneider to be from eastern Asia, and to be commonly cultivated under the name of *P. Grayana*.³

¹ *Fl. Brit. India*, ii. 315 (1878).

² *P. Laucheana*, Bolle, in Lauche, *Deut. Dend.* 652 (1882) is said to be a hybrid between *P. Padus* and *P. Virginiana*; and, according to Schneider, is sometimes known in cultivation as *P. Patus*, var. *rotundifolia*.

³ Cf. *Garden and Forest*, i. 295 (1888). *P. Grayana*, Maximowicz, in *Bull. Acad. St. Petersb.* xxix. 107 (1883), is a distinct Japanese species.

6. Var. *bracteosa*, Seringe, in De Candolle, *Prod.* ii. 539 (1825). Leaves at the base of the raceme very large.

7. Var. *aucubæfolia*, Kirchner, *Arb. Musc.* 259 (1864). Leaves spotted with yellow.

8. Var. *aurea*, Nicholson, *Kew Hand-List Trees*, i. 229 (1902). Leaves yellow.

9. Forms, pyramidal and pendulous in habit, are also in cultivation; and a variety with double flowers is mentioned by Schneider, and is in cultivation at Kew.

DISTRIBUTION

P. Padus is the most widely distributed of all the species of *Prunus*, occurring throughout nearly all Europe, in Siberia, Manchuria, Japan, north China, the Caucasus, Persia, and the Himalayas.

In Europe, it is more common in the north, as in Scandinavia, Denmark, and northern Russia; but is also widely spread in central Europe, and extends in the south to the mountains of northern Portugal, the Sierra Nevada in Spain, Pyrenees, Apennines, and the mountainous regions of the northern Balkan States. In Russia, it extends as far north as the Kola peninsula; but is rare in the southern provinces, and does not occur on the mountains of the Crimea. Bode¹ saw a tree in Courland, 40 feet in height and 4 feet in girth.

In the British Isles, it is most common in the Highlands; but occurs in many woods in northern England, ascending to 1500 feet in Yorkshire. In Radnorshire and other parts of Wales it is in waste places more often a shrub than a tree. It has been found² in the fossil state in neolithic beds at Northampton, Hornsea and Sand le Meer in Yorkshire, and at Hailes near Edinburgh, and in interglacial deposits at Selsey, Sussex, and at Airdrie, Lanarkshire. In Ireland, it is widely distributed,³ occurring in old woods and in river glens; but is absent from the southern uplands and rare on the central plain. (A. H.)

Dr. Walker⁴ states that at Drumlanrig there were in 1773 two trees about 40 feet high, one being no less than 8 feet in girth. In 1834, however, they had quite disappeared. We have seen none approaching these in size.

Schübeler says that in Norway where the tree is called "Hegg," from which the Scotch name hagberry is no doubt derived, he saw a tree at Mollenhof near Drammen, which was 58 ft. high, by 5 ft. 5 in. in girth; and in Sweden he mentions one which at 1 foot from the ground was 9 ft. in girth.

Though now seldom planted in England, the bird cherry is very ornamental when in flower, easily raised from seed, and flourishes on poor dry soil. Loudon strongly recommends the variety *bracteosa*, on account of its large pendulous racemes of flowers and fruit.

I have not heard of any use being made of its hard yellowish wood in England, but in France it was formerly used by country cabinetmakers. (H. J. E.)

¹ Köppen, *Holzgewächse Europ. Russlands*, i. 300 (1888).

² Cf. C. Reid, *Origin British Flora*, 114 (1899).

³ Praeger, in *Proc. Roy. Irish Acad.* vii. 95 (1901).

⁴ *Essays on Nat. Hist.* 74 (1812).

PRUNUS SEROTINA, AMERICAN BLACK CHERRY

Prunus serotina, Ehrhart, *Beit.* iii. 20 (1788); Bentley and Trimen, *Medicinal Plants*, ii. t. 97 (1880); Sargent, *Silva N. Amer.* iv. 45, t. 159 (1902), and *Trees N. Amer.* 524 (1905); Von Schwerin, in *Mitt. Deut. Dend. Ges.* 1906, p. 1.

Prunus virginiana, Miller, *Gard. Dict.* ed. 8, No. 3 (1768) (not Linnæus).

Cerasus serotina, Loiseleur, *Nouv. Duham.* v. 3 (1812); Loudon,¹ *Arb. et Frut. Brit.* ii. 712 (1838).

Cerasus virginiana, Michaux, *Fl. Bor. Amer.* i. 285 (1803) (not Loiseleur); Loudon,¹ *Arb. et Frut. Brit.* ii. 710 (1838).

Padus serotina, Agardh, *Theor. Syst.* t. 14, f. 8 (1858); Schneider, *Laubholzkunde*, i. 643 (1906).

A deciduous tree, attaining in America 100 ft. in height and 15 ft. in girth. Bark, $\frac{1}{2}$ to $\frac{3}{4}$ in. thick, broken on the surface into small irregular scaly plates. Young branchlets glabrous. Leaves slightly coriaceous, about 3 to 4 in. long, and $1\frac{1}{4}$ to 2 in. broad, obovate-oblong or elliptic, acuminate at the apex, tapering at the base; shining and glabrous above; lower surface light green, with a dense band of rusty pubescence on each side of the midrib, elsewhere glabrous; regularly and sharply glandular-serrate; with one or two glands at the base of the leaf, or on the summit of the glabrous petiole.

Flowers in racemes, terminating short leafy branchlets; axis and slender pedicels glabrous; calyx cup-shaped, with short ovate sepals, which persist on the ripe fruit; petals obovate, white. Fruit globose, slightly lobed, $\frac{1}{3}$ to $\frac{1}{2}$ in. in diameter, red before ripening, almost black when ripe; flesh dark purple, juicy; stone obovate, compressed, smooth, broadly ridged on the ventral suture.

This species is often confused with *P. virginiana*, Linnæus, a North American shrub. The leaves of the latter are oval, cuspidate-acuminate, usually glabrous beneath, with long pointed serrations; and the inner bark of the branchlets has a strong disagreeable odour, that of *P. serotina* being aromatic and agreeable. In the former species the calyx is deciduous; in the latter it is persistent on the fruit.

VARIETIES

I. This species is very variable in the wild state: and several geographical forms have been distinguished, and ranked by American botanists as either varieties or distinct species:²—

1. Var. *neomontana*, Small, *Fl. S.E. United States*, 574 (1903). Leaves coriaceous, very large, coarsely toothed, whitish beneath; sepals pubescent. Occurs on the higher summits of the Alleghany Mountains.

2. *Prunus Cuthbertii*, Small, in *Bull. Torrey Bot. Club*, xxviii. 290 (1901). Branchlets, axis of the inflorescence, and pedicels pubescent. Leaves coriaceous. A shrubby form, growing in rich sandy soil in Georgia.

¹ Loudon describes *P. serotina* under both *C. virginiana* and *C. serotina*; and seems to have been unacquainted with the true *P. virginiana*, Linnæus.

² *Padus eximia*, Small, *Fl. S.E. United States*, 573 (1903), a glabrous form with leaves delicately reticulate-veined beneath, occurring in river valleys in southern Texas, can scarcely be distinguished from the type.

3. *Prunus australis*, Beadle, in *Biltm. Bot. Studies*, i. 162 (1902). Branchlets, axis of the inflorescence, and pedicels pubescent. Leaves covered beneath with reddish brown pubescence. Fruit dark purple. Occurs only in one locality, on clay soil at Evergreen in Alabama, where it is a tree about 60 ft. high.

4. *Prunus alabamensis*, Mohr, in *Bull. Torrey Bot. Club*, 1899, p. 118. Branchlets, axis of the inflorescence, and pedicels pubescent. Leaves slightly pubescent beneath. Fruit purple. A tree about 30 ft. high, occurring in the mountains of Alabama and Georgia.

5. *Prunus Capuli*, Cavanilles, ex Sprengel, *Syst.* ii. 477 (1825); Hemsley, in *Biol. Cent. Amer. Bot.* i. 367 (1879); Bolle, in *Mitt. Deut. Dend. Ges.* 1898, p. 56.

Cerasus Capollin, De Candolle, *Prod.* ii. 539 (1825); Loudon, *Arb. et Frut. Brit.* ii. 713 (1838).

Cerasus Capuli, Lavallée, *Arb. Segrez.* 115, t. 34 (1885).

Leaves lanceolate, long acuminate at the apex; underneath without bands of pubescence along the midrib. Inflorescence long and slender, fruit larger than in *P. serotina*. This occurs in the mountains of New Mexico, Arizona, Mexico, and Guatemala. It is said by Loudon to have been introduced in 1820; and in 1838 a vigorous tree, trained against a wall in the Horticultural Society's Garden, retained its leaves nearly all the winter. It is cultivated in France,¹ where, according to Lavallée, it was introduced in 1867, and endured the severe winter of 1879-1880; and in Algeria attains about 30 ft. in height.

6. *Prunus salicifolia*, Humboldt, Bonpland, and Kunth, *Nov. Gen. et Spec.* vi. 190, t. 563 (1825). An evergreen tree, occurring in Colombia, Ecuador, Peru, and Bolivia. It differs little in botanical characters from *P. Capuli*. Not introduced.

II. A number of varieties have appeared in cultivation in Europe:—

7. Var. *variegata*, Zabel, *Laubholz-Benennung*, 244 (1903). Leaves variegated with white.

8. Var. *pendula*, Dippel, *Laubholzkunde*, iii. 645 (1893). Branches pendulous.

9. Var. *salicifolia*,² Nicholson, *Kew Hand-List Trees*, i. 144 (1894).

Var. *phelloides*, Schwerin, in *Mitt. Deut. Dend. Ges.* 1906, p. 3.

Leaves lanceolate, long acuminate at the apex.

This variety, which has been confused with *P. Capuli*, is represented at Kew by a tree, about 30 ft. high, which flowers and fruits at the same season as the type, and is equally hardy. It may possibly have come from the United States, where narrow-leaved forms are said to occur.

10. Var. *aspleniifolia*, Kirchner, *Arb. Musc.* 260 (1864). Leaves irregularly dentate.

11. Var. *cartilaginea*, Kirchner, *Arb. Musc.* 260 (1864). Leaves very shining on both surfaces. (A. H.)

¹ Cf. Hamelin, in *Rev. Hort.* lvi. 111 (1884), and Carrière, in *Rev. Hort.* lxxiii. 62, 196, figs. 19, 20 (1891). Sargent states that plants of reputed *P. Capuli*, from France, proved hardy in the Arnold Arboretum; and he doubts their Mexican origin. I saw a tree about 40 ft. high under this name at Segrez in 1907, and raised seedlings from its fruit, which are alive at Colesborne, but do not grow as vigorously as the northern form.—H. J. E.

² This variety must not be confused with *Prunus salicifolia*, H.B.K., mentioned above.

DISTRIBUTION

The typical form of *P. serotina* is widely distributed in North America, occurring in Canada from Nova Scotia westwards to the northern shores of Lake Superior; and in the United States southwards to Florida, and westwards to Dakota, eastern Nebraska, Kansas, Indian Territory, and eastern Texas. Further west in southern Arizona and New Mexico, it is replaced by *P. Capuli*. Sargent states that it was once very abundant in the Alleghany Mountains, reaching its largest size from West Virginia to Georgia and Alabama. In the United States it usually grows in rich moist soil, but sometimes occurs on low sandy soil and on rocky cliffs by the sea-shore in New England. Pinchot¹ states that it grows fairly well in dry situations; but it is only in moist well-drained rich soils of mild climates that the maximum development is reached, as in the southern Alleghanies, where trees 90 ft. high and 4 ft. in diameter are not uncommon. In plantations in America it grows rapidly in youth; but is looked upon as a short-lived tree. Owing to the great value of its timber it has now become scarce in all accessible regions, and large trees are hardly to be found, the largest of which I have any record being a tree measured by Dr. Schneck in Wabash Co., Illinois, which was 135 ft. high by 10½ ft. in girth.²

I saw no such trees, however, in the Wabash valley; and in Canada in 1904, near Ottawa, where I found it scattered in the forest, it is a comparatively small tree. In southern Ontario, however, there are still, according to Macoun, many fine trees standing which are largely used for furniture making.

In Massachusetts, Emerson says³ that it rarely exceeds 40 to 50 ft. in height; but on the Ohio river, Michaux measured trees from 80 to 100 ft. high, with trunks 12 to 16 ft. in girth and clear of branches to 25 or 30 ft. He recommended its culture in the Rhine valley, which, he says, has most resemblance to its native regions.

CULTIVATION

It is difficult to say when this species was introduced, as it was formerly confused with *P. virginiana*, which Loudon says was introduced in 1724. It has never become a common tree, and was hardly known to nurserymen until recently, when it has been planted largely as a forest tree in some places in Europe.

The only place where I have seen this tree fairly at home in England is in Sherwood Forest, where several trees have been planted on Lord Manvers' property. The first of these I found quite unexpectedly myself, and recognised it by its shining foliage; the others were pointed out to me by Mr. Foljambe, who said he had known them as American cherries for many years, though I could obtain no information as to how or when they were introduced. One of these trees was about 50 ft. by 4½ ft., and bore a few ripe fruits in October 1905, from which I raised a plant the

¹ U.S. Forest Circular, No. 94 (1907).

² Ridgway, in *Proc. U.S. Nat. Mus.* xvii. 411 (1894).

³ *Trees and Shrubs of Massachusetts*, ii. 516 (1875).

following spring. Another not far from the Buck Gate was 46 ft. by 6½ ft., and had a large limb broken off, from which I got a small board which shows nice colour and well-marked medullary rays.

There was a large but decayed tree at Chiswick House near Kew, which in 1904 was about 50 ft. by 7 ft., probably the same as the tree mentioned by Loudon in 1838 as being 25 ft. high, eight years after planting.

At Arley Castle a tree, probably planted about 1820, was, in 1904, 53 ft. high and 7½ ft. in girth near the ground, below the point where it gives off a large limb.

Judging from these, and from what I know of its native habitat, this species might be tried with a fair chance of becoming a small timber tree, in rich sandy soil and sheltered woods in the warmest parts of England; but the tree has such a strong tendency to become bushy, that unless carefully pruned and closely crowded it will form a large shrub rather than a tree.

Seedlings raised at Colesborne from seed which I collected near Ottawa grow slowly and seem to want more heat than they get here, but my soil probably contains more lime than this tree likes.

It is rare in Scotland, but Renwick¹ measured in 1907 a tree at Auchendrane, Ayrshire, 42 ft. high with a short bole 5 ft. 8 in. in girth, and dividing into two stems at three feet from the ground. It was planted in 1818. Walker² mentions a tree at Hopetoun House, which was planted in 1747, and cut down in 1788, when it was 3 ft. 10 in. in girth. It yielded a plank, a foot broad, of red wood, which was finely veined and took a good polish, equalling mahogany in appearance.

In an article on this species by Graf von Schwerin³ a tree is mentioned as growing in the Palace garden at Rastede, Oldenburg, which at seventy-six years old is 15 metres high and 2.35 metres in girth at one metre from the ground. The photograph of this tree shows it to be a very well-shaped one with a fine head 12 metres in diameter; and a coloured plate of the leaves, flowers, and fruit is given. It is said to succeed best in dry sandy ground, and to be well worth cultivating as a forest tree on account of its beauty and the value of its wood.

This species has been tried as a forest tree in Germany. Schwappach lately reports⁴ that it thrives well on fresh loamy sand, attaining about 50 ft. in height and 10 in. in diameter at twenty years old. It grows remarkably fast in youth, and is very suitable for filling up gaps in broad-leaved woods or in pine plantations. It succeeds best when mixed singly with beech, as it then forms a clean stem. When planted in groups, it is apt to become very branching. It has been tried⁵ in Belgium for planting along roads, and has been successful between Curange and Zolder in Campine.

Mayr however considered that it will only be a success as a timber tree in those localities which have a warm summer, and rich light soil, for though it exists as far north as Canada, it only attains large size where the summers are longer and hotter than in any part of England, and where the soil is unusually fertile.

¹ *Trans. Nat. Hist. Soc. Glasgow*, viii. 234 (1907).

² *Essays on Nat. Hist.* 81 (1812).

³ *Mitt. Deut. Dend. Ges.* 1906, p. 1.

⁴ In *Zeitschrift Forst- und Jagdwesen*, xliii. 610 (1911).

⁵ *Bull. Soc. Cent. Forest. Belg.* xvii. 180 (1910).

TIMBER, BARK

Next to black walnut, this was considered in the United States as the finest native hardwood in general use, but has now become so scarce, that it is hardly procurable for export and has been generally superseded as a furniture wood by imported mahogany. It is pale red, and when figured is extremely handsome, but such specimens are rare. A large board of it, which was given me from the State Exhibit of St. Louis at the Exhibition in 1904, was cut from a tree which grew in Cape Girardeau, County Missouri, and produced 2000 ft. of good lumber, of which more than a quarter was 2 ft. wide and over. From this a handsome table top has been made, the legs of which were cut from a tree of the same species grown at Arley Castle, of which a plank was kindly given me by Mr. R. Woodward.

Defebaugh¹ quotes the reminiscences of E. N. Mead of Buffalo, an early lumberman in M'Kean County, Pennsylvania, as to the abundance and size of the cherry which existed there sixty years or more ago, very little of which is now left, as follows:—"The operation with which I was connected, was a small one, only about 300 acres, but it was considered the best cherry grove in the county. We turned out a little over 3 million ft., or an average of 10,000 ft. per acre. We cut nothing under 12 in. at top, and not so small as 12 in. unless very smooth and straight. It would, I suppose, be impossible to find any stock to-day which would approach this in quality. It was pronounced the finest ever sent to the Albany market. We cut it all with a circular saw. With a modern bandsaw we could have produced lots of stock 36 inches wide. I will relate one circumstance that occurred. Two of my log-cutters sawed down most of their trees. In this case they cut entirely through the tree, driving wedges behind the saw, and the tree stood on the stump 24 hours, until a breeze toppled it over. It was over 3 ft. in diameter at the butt, made four 16 ft. logs, and stood straight as a gun barrel."

The bark² of *P. serotina* has long been used medicinally, and is recognised both by the United States and British Pharmacopœias.

The fruit is small and black, like that of the Portugal laurel, and was used in America to flavour brandy, the flavour being superior to that of the common cherry. (H. J. E.)

¹ *Lumber Industry of America*, ii. 618 (Chicago, 1907).

² Cf. Power and Moore, in *Trans. Chem. Soc.* xcv. 243-261 (1909), who have analysed the bark, which yields prussic acid and many other constituents. The same authorities, in *Trans. Chem. Soc.* xcvi. 1009 (1910), give an account of the chemical properties of the leaves. The barks of other species of *Prunus* are frequently used as adulterants. Cf. F. M. Holmes, in *Pharm. Journ.* 1909, p. 192.

PRUNUS LAUROCERASUS, COMMON LAUREL

Prunus Laurocerasus, Linnæus, *Sp. Pl.* 474 (1753); Bentley and Trimen, *Medicinal Plants*, ii. t. 98 (1880).

Padus Laurocerasus, Miller, *Gard. Dict.* ed. 8, No. 4 (1768).

Cerasus Laurocerasus, Loiseleur, *Nouv. Duhamel*, v. 6 (1812); Loudon, *Arb. et Frut. Brit.* ii. 716 (1838); Boissier, *Fl. Orient.* ii. 650 (1872).

Laurocerasus officinalis, Roemer, *Fam. Nat. Syn.* iii. 91 (1847); Schneider, *Laubholzkunde*, i. 646 (1906).

An evergreen large shrub, occasionally arborescent. Young branchlets glabrous. Leaves coriaceous, persistent two years, 5 to 6 in. long, 2 to 3 in. broad, obovate-oblong or narrowly elliptic, acuminate at the apex, tapering at the base, with a few remote minute serrations; glabrous; shining above; duller and lighter green beneath, and marked on each side of the midrib near the base with one or two circular glands; lateral nerves pinnate, about 8 to 10 pairs, dividing and looping before reaching the margin; petiole short, stout, without glands.

Flowers, in erect leafless racemes, about 4 in. long, arising in an axil of a leaf on the preceding year's shoot; axis and pedicels glabrous; calyx-tube wide at the mouth; sepals minute, triangular, often with peculiar teeth; petals small, wrinkled; ovary superior, glabrous, green, with a short glabrous style, and a capitate stigma. Fruit ellipsoid, $\frac{1}{2}$ in. long, plum-coloured when ripe, depressed at the base; flesh scanty; stone ovoid, pointed at the apex, smooth, with a prominent ridge on one side.

VARIETIES

I. The common laurel varies in the wild state, the typical large-leaved form being common at low altitudes in the Caucasus; while at high elevations, between 6000 and 7000 feet on limestone formation, there occurs a form with shorter racemes and smaller leaves, var. *brachystachius*, Albow, *Fl. Colchica*, 68 (1895). Another form with longer narrower leaves, var. *laurifolius*, Albow, is met with in the valleys of Guria. The following appears to be the European variety of the species:

1. Var. *shipkaensis*, Späth, ex Dippel, *Laubholzkunde*, iii. 649 (1893). Leaves, lanceolate or narrowly elliptic, about 3 in. long, and 1 in. broad, entire in margin; glands on the back inconspicuous or absent. Racemes, $1\frac{1}{2}$ in. long; calyx green; sepals broad, triangular, each with two minute reddish glands on the margin; petals white, orbicular, not wrinkled.

This is a small shrub, about 3 ft. high, which has been found wild on the Balkan range, near the Shipka Pass, and in other localities. It was introduced into cultivation by Späth, and has proved much hardier¹ than the type in Switzerland and Germany, and thrives in the United States as far north as central New York.² It is in cultivation at Kew and Cambridge.

¹ *Mitt. Deut. Dend. Ges.* 1898, p. 96.

² Rehder, in Bailey, *Cyc. Amer. Hort.* 1455 (1901).

Var. *serbica*, Pančić, from Servia, is similar, but not exactly identical, having a more upright growth, with obovate wrinkled leaves. It is not in cultivation in England; but has proved very hardy¹ in Germany, where it bore -20° Cent. at Bergsdorf.

II. A large number of varieties² have appeared in cultivation, of which the more important are:—

2. Var. *angustifolia*, Nicholson, *Kew Hand-List Trees*, i. 145 (1894). Leaves long and narrow, scarcely an inch in breadth.

3. Var. *rotundifolia*, Nicholson, *loc. cit.* Leaves rounded at the apex. This is said³ to be more suitable for making hedges than the type, and succeeds better than it in towns.

4. Var. *parvifolia*, Nicholson, *loc. cit.* Leaves, $1\frac{1}{2}$ in. long, $\frac{1}{2}$ in. broad, with a few coarse serrations. A low shrub, in cultivation at Kew.

5. Var. *camelliæfolia*, Nicholson, *loc. cit.* Leaves bent back, and twisted on their base. A curious form, not common in cultivation. The best specimen that we have seen is at Poles Park, Herts.

6. Var. *variegata*, Nicholson, *loc. cit.* Leaves blotched with white.

DISTRIBUTION AND CULTIVATION

The common laurel is a native of the Balkan Peninsula, Asia Minor, the Caucasus, and North Persia. It is most common in the Caucasus, where, however, it is not known in Georgia or Talysch, being confined to the west, in Abchasia, Mingrelia, and Imeritia, where the typical broad-leaved form occurs at all elevations between sea-level and 4000 ft., being replaced higher up by peculiar shrubby forms.⁴ Boissier records it in Asia Minor from near Trebizond, and at the base of Mount Olympus in Bithynia. In Europe, it is recorded by Adamovic⁵ for south-eastern Servia, the Balkan range between Rumelia and Bulgaria, Thrace, and Laconia in Greece.⁶

(A. H.)

The laurel was introduced to Vienna in 1576 by Ugnad from Constantinople, at the same time as the horse chestnut; and soon spread over Europe. According to Evelyn, it was first brought into England, in 1614, by the Countess of Arundel, at Wardour Castle, where, Loudon says, there were in his time a great number of very old laurels. Parkinson in 1629 says that he had seen it in fruit at Highgate; and it became very common at an early period in English gardens, and in many parts of Ireland, where old houses are often surrounded by a dense thicket of laurels, which grow in that country, as in all the moister parts of England, with great luxuriance. It is now by no means so popular as formerly, but on account of the facility with which it can be reproduced from cuttings and layers, and its persistence in coming up from the stool when cut to the ground, it is likely to remain one of our commonest garden shrubs.

¹ *Mitt. Dent. Dend. Ges.* 1897, p. 68.

³ *Cf. Gard. Chron.* viii. 572 (1890).

⁶ *Veg.-verhalt. Balkanländer*, 132, 464, 489 (1909).

² *Cf. Gard. Chron.* v. 620, figs. 105, 106 (1889).

⁴ Radde, *Pflanzenverbr. Kaukasus*, 178, 347 (1899).

⁵ *Cf. Halacsy, Consp. Fl. Græcæ*, i. 498 (1901).

By far the largest on record in England, is mentioned by Mr. E. C. Batten,¹ who quotes Dr. Prior for the fact that a common laurel at Fyne Court, Somersetshire, grew to the height of 72 ft. before it was cut. At Powis Castle I have seen a bush over 40 ft. high with five stems over 4 ft. in girth. It was cultivated at Mill Hill by Collinson about 1750, and I have seen at that place what is supposed to be part of the original plant.

At Shelton Abbey, Wicklow, there was a magnificent specimen in Loudon's time, which was 45 ft. in height and 6 ft. in girth, at 90 years old.

The laurel is not hardy in most parts of Germany, and at Karlsruhe suffers much in severe winters; but at Baden-Baden and Mainau, where the humidity of the air is greater, it succeeds fairly well.² In the United States, it is hardy as far north as Washington, D.C.³

The leaves are used in medicine; and when distilled with water, yield bitter almond oil and prussic acid.⁴ The fresh leaves are sometimes used for flavouring sweetmeats, custards, creams, etc.; but should be used with caution, as, on account of their poisonous qualities, they may produce injurious or even fatal effects.

The wood is, so far as I know, of no value except for firewood.

(H. J. E.)

PRUNUS LUSITANICA, PORTUGAL LAUREL

Prunus lusitanica, Linnaeus, *Sp. Pl.* 473 (1753).

Padus lusitanica, Miller, *Gard. Dict.* ed. 8, No. 5 (1768).

Padus eglandulosa, Moench, *Meth.* 672 (1794).

Cerasus lusitanica, Loiseleur, *Novv. Duham.* v. 5 (1812); Loudon, *Arb. et Frut. Brit.* ii. 714 (1838).

Laurocerasus lusitanica, Roemer, *Fam. Nat. Syn.* iii. 92 (1847).

An evergreen tree, attaining occasionally 50 or 60 feet in height, and 6 feet in girth; often shrubby. Young branchlets glabrous. Leaves persistent two years, coriaceous, but thinner in texture than those of *P. Laurocerasus*, ovate-oblong, 3 to 4 in. long, $1\frac{1}{2}$ to 2 in. broad, acuminate at the apex, rounded at the base; glabrous; above shining, beneath lighter green and without glands; lateral nerves 8 to 10 pairs, dividing and looping before reaching the margin; regularly serrate, the serrations ending in glandular points; petiole about $\frac{3}{4}$ in. long, usually without glands.

Flowers in racemes, about 4 in. long, arising in the axils of the leaves on the preceding year's shoot; axis and pedicels glabrous; calyx wide at the mouth; sepals irregular, dentate; petals white. Fruit ovoid, with scanty flesh, about $\frac{3}{8}$ in. long.

¹ *Trans. Eng. Arb. Soc.* ii. 221 (1895).

² *Mitt. Dent. Dend. Ges.* 1908, p. 150.

³ Rehder, in Bailey, *Cycl. Amer. Hort.* 1455 (1901).

⁴ *Cf. Flückiger and Hanbury, Pharmacographia*, 255 (1879).

VARIETIES

I. In addition to the typical form, which occurs in Spain and Portugal, the following geographical varieties are known:—

1. Var. *Hixa*, De Candolle, *Prod.* ii. 540 (1825); Lowe, *Flora Madeira*, i. 236 (1836). Leaves narrower, more oblong, about 5 in. long and $1\frac{1}{2}$ in. broad. Racemes, 6 to 8 in. long, with flowers less crowded than in the type.

Indigenous in the Madeira and Canary Islands. Lowe states that in 1836, it was nearly extinct in Madeira; but a few trees remained, 40 to 60 ft. in height, and occasionally 6 ft. in girth. According to Webb and Berthelot,¹ it grows on the north-east of Teneriffe in woods, at about 2000 feet, attaining in the wood of Las Mercedes 30 ft. in height. Webb, however, informed Loudon that on Teneriffe, Grand Canary, and Palma, it occasionally reached a height of 60 or 70 ft.

2. Var. *azorica*, Nicholson, in *Kew Hand-List Trees*, i. 147 (1894). Leaves more coriaceous, and more coarsely serrate than in the type. Racemes short, densely flowered. Indigenous in St. Miguel in the Azores, where it was collected by Hunt in 1845, and later by Godman.² This variety, which is in cultivation at Kew, is shrubby.

II. Several varieties have arisen in cultivation as seedlings:—

3. Var. *myrtifolia*, Nicholson, *loc. cit.* A shrub of compact habit, with small leaves, $1\frac{1}{2}$ to 2 in. long.

4. Var. *variegata*, Nicholson, *loc. cit.* Leaves variegated with white. This is said by Koch, *Dendrologie*, i. 125 (1869), to be cultivated in France.

DISTRIBUTION AND CULTIVATION

P. lusitanica is a native of Spain and Portugal, and of the Azores, Canary, and Madeira Islands. In Portugal, where it is called *azareiro*,³ it is apparently not a common tree, as the only localities mentioned by Willkomm,⁴ where it is indigenous, are the Serras of Bussaco, Estrella, and Gerez.⁵ It is abundant in the woods of Bussaco, where Elwes⁶ saw it in 1909 attaining a height of 50 to 60 feet and 5 to 6 ft. in girth.⁷ On the Serra de Gerez, it grows up to 3000 ft. elevation as a scattered tree in woods composed mainly of *Quercus pedunculata*, *Arbutus*, holly, and sycamore. Webb informed Loudon that it formed here a small tree 20 ft. high; but growing with it was a taller tree, 60 to 70 ft. high, which he supposed to be var. *Hixa*, but which was undoubtedly the same.⁸ In Spain this species is rare and

¹ *Hist. Nat. Isles Canar.* iii., *Phyt.* ii. 19, t. 38 (1836). The leaves figured scarcely differ from those of the Portuguese tree; but the flowers are in longer racemes.

² Watson, in Godman, *Nat. Hist. Azores*, 158 (1870).

³ Broteiro, *Fl. Lusit.* ii. 252 (1804).

⁴ *Pflanzenverb. Iber. Halbinsel*, 112, 312, 318, 321 (1896).

⁵ It was collected also at Cintra by Welwitsch.

⁶ In the forest of Bussaco the Portugal laurel attained a height of 50 to 60 ft., with trunks 5 to 6 ft. in girth, but it did not form an important element in the forest, either here or in the Serra de Gerez, where it was smaller. I did not see in the Serra de Gerez any tree so large as the ones mentioned by Webb.—H. J. E.

⁷ Cf. J. de Vilmorin, in *Bull. Soc. Dend. France*, 1907, p. 49.

⁸ Webb, *Iter. Hisp.* 48 (1838), mentions only one form of *P. lusitanica*, as occurring in the Serra de Gerez.

local, occurring according to Willkomm on the north slope of Montseny, near Barcelona, and in a few woods in Navarre. (A. H.)

The Portugal laurel is stated by Aiton to have been introduced into the Oxford Botanic Garden in 1648; and Loudon says that this tree survived until 1828, when it was cut down, the trunk being nearly 2 ft. in diameter; but Collinson¹ states that it was first brought to England in 1719 by Fairchild, the famous nurseryman at Hoxton.

Though the Portugal laurel is hardy in the greater part of England, it is liable to be severely injured, and sometimes killed to the ground in very severe winters, and grows best in the south and west of England, especially near the sea. It ripens fruit in most seasons, and is easy to raise from seed; and though an ornamental tree of some merit, is not so popular now as it formerly was.

The oldest living tree that I know of is one at Mill Hill, where it was probably planted by Peter Collinson about 160 years ago, and is now decaying. It had five stems over 4 ft. in girth. At Fyne Court, Somersetshire, Mr. Batten,² quoting Dr. Prior, says that Portugal laurels of enormous size were formerly seen with their boughs bending to the ground and rooting, and an upright trunk grew from the arch thus formed. Henry saw at Belvoir Castle, in 1907, a well-shaped tree, 40 ft. in height, and 6 ft. in girth; and another at Leonardslee in 1910, 45 ft. by 4 ft. 3 in.

In Scotland it is hardy as far north as Banffshire, and grows to a very large size at Gordon Castle. At Moncrieffe, Hunter³ mentions a specimen which in 1883 covered an area 186 ft. round, though cut back on one side, but I did not see this when I visited the place in 1907. At Biel, the seat of Mrs. Hamilton Ogilvy in East Lothian, I saw a very fine tree in 1911, with a clean trunk, 4 ft. 8 in. in girth. Bean⁴ saw a specimen at Ochertyre in 1907, which was 30 ft. high, with a spread of foliage 50 ft. in diameter; and there are two trees at Raith, with short stems, nearly 2 ft. in diameter.

In Ireland we have not noted any remarkable for their size, but, as a rule, it grows luxuriantly.

The Portugal laurel, though rarely planted in Germany, where it is supposed not to be hardy, has borne at Karlsruhe — 16° C. of frost in winter; and produces flowers and fruit every year at Mainau.⁵

The wood, as shown by a fine specimen in the Earl of Yarborough's exhibit at Lincoln in 1907, resembles that of the cherry in colour, and shows well-marked medullary rays which make it very ornamental. It seems well fitted for small cabinet work. (H. J. E.)

¹ Dillwyn, *Hortus Collinson.* 11 (1843).

² *Trans. Eng. Arb. Soc.* ii. p. 221 (1895).

³ *Woods, Forests, and Estates of Perthshire*, 136 (1883).

⁴ *Gard. Chron.* xli. 168 (1907).

⁵ *Mill. Deut. Dend. Ges.* 1907, p. 258.

PYRUS (*continued*)

IN our Article in Vol. I. pp. 141-170, the genus *Pyrus* has been defined, and some of the sections have been fully described. In this concluding part, an account will be given of the apples, pears, and mountain ashes, which constitute three sections of the genus.

SECTION PYROPHORUM

This section of the genus *Pyrus* comprises the true pears, which are deciduous trees or shrubs, with branchlets of two kinds, long shoots and short shoots, the latter spur-like and often ending in thorny points. Leaves simple, stalked, scattered on the long shoots, clustered on the spurs; in the bud rolled inwards towards the midrib. Flowers perfect, in corymbs on the short shoots; sepals five, usually persistent on the apex of the fruit, occasionally deciduous; ovary usually five-celled, rarely two- or three-celled; styles five, rarely two or three; fruit turbinate or sub-globose, with granular flesh.

The true pears comprise about sixteen species, natives of Europe, northern Africa, and extra-tropical Asia. The following synopsis gives a brief account of the wild species which are in cultivation:—

I. *Leaves deeply cut into small segments.*

1. *Pyrus heterophylla*, Regel and Schmalhausen, in *Act. Hort. Petropol.* v. pt. ii. 581 (1878).

A small thorny tree, with glabrous branchlets. Leaves very remarkable, about 2 in. long, glabrous, deeply and pinnately cut to near the midrib into about five variously lobed and serrate narrow segments. Fruit depressed-globose, about 1 in. in diameter.

This occurs in mountain valleys at high elevations in Turkestan. It is represented at Kew by a straggling bush about 3 ft. high.

II. *Leaves sharply serrate, the serrations ending in long slender points.*

2. *Pyrus sinensis*, Lindley, in *Trans. Hort. Soc.* vi. 397 (1826), and *Bot. Reg. Bot.* 1248 (1829).

Pyrus ussuriensis,¹ Maximowicz, *Prim. Fl. Amur.* 102 (1859).

Pyrus Simonii,² Carrière, in *Rev. Hort.* 1872, p. 28.

¹ This is the Manchurian pear, which is said by Ascherson and Graebner, *op. cit.* 60, to be the earliest of all pears to flower in the Berlin Botanic Garden, where it was raised from seed sent by Maximowicz.

² Sent to the Jardin des Plantes at Paris by Simon in 1861. This is considered by Bretschneider, *Hist. Europ. Bot. Disc. China*, 830 (1898), to be a cultivated variety, the *Pai-li* of north China, which bears delicious apple-shaped fruit of a pale yellow colour.

A tree without thorns, attaining 60 ft. in height. Branchlets and buds glabrous. Leaves, 3 to 4 in. long, ovate, acuminate, glabrous, glandular on the midrib above, distinct from all the other species in the fine serrations with long slender points. Fruit globose, about 1 in. in diameter.

A native of China, Manchuria, Korea, and Japan. Introduced in 1820. It is the *Sha-li* or "sand pear" of the Chinese. Many cultivated varieties are known, some of which have proved useful in the United States, where this species is an excellent ornamental tree, very vigorous in growth.¹ Trees at Kew about 25 ft. high are very thriving.²

III. *Leaves sharply serrate, the serrations without long points.*

3. *Pyrus betulifolia*, Bunge, *Enum. Pl. Chin. Bor.* 27 (1834).

A small tree without thorns. Branchlets and buds grey tomentose. Leaves, 1½ to 2½ in. long, ovate to ovate-rhombic, acuminate; dark green and shining above with glands on the midrib, lighter green beneath, both surfaces retaining in summer traces of the tomentum with which they were covered in spring; petiole long, tomentose. Flowers with a two-celled ovary and two styles. Fruit depressed-globose, about ¾ in. in diameter.

A native of north China, where it is called *tu-li*. Introduced first in 1863 by Simon³ into the Jardin des Plantes at Paris; and subsequently by Bretschneider,⁴ who sent seeds to Kew and the Arnold Arboretum⁵ in 1882. A tree at Kew of this origin, about 30 ft. high with pendent branches, is very thriving.

4. *Pyrus syriaca*, Boissier, *Diag. Nov. Pl. Orient.* x. 1 (1849).

A shrub or small tree, usually thorny. Branchlets and buds glabrous. Leaves, 1½ to 2 in. long, lanceolate or obovate; acute, rounded, or mucronate at the apex; variable at the base, often very tapering, and decurrent on the petiole; glabrous; sharply and finely serrate. Fruit turbinate, 1½ in. in diameter, with a thickened stalk.

A native of Cyprus, Syria, Asia Minor, and Kurdistan. A small tree at Kew,⁶ about 15 ft. high, was obtained from Decaisne in 1874.

IV. *Leaves crenate in margin.*

* *Leaves coriaceous in texture.*

5. *Pyrus Korshinskyi*, Litwinow, in *Trav. Mus. Bot. Acad. Imp. Sc. St. Petersb.* i. 17 (1902).

A tree, height not stated. Branchlets and buds grey tomentose. Leaves coriaceous, about 3 in. long and ½ to 1½ in. broad, lanceolate or ovate-oblong, more or less grey tomentose on both surfaces; with coarse crenate or bi-crenate

¹ Cf. Bailey, *Cyc. Am. Hort.* 1470, 1471 (1901).

² A tree at Kew labelled *P. sinensis*, with coarse sharp-pointed serrations to the leaves, is perhaps *P. Balansa*, Decaisne, *op. cit.* t. 6 (1871), raised from seed brought from Laristan in Persia. It is intermediate in foliage between *P. sinensis* and *P. communis*.

³ Cf. Carrière, *Rev. Hort.* 1879, pp. 318, 319, where the plant is figured from specimens cultivated at Paris.

⁴ *Hist. Europ. Bot. Disc. China*, 1053 (1898).

⁵ Cf. *Garden and Forest*, vii. 224 (1894), where a figure is given.

⁶ This species has been confused with *P. glabra*, Boissier, *Diag. Nov. Pl. Orient.* vi. 53 (1845), which is not in cultivation. The latter, a native of Persia, differs from all the species, in having glabrous entire lanceolate leaves.

serrations, tipped with peculiar minute sharp incurved glands; petiole long, grey tomentose. Fruit sub-globose, $\frac{7}{8}$ in. in diameter, on stout peduncles, crowned by the persistent calyx.

This very distinct species¹ occurs in the mountains of Bokhara, Fergana, and Turkestan, at 4000 to 7000 ft. elevation. It is represented at Kew by a tree² about 20 ft. high, obtained from Dieck in 1891, and by a shrub obtained from Späth in 1900.

** *Leaves not coriaceous.*

(a) *Midrib glandular above (in some of the leaves at least).*

6. *Pyrus Pashia*, Buchanan-Hamilton, *ex Don, Prod. Fl. Nepal.* 236 (1825).

A variable species in the Himalayas, of which the following form is in cultivation:—

Var. *Kumaoni*, Stapf, in *Bot. Mag.* t. 8256 (1906).

A tree without thorns, attaining about 50 ft. in height. Branchlets and buds glabrous. Leaves narrowly ovate, 2 to $3\frac{1}{2}$ in. long, $1\frac{1}{4}$ to 2 in. broad, glabrous, subcordate at the broad rounded base, contracted into a long acuminate apex, frequently glandular on the midrib above; petiole long, glabrous. Fruit globose, 1 in. in diameter, from the apex of which the sepals fall off early.

This is represented at Kew by a grafted tree, about 25 ft. high, which has been growing in the collection of Rosaceæ for many years.³ The flowers are handsome, at first suffused with pink, ultimately becoming white.

(b) *Midrib without glands.*

7. *Pyrus communis*, Linnæus. See p. 1560.

V. *Leaves entire in margin, or partly indistinctly crenulate.*

* *Midrib glandular above.*

8. *Pyrus eleagrifolia*, Pallas, in *Nov. Act. Petrop.* vii. 355, t. 10 (1793).

A spiny tree or shrub. Branchlets and buds grey tomentose. Leaves about 2 in. long and $\frac{3}{4}$ in. broad, obovate or obovate-lanceolate, usually tapering in the basal half, acute or rounded and mucronate at the apex, entire in margin; upper surface with scattered tomentum throughout, and peculiar dark glands on the midrib; lower surface densely covered with grey tomentum, obscuring the venation; stalks short, tomentose. Fruit pyriform, 1 in. long, with the upper part of the peduncle much thickened.

A native of the Crimea, Caucasus, and Asia Minor. Introduced in 1800.

There is a good specimen at Arley Castle, which Elwes found to be 44 ft. by 4 ft. in 1911. It is forked at two feet from the ground, and bears fruit regularly in some quantity. There is a tree of this species at Glasnevin, which has long been labelled *P. sinaica*.⁴ Elwes measured it, in 1908, as 40 ft. by 5 ft. 7 in.,

¹ *P. bucharica*, Litwinow, *op. cit.* i. 18 (1902), described from a sterile branch and said occasionally to have lobed and pinnatifid leaves, appears to be the same species.

² Both the specimens at Kew were obtained under the name *P. heterophylla*, which is a totally distinct species. Cf. p. 1556.

³ The history of this tree is unknown. *P. Pashia* is said by Loudon, *Arb. et Frut. Brit.* ii. 891 (1838), to have been introduced in 1825; but we have seen no specimens except the tree at Kew.

⁴ Cf. p. 1559, note 1.

with a bole 10 ft. long; and it appears to be one of the earliest trees planted in this garden, which was founded in 1798. A tree at Beauport, Sussex, 32 ft. by 5 ft., was bearing fruit in November 1911.

** *Midrib without glands.*

(a) *Under surface of the leaves with only traces of tomentum in summer.*

9. *Pyrus amygdaliformis*, Villar, *Cat. Meth. Jardin Strasbourg*, 323 (1807).

A spiny shrub or small tree. Branchlets and buds slightly tomentose. Leaves, 1 to 2 in. long, coriaceous; variable in shape, lanceolate to narrowly elliptical, acuminate or rounded with a mucro at the apex; covered in spring on both surfaces with grey tomentum, which disappears in greater part during summer, usually entire in margin; petiole short, slightly tomentose. Fruit sub-globose, $\frac{3}{4}$ in. in diameter, with the stalk scarcely thickened.

A native¹ of southern Europe, occurring in France on dry arid soil in the region of the olive, and spread through Spain, Italy, Istria, Dalmatia, Balkan States, Greece, and Asia Minor. In March 1910 Elwes saw a fine tree in flower on the Plan d'Aups near St. Baume, in the department of Var, at about 3000 ft. altitude. It was about 25 ft. by 6 ft.

Introduced in 1810, and occasionally seen in botanic gardens; it attains at Cambridge 30 ft. in height.

(b) *Leaves densely tomentose beneath in summer.*

10. *Pyrus nivalis*, Jacquin, *Fl. Austr.* ii. 4, t. 107 (1774).

A tree without thorns. Young branchlets and buds more or less tomentose. Leaves $2\frac{1}{2}$ to 3 in. long, $1\frac{1}{4}$ to $1\frac{1}{2}$ in. broad, elliptic to obovate-oblong, usually cuneate at the base, abruptly contracted into an acuminate apex; covered at first with a grey tomentum, persisting in summer on the under surface, and to a less extent on the shining green upper surface; margin entire or irregularly and minutely crenulate towards the apex; petiole tomentose, about 1 in. long. Fruit pyriform, about $1\frac{1}{2}$ in. in diameter.

This tree, which is known in Austria as the *schnee birn* or "snow pear," is doubtfully wild in Croatia, Hungary, and Transylvania. Schneider regards it as a cultivated form of *P. eleagrifolia*; but Focke² with more probability considers it to be a cross between *P. amygdaliformis* and *P. communis* which has escaped from cultivation. It appears to be closely allied to, if not identical with *P. salvifolia*,³ De Candolle, *Prod.* ii. 634 (1825), which is naturalised in woods and hedges in central France, and often cultivated for making perry.

P. nivalis was introduced in 1826, and is represented at Kew by a tree about 25 ft. high.

¹ *P. persica*, Persoon, *Syn. Pl.* ii. 40 (1807) is probably a hybrid, arising from *P. amygdaliformis*, as there are no grounds for supposing it to be a native of Persia or Mount Sinai, as was formerly supposed. It has obovate-oblong or elliptic leaves, 2 to $2\frac{1}{2}$ in. long, 1 in. broad, entire in margin, mucronate at the rounded apex, dark shining green and slightly tomentose above, pale and with scattered tomentum beneath; buds glabrous. This is represented at Kew by a tree 20 ft. high obtained in 1875 from Decaisne, as *P. sinaica*, Thouin, in *Mém. Mus. Hist. Nat.* i. 170 (1815); and by an older tree, 30 ft. high, similarly labelled, at Cambridge. Decaisne, *Jardin Fruitier*, t. 15 (1871), however, gives a figure of *P. sinaica*, which does not agree in foliage with the tree which he sent to Kew.

² *Ex Ascherson and Graebner, op. cit.* 65 (1906).

³ Cf. Mathieu, *Fl. Forest.* 170 (1897).

11. *Pyrus salicifolia*, Pallas, *Itin.* iii. 734 (1736).

A tree, often spiny, about 30 ft. high. Branchlets grey tomentose. Buds with brown ciliate scales, usually glabrous on the surface. Leaves, 2 to 3 in. long, averaging $\frac{1}{2}$ in. broad, linear-lanceolate, very tapering at both ends, and often prolonged at the apex into a sharp point; entire in margin; covered slightly on the upper surface and densely on the lower surface with a white silky appressed tomentum; petioles short, tomentose. Fruit turbinate, about $\frac{3}{4}$ inch in diameter, with a persistent calyx.

A native of the Crimea, Caucasus, and Armenia. Introduced in 1780, and often planted as an ornamental tree, on account of its whitish foliage, which at a distance resembles that of *Salix alba*.

P. canescens,¹ Spach, *Hist. Veg.* ii. 129 (1834), judging from a tree at Kew, about 30 ft. high, obtained from Decaisne in 1875, is possibly a hybrid of *P. salicifolia*. It has lanceolate or narrowly elliptic leaves, about $2\frac{1}{2}$ in. long, acute or mucronate at the apex, minutely crenulate, often twisted, and resembling in tomentum those of *P. salicifolia*. The buds are also like those of the latter species. (A. H.)

PYRUS COMMUNIS, COMMON PEAR

Pyrus communis, Linnæus, *Sp. Pl.* 459 (1753); Loudon, *Arb. et Frut. Brit.* ii. 880 (1838); Willkomm, *Forstliche Flora*, 843 (1887); Mathieu, *Flore Forestière*, 167 (1897); Schneider, *Laubholzkunde*, i. 661 (1906); Ascherson and Graebner, *Syn. Mitteleurop. Flora*, vi. pt. 2, p. 60 (1906).

A tree or shrub, with numerous short shoots or spurs, which often end in thorny points. Bark smooth at first, ultimately broken on the surface into small scales. Young branchlets glabrous. Leaves, scattered on the long shoots, clustered on the short shoots, variable in size and shape, usually ovate or oval, rounded or subcordate at the base, acute or shortly acuminate at the apex; minutely crenate in margin except occasionally near the base; slightly tomentose when young, nearly quite glabrous in summer, dark green and shining above, paler beneath; petiole slender, nearly as long as or even exceeding the blade in length. In winter the buds are ovoid, pointed, shining brown, with a few glabrous ciliate scales; lateral buds, nearly as large as the terminal bud, either appressed or slightly diverging from the twig; leaf-scars crescentic, three-dotted.

Flowers, six to twelve in a leafy corymb, the axis of which, together with the pedicels, and external surface of the calyx-tube and sepals, is more or less covered with greyish tomentum; inner surface of the sepals with a dense rusty tomentum; petals white, with a short claw; styles five, free, almost as long as the fifteen to twenty stamens. Fruit turbinate, narrowing gradually towards the thickened stalk, crowned by the persistent calyx.

¹ *P. canescens*, Decaisne, *Jardin Fruitier*, t. 19 (1871) does not appear to agree with Spach's description.

VARIETIES AND HYBRID

1. Var. *Pyraster*, Linnæus, *Sp. Pl.* 479 (1753), is similar to the type in foliage and thorns; but has globose fruit. It is of uncertain origin, and is seldom found in woods, being probably in most cases an escape from an adjoining orchard.

2. Var. *sativa*, De Candolle, *Prod.* ii. 634 (1825). This name is applied to the cultivated varieties¹ of the pear, which are usually large trees without thorns. They also differ from the wild type, in having larger foliage, and larger and more edible fruit. Many forms of cultivated pears are probably, however, of hybrid origin; and can scarcely be assigned to var. *sativa*.

The following, which have been described as three distinct species, are probably geographical races of *P. communis*.

3. Var. *cordata*, J. D. Hooker, *Student's Flora*, 131 (1878).

Var. *azarolifera*, Durieu de Massoneuve, in *Bull. Soc. Bot. France*, v. 726 (1858).

Var. *Briggsii*, Boswell-Syme, in *Journ. Bot.* ix. 182 (1871).

Pyrus cordata, Desvieux, *Obs. Pl. Anjou*, 152 (1818); Decaisne, *Jardin Fruitier*, i. 330 (1871); Masters, in *Journ. Bot.* xiv. 225, t. 180 (1876); Hy, in *Bull. Herb. Boissier*, 1895, App. 1, p. 9.

Fliche, in *Bull. Soc. Bot. France*, xlvii. 108 (1900).

A spiny shrub, said by Fliche to propagate itself freely by root-suckers. Leaves smaller than in the type, sub-orbicular to ovate, about 1 in. in width, subcordate at the base. Flowers smaller than in the type. Fruit, globose on the French shrub, slightly turbinate on the English plant, very small, not exceeding $\frac{1}{2}$ in. in diameter; calyx persistent.

This remarkable pear is wild in the west of France, in Brittany, Anjou, and the Landes. The English form, which differs only in the shape of the fruit, was first found in a hedge between Thornbury and Wood Common in Devon, and later in two hedgerows in Cornwall²; but is now known to be undoubtedly wild³ in the valley of the Wye, at Symonds Yat, on Dorward, and in Dixton parish. There is a specimen at Kew about 12 ft. high, which was obtained from Veitch in 1898.

A similar plant, *P. Boissieriana*, Buhse, *Aufzähl. Pfl.* 87 (1860), found on Mt. Elburz, in Persia, was identified by Boissier⁴ with *P. cordata*; and, as no similar pear has been found in the vast region intervening between western France and northern Persia, this disjointed distribution has given rise to much speculation.⁵

4. Var. *longipes*, Henry (var. *nova*).

Pyrus longipes, Cosson and Durieu, in *Bull. Soc. Bot. France*, ii. 310 (1855).

A small tree, with a few spines. Leaves, about 2 in. long and 1 in. broad, ovate, acuminate, sub-cordate, glabrous, finely and crenately serrate, on long slender petioles. This, which differs little in foliage from *P. cordata*, has also

¹ These are described by Decaisne, *Jardin Fruitier du Muséum* (1871-1872).

² Davey, *Flora of Cornwall*, 183 (1909).

³ Riddelsdell, in *Journ. Bot.* xlix. 170 (1911). A small tree about 10 ft. high, which produces flowers very sparingly, on the cliff at Pen Moel, Chepstow, is probably wild.

⁴ *Fl. Orient.* ii. 653 (1872).

⁵ Dr. Phené associates *P. cordata* with the island of Avalon (which means "apples"), now Glastonbury, where King Arthur is said to have been buried. Cf. *Gard. Chron.* iv. 684 (1875).

small globose fruit, about $\frac{1}{2}$ in. in diameter, from the summit of which the calyx ultimately falls off completely. It is a native of the borders of mountain streams in Algeria. A tree at Kew, about 25 ft. high, was obtained from Decaisne in 1875.

5. Var. *Mariana*, Willkomm, in *Linnaea*, xxv. 25 (1852).

Pyrus Bourgeana, Decaisne, *Jardin Fruitier*, i. t. 2 (1871).

A small tree. Leaves ovate, about an inch in length, rounded at the base, on very long slender petioles. Fruit globose, about $\frac{1}{2}$ in. in diameter, with a persistent calyx. This is a little-known variety, which occurs in the Sierra Morena in Spain.

6. *Pyrus auricularis*, Knoop, *Pomol.* ii. 38 (1763).

Pyrus irregularis, Muenchhausen, *Hausvater*, v. 246 (1770).

Pyrus Polloeria, Linnæus, *Mant.* ii. 244 (1771).

Pyrus Bollwyleriana, De Candolle, *Fl. France, Suppl.* v. 530 (1815); Loudon, *Arb. et Frut. Brit.* ii. 890 (1838).

A tree, attaining about 50 ft. in height. Branchlets and buds tomentose. Leaves, 3 to 4 in. long, 1 to 2 in. broad, elliptic, rounded, and unequal at the base, shortly acuminate at the apex; margin irregularly, coarsely, and sharply serrate or biserrate; upper surface shining green, glabrescent, with glands on the midrib; lower surface more or less covered with greyish tomentum; petiole $\frac{3}{4}$ to $1\frac{1}{2}$ in. long, grey tomentose. Flowers five to twenty, in tomentose corymbs: sepals tomentose on both surfaces; styles two to five, united and tomentose at the base. Fruit pyriform, 1 in. in diameter, reddish yellow, sweet to the taste.

This tree, which is a hybrid between *P. communis* and *P. Aria*, was first noticed at Bollweiler in Alsace, about 1650, when it was described by Bauhin.¹ It apparently does not come true from seed; and one of the seedlings, which is nearer to *P. communis*, has been named var. *bulbiformis*, Tartar.² *P. auricularis* was introduced in 1786, and is occasionally seen in botanic gardens. A large tree of it was cut down in Kew Gardens some years ago, of which a board a foot wide is now in the Cambridge Forestry Museum. There is a fine specimen at Arley Castle, which measured 59 ft. by 4 ft. 5 in. in 1904. Elwes saw an old tree, 43 ft. high, with a short bole, near the house at Beauport, Sussex, in 1911. It bears fruit very sparingly, scarcely any being produced in some seasons.

DISTRIBUTION

There is no agreement amongst botanists as to the distribution of the common pear, which has long been in cultivation in Europe. In many places, where it is now apparently wild, it is probably only an escape from orchards. It occurs either wild or naturalised throughout the greater part of Europe, northern Africa, Asia Minor, the Caucasus, and north Persia. According to Willkomm, it is not met with in the greater part of Scandinavia, in Finland, northern Russia, Esthonia, Livland, and the provinces east of the Volga; but it is wild in the ash forests of the Ukraine, and in the mountains of the Crimea. In Germany, it is rare and only naturalised

¹ *Hist. Plant.* i. 59 (1650).

² *Wien. Obst. u. Gartens.*, 1878, p. 26, fig. 8.

in the north-western plain; and elsewhere is seen in hedges, copses, and the edges of the broad-leaved forests. In the Swiss Alps and the Jura,¹ it ascends to 2700 ft. and in the Tyrol to 4800 ft. In France, it is found as a scattered tree in most of the broad-leaved forests of the plains and low hills; but is absent in the region of the olive. In England, it occurs as a rare tree in woods, thickets, and hedgerows from Yorkshire southwards, but it is a doubtful native, except in the form var. *cordata*. *P. communis* has been found² in the fossil state in neolithic peat at Crossness, Essex, determined from wood examined by the late Professor Marshall Ward.

(A. H.)

REMARKABLE TREES

It is not our intention to deal here with the cultivated varieties of pear, which are very numerous; and with regard to those used for making perry, we refer our readers to the *Herefordshire Pomona* as the most comprehensive recent work on the subject.

The largest pear tree which I have ever seen or heard of stands alone on the north side of a hill on Church Farm in the parish of Lassington, about two miles from Gloucester, in a grass field of rather strong land on the Old Red Sandstone. Whether it is, as I believe a wild pear, or not, it is on its own roots, and bears small fruit which ripen earlier than any of the perry pears of the district. It is described in Witchell's *Fauna and Flora of Gloucestershire*, 264 (1892), as being 18 feet in girth, but I measured it, in January 1909, as $16\frac{1}{2}$ ft. in girth and about 50 ft. high. The trunk is about 15 ft. high, and, though hollow at the base, with a large limb broken off, seems healthy, and the branches are full of young wood. By a rough estimate it must contain at least 200 cubic feet in the trunk, and another 100 feet or more in the larger limbs, and is the oldest-looking pear tree that I ever saw (Plate 356).

Another very large pear tree grows at Hardwicke Court near Gloucester, and measures $13\frac{1}{2}$ ft. in girth at a foot from the ground, dividing above this point into three main trunks.

One of the most remarkable trees in Great Britain is the pear at Holme Lacy Rectory. This is described in Littlebury's *Herefordshire Gazetteer* as having been a very old tree in 1776, when it yielded 15 to 16 hogsheads of perry in one year. At that time it covered half an acre of ground. It was described by a correspondent of Loudon in 1836 as at this time much smaller, but still healthy and vigorous.³ Its peculiar feature is the way in which its branches after extending laterally to a considerable distance, fall to the ground and take root, giving rise to a new tree which again extends in the same way, so that it is a remarkable instance of layering. It is now impossible to say where the original trunk first stood, as it is divided into three parts, of which the principal trunk measures 59 ft. by 8 ft. 8 in., and spreads a long way into a shrubbery; another in the meadow outside the

¹ Lord Ducie has a thriving tree at Tortworth raised from seed sent from the Jura by Mr. G. H. Wollaston.

² Cf. C. Reid, *Origin British Flora*, 119 (1899).

³ Edwin Lees figures in *Gard. Chron.* ix. 268, fig. 45 (1878), a part of this tree, which he said measured 80 feet from the base of the principal fallen trunk to the end of the branches; but I cannot recognise the part of the tree which he sketched.

garden has several stems, which spread a long way; and the fallen stems seem sound. Perhaps the most striking part of this tree, which has probably been separately planted, is now in a meadow 200 yards off on the banks of the Wye. This has eight different stems whose various branches measured, in July 1908, 126 paces in circumference. The older trunks have very rugged bark, and twist from left to right. The late Rev. A. Ley informed me that the fruit was small; and the local blacksmith, who makes perry from it which I found to be very fair, said that it most resembled a variety locally called "Taunton Squash."

The cultivated pear seems to attain its greatest size on rather heavy Red Sandstone soils in the neighbourhood of Worcester. One of the largest I have seen is in an orchard at Eardiston, $15\frac{1}{2}$ miles from Worcester, on the road to Ludlow, and $3\frac{1}{2}$ miles from Newnham Bridge Station. This pear tree is mentioned by Rider Haggard in *Rural England*, i. 340 (1902), as being 17 ft. in girth, but when I visited it in March 1907, I made it 62 ft. by $13\frac{1}{2}$ ft. It grows on a steep bank sheltered from the north, on which side it is hollow at the butt. (Plate 357.)

There is an orchard of very fine old pears, many of which are now decaying and others gone, since they were described in *Herefordshire Pomona* (vol. i. p. 20) as "an orchard of Barland pears, perhaps unequalled in the world." They grow on Monkland farm between Worcester and Malvern, and, according to tradition, were planted by the Monks of Malvern, in which case they must be 300 years old. Mr. E. Lees, in *Botany of the Malvern Hills*, 62 (1843), writes of them:—"There are more than seventy lofty trees, and in a 'hit,' as it is called, the produce has amounted to 200 hogsheads. The orchard in question occupies five or six acres, and the price of perry varies from 6d. to 1s. 6d. per gallon. Supposing the average price to be £3 per hogshead, the perry produced would be worth £600, but a 'hit' must not be expected every year, and the trees are now becoming very old."

There is another orchard not far off on Lower Woodfield Farm which Mr. Slater, forester to Earl Beauchamp, showed me in 1908, and which are also called Barland pears.¹ The best of these are about 60 ft. high, and two which I measured were 11 ft. and $8\frac{1}{2}$ ft. in girth.

At Forthampton Vicarage near Tewkesbury there is another magnificent orchard of so-called "Hufcap" pears,² which strongly resemble the Barland in bark and habit, and like them are all grafted at about 6 ft. from the ground. These are said to have been planted in the reign of Charles II., and are growing on a strong red marl. They are in three lines, and though several of them are partially decayed,

¹ The Barland pear is figured by Hogg and Bull, *Herefordshire Pomona*, vol. i. plate xviii. (1876-1885), and is said to have originally grown in a field called Bare Lands, near Ledbury. Evelyn says of it in his *Pomona*:—"The horse pear and Barland pear are reputed of the best as bearing almost their weight of spritful and vinous liquor. They will grow in common fields of gravelly and stony ground to that largeness, as only one tree has been usually known to make three or four hogsheads." The fruit he describes as "of such insufferable taste that hungry swine will not smell to it, or if hunger tempt them to taste, at first crush they shake it out of their mouth." The authors of *Pomona*, however, say that Barland perry does not bottle well. It curdles in the bottles, and in Herefordshire is usually drunk as soon as made, when it is considered very wholesome, and singularly beneficial in nephritic complaints.

² The Black Hufcap pear is figured by Knight, *Pomona Herefordiensis*, plate xxiv. (1811), and is said to have been known from the seventeenth century and to be best of all the varieties. The fruit is very harsh and austere, but becomes very sweet during the process of grinding. Its perry possesses much strength and richness, and has the credit of intoxicating more rapidly than that made from any other pear. The Yellow Hufcap is a very favourite pear near Ledbury, earlier than the Black Hufcap, and bears freely, though usually in great abundance every second year. Its perry is excellent.

flower profusely, and in some years produce abundance of fruit. The largest sound tree that I measured here was over 50 ft. high and 10 ft. in girth.

In Scotland the pear rarely attains a great size; and I have seen none which were very noteworthy; but in the *Old and Remarkable Trees of Scotland* (p. 244), the Rev. R. Bremner describes a Chaumontel pear tree in the minister's garden at Banff, which was reported to be one hundred and fifty years old, and was 42 ft. by 9 ft. and 150 ft. round the branches.

Walker¹ measured in 1799 a tree at Restalrig, near Edinburgh, which was 12 ft. in girth at $2\frac{1}{2}$ ft. from the ground, above which point it began to branch. This was a sort of early pear, called the "Golden Knap," which he considered to be the largest and most durable of any of the kinds of pear; and recommended it to be raised from seeds and planted out without being grafted, as these wildings, as they are called, form the most vigorous and largest trees, and should be chosen as stocks for grafting. The fruit, though often scarcely edible, is useful in making perry.

Hunter² mentions an orchard pear tree at Gourdie Hill near Perth, which was no less than 65 ft. by 10 ft., but we do not know if either of these is still living.

TIMBER

It seems strange that a wood, having such valuable qualities as the pear, should be practically neglected in this country. It is so hard, fine-grained, and compact that it is one of the very best woods for cogs, wood-screws, and tool-handles. It takes dye so well that when stained black it is difficult to distinguish from ebony, and for carving it is one of the finest hardwoods known.³ At Windsor Castle there is a very beautiful panel carved in high relief from pear wood.

Like many hardwoods it is slow and difficult to season, and unless thoroughly dry is liable to warp and crack badly. When trees of sufficient size can be procured, it is better, in order to avoid warping, to cut the boards on the quarter; and as it takes a fine polish and has a rich pinkish brown colour, it might be used for chair and cabinet-making with good effect. But the greater part of the old pear trees which are grown in the Severn valley are only used for firewood, and are said to burn with a very hot and slow flame. (H. J. E.)

¹ *Essays on Nat. Hist.* 84 (1812).

² *Woods and Forests of Perthshire*, 503 (1883).

³ Drawing squares and curves are often made of pear wood.

SECTION MALUS

This section of the genus *Pyrus* comprises the apples, which are deciduous trees or shrubs, resembling the true pears in the occurrence of long and short shoots and in the arrangement of the leaves. Leaves simple, often lobed, stalked. Flowers in cymes, terminal on the short shoots; sepals 5, acuminate, either persistent and erect on the fruit or deciduous; ovary usually 5-celled, rarely 3-celled; styles united at the base. Fruit with homogenous flesh, hollowed out or rounded at the base; with papery carpels joined at the apex, free in the middle.

There are about ten species of apples, distributed in Europe, extra-tropical Asia, and North America. The following synopsis gives a brief account of the wild species, and of some of the more important hybrids, which are met with in cultivation.

I. EUMALUS, Zabel, *Laubholz-Benennung*, 185 (1903).

Leaves rolled inwards in the bud; on adult trees, serrate, without lobes or irregular teeth.

* *Calyx persistent on the fruit.*

† *Fruit depressed at both the base and apex.*

1. *Pyrus Malus*, Linnæus. See p. 1570.

†† *Fruit not depressed at the apex.*

2. *Pyrus Ringo*, Koch, *Dendrologie*, i. 213 (1869); Wenzig, in *Linnaea*, xxxviii. 37 (1874); Stapf, in *Bot. Mag.* t. 8265 (1909).

Branchlets more or less tomentose. Leaves elliptic-ovate, 2 to 3 in. long, shortly acuminate, more or less tomentose beneath, finely and sharply serrate. Fruit ovoid, about $1\frac{1}{4}$ in. long and 1 in. in diameter, yellow, hollowed at the base, crowned by the persistent sepals, which are united together at their base.

A small tree introduced by Siebold from Japan in 1856. It is supposed to be a hybrid between *P. Malus* and *P. spectabilis*. At Kew, it is very ornamental, when covered with its beautiful fruits; and is represented by two trees, one with densely tomentose leaves, the other with slightly tomentose leaves. A pyramidal variety, var. *fastigiata bifera*, Dieck, is also known, which is said to flower usually twice in the season.

3. *Pyrus spectabilis*, Aiton, *Hort. Kew.* ii. 175 (1780).

Branchlets slightly pubescent. Leaves oblong-elliptic, 2 to 3 in. long, 1 to $1\frac{1}{4}$ in. broad, acute at the apex, pubescent on the midrib beneath and on the petiole; margin with minute close serrations, which are callous and mostly incurved at their tips. Fruit globose, yellow, about 1 in. in diameter, not hollowed out at the base, crowned by the persistent sepals, which are united together at their base.

A native of north China and Japan. Introduced in 1780, and often cultivated

on account of its large pink flowers, about 2 in. across, which appear early in the season. Forms with double flowers occur, one of which with very large flowers is known as var. *Riversii*.

4. *Pyrus prunifolia*, Willdenow, *Phytog.* i. 8 (1794); J. D. Hooker, in *Bot. Mag.* t. 6158 (1875).

Young branchlets tomentose. Leaves usually elliptic, about 3 in. long and 2 in. broad (occasionally a few are sub-orbicular and smaller), contracted above into a cuspidate acuminate apex, tomentose on the midrib and nerves beneath and on the petiole, conspicuously glandular on the midrib above; margin with irregular serrations, which are crenate or bluntly triangular. Fruit globose or ovoid, about an inch in diameter, yellow on one side, bright red on the other, depressed at the base, crowned by the persistent sepals, which are united together at their base.

P. prunifolia has never been found in the wild state, and is of uncertain origin. It was reputed, when introduced in 1753, to have come from Siberia. It closely resembles *P. baccata*, differing mainly in the persistent calyx of the fruit; and is supposed by Bailey¹ to be a hybrid between that species and *P. Malus*. It is cultivated at Kew; and at Bayfordbury there is a fine specimen, 35 ft. by 5 ft. 7 in., with the stem forked a few feet from the ground.

5. *Pyrus Scheideckeri*, Späth, in *Gartenflora*, liii. 417, t. 1529 (1904).

Young branchlets slightly pubescent. Leaves ovate, acuminate, about 3 in. long, with scattered pubescence on the under surface and hairy petioles; margin coarsely and sharply serrate and biserrate. Fruit, $\frac{3}{4}$ in. in diameter, globose, usually crowned by the persistent calyx, occasionally some of the sepals being deciduous.

This originated in Scheidecker's nursery at Munich, as a seedling of *P. floribunda*, but is evidently a hybrid, the other parent being probably *P. prunifolia*. It is a small tree, producing large flowers, white tinged with pink, in great abundance; and is in cultivation at Kew.

** *Calyx not persistent on the fruit.*

6. *Pyrus baccata*, Linnæus, *Mant.* 75 (1767).

Branchlets glabrous. Leaves ovate-oblong, $2\frac{1}{2}$ to $3\frac{1}{2}$ in. long, $1\frac{1}{4}$ to 2 in. wide, contracted above into a cuspidate acuminate apex; glabrous beneath, except for slight pubescence on the midrib; glandular on the midrib above; margin with shallow usually crenate serrations. Fruit globose, $\frac{3}{4}$ in. in diameter, hollowed at the base and apex, the apex being marked with a circular brown scar, no trace of the calyx remaining.

This species,² which is usually known as the Siberian crab, is widely distributed in eastern Siberia, Manchuria, central and northern China, and throughout the Himalayas at 6000 to 10,000 ft. altitude. It was introduced in 1784.

¹ *Cycl. Amer. Hort.* 1472 (1901).

² Figured by Sir J. D. Hooker in *Bot. Mag.* t. 6112 (1874), who states that, in the western parts of the Himalayas, this species becomes more pubescent in all its parts.

It is one of the most beautiful and generally cultivated of its genus, both for its flowers, and its fruit,¹ which makes a delicious jelly. It grows on good soil to a considerable size. Elwes saw at Patshull, Staffordshire, the seat of the Earl of Dartmouth, a tree, measuring 40 ft. by 7 ft., with a burry trunk.

7. *Pyrus sikkimensis*, J. D. Hooker, *Flora Brit. India*, ii. 373 (1878), and in *Bot. Mag.* t. 7430 (1895).

Branchlets tomentose. Leaves ovate to ovate-oblong, 2 to 3 in. long, ending in a long caudate-acuminate apex; tomentose beneath; margin with fine close sharp-pointed serrations. Fruit, $\frac{2}{3}$ in. in diameter, turbinate, not depressed at the base, marked at the apex with a brown circular depressed scar, no trace of the calyx remaining.

A small tree, native of Sikkim and Bhutan between 7000 and 10,000 ft. altitude. It is in cultivation at Kew, where a tree about 25 ft. high has spiny branches on the trunk.

8. *Pyrus Halleana*, Sargent, in *Garden and Forest*, i. 152 (1888).

Branchlets slightly pubescent. Leaves coriaceous, lanceolate to ovate, 2 to 3 in. long, usually tapering gradually to an acuminate apex; quite glabrous on both surfaces and on the petiole, glandular on the midrib above; margin undulate, finely serrate. Fruit globose, $\frac{1}{4}$ in. in diameter, not hollowed at the base, marked at the apex by a depressed circular scar, no trace of the calyx remaining; and containing very large seeds.

This small tree was introduced in 1863 into the United States from Japan, where, however, it is not known in the wild state. It bears beautiful pink flowers, which are usually double. The original tree in Mr. Parkman's garden in Jamaica Plain, Massachusetts, was 18 ft. high in 1888. There is a small specimen at Kew.

- II. SORBOMALUS, Zabel, *Laubholz-Benennung*, 189 (1903). Leaves folded in the bud; on adult trees irregular in outline, some being lobed or dentate.

* *Calyx persistent on the fruit.*

† *Leaves covered beneath with dense grey tomentum.*

9. *Pyrus ioensis*, Bailey, in *Amer. Gard.* xii. 473 (1889).

Branchlets densely grey tomentose. Leaves ovate, acute, about 3 in. long, often with two or four lateral lobes, crenately serrate, covered beneath with a dense grey tomentum; petioles tomentose. Fruit sub-globose, $1\frac{1}{4}$ in. in diameter, depressed at the base, on a stout tomentose stalk.

This is the common crab-apple of the Mississippi basin in the United States. It was introduced at Kew in 1906. Bechtel's crab, a form with large pink double flowers, is often cultivated in the United States. *P. Soulardi*,² Bailey, which is wild here and there in the Mississippi valley, is supposed to be a natural hybrid between *P. Malus* and *P. ioensis*.

¹ The fruit which I bought at several railway stations in Siberia in May 1912 was juicy and well-flavoured.—H. J. E.

² Britton and Shafer, *N. Amer. Trees*, 434 (1908), say that this hybrid is cultivated in the north central States for its fruits, which are highly prized for cider and jellies, and used as a substitute for the quince where that fruit will not thrive.

†† *Leaves not covered beneath with dense grey tomentum.*

10. *Pyrus coronaria*, Linnæus, *Sp. Pl.* 480 (1753).

Young branchlets slightly tomentose. Leaves variable in shape, ovate or triangular, about 3 in. long, acute at the apex; margin irregular with large serrated teeth; lower surface green, pubescent on the nerves. Fruit 1 to $1\frac{1}{2}$ in. in diameter, globose, depressed at the base, fragrant, covered with a waxy exudation.

A native of the eastern parts of Canada and the United States. Introduced in 1824, and said by Loudon¹ to have become naturalised near White Knights and Godalming, where it attained 30 ft. in height.

11. *Pyrus angustifolia*, Solander, in Aiton, *Hort. Kew.* ii. 176 (1789).

Branchlets glabrous. Leaves oblong-lanceolate, $1\frac{1}{2}$ to 3 in. long, acute or rounded and apiculate at the apex, tapering at the base; margin with irregular teeth and crenate serrations; under surface glabrous except for slight pubescence on the midrib. Fruit sub-globose, 1 in. in diameter, very fragrant.

A native of the United States from Pennsylvania to Florida and Louisiana. Introduced in 1750.

** *Calyx not persistent on the fruit.*

12. *Pyrus rivularis*,² Douglas, *ex Hooker, Fl. Bor. Amer.* i. 203 (1833).

Branchlets slightly tomentose. Leaves ovate, about 3 in. long, acute or acuminate, slightly tomentose beneath; margin sharply serrate, with often two to four small lateral lobes or large teeth. Fruit ellipsoid, $\frac{1}{2}$ to $\frac{3}{4}$ in. long.

A tree, 40 ft. high, occurring in western North America from Alaska to California. Introduced in 1836.

13. *Pyrus Toringo*, Siebold, in *Ann. Mus. Lugd. Bot.* iii. 41 (1856).

Malus Toringo, Siebold, *Cat. Rais.* 4 (1856); Carrière, in *Rev. Hort.* 1870-1871, p. 451, coloured plate.

Branchlets tomentose. Leaves on the short shoots, ovate, $1\frac{1}{2}$ to 2 in. long, more or less tomentose beneath, sharply serrate; on the long shoots, 2 to $2\frac{1}{2}$ in. long, trilobed, with a large ovate acuminate irregularly serrated terminal lobe, and two smaller triangular lateral lobes. Fruit globose, about $\frac{1}{4}$ in. in diameter.

A native of Japan,³ introduced by Siebold in 1856.

14. *Pyrus floribunda*, Nicholson, in *Kew Hand-List Trees*, 181 (1894) (not Lindley).

Malus floribunda, Siebold, *Cat. Rais.* 5 (1859), *ex Van Houtte, Flore des Serres*, xv. t. 1585 (1865); Carrière, in *Rev. Hort.* 1870-1871, p. 591, coloured plate.

Branchlets slightly pubescent. Leaves ovate to elliptic, 2 to $2\frac{3}{4}$ in. long, 1 to $1\frac{1}{2}$ in. broad; petiole and under surface pubescent, the pubescence dense on

¹ *Arb. et Frut. Brit.* ii. 908 (1838).

² Britton and Shafer, *N. Amer. Trees*, 435 (1908), adopt for this species the name *Pyrus diversifolia*, Bongard, in *Mem. Acad. Petersb.* ii. 133 (1833), which is strictly applicable to a pubescent variety.

³ *Malus Sargentii*, Rehder, in Sargent, *Trees and Shrubs*, i. 71 (1903), is a very tomentose variety of *P. Toringo*, which was found by Sargent in a brackish marsh near Moronan in Japan.

the midrib and scattered elsewhere; margin sharply serrate, some of the leaves having one or two large teeth on each side. Fruit globose, $\frac{1}{4}$ to $\frac{1}{3}$ in. in diameter, with a depressed circular scar at the apex, no trace of the calyx remaining.

This was introduced in 1856 by Siebold from Japan, where it is not known in the wild state; and is supposed by Schneider to be a cross between *P. baccata* and *P. Toringo*. It is a shrub, producing an abundance of beautiful pink flowers, which appear with the leaves. (A. H.)

PYRUS MALUS, COMMON APPLE

Pyrus Malus, Linnæus, *Sp. Pl.* 479 (1753); Loudon, *Arb. et Frut. Brit.* ii. 891 (1838); Wilkomm, *Forstl. Flora*, 847 (1887); Ascherson and Graebner, *Syn. Mitteleurop. Flora*, vi. pt. 2, p. 74 (1906).

A tree or large shrub with scaly fissured bark. Leaves scattered on the long shoots, clustered on the short spurs, usually oval, rounded at the base, shortly acuminate at the apex, crenate in margin. Flowers, 5 or 6 in an umbellate cyme, at the apex of a short shoot; sepals 5, triangular, acuminate; petals 5, pink externally, white internally; stamens about 20, with white filaments and yellow anthers; styles 5, united at the base. Fruit sub-globose, about an inch in diameter, depressed both at the base and apex, crowned by the calyx-segments, which are not united at the base.

The wild apple, described above, is often considered to constitute two species, which, as intermediate forms are common, are best treated as two varieties:—

1. Var. *sylvestris*, Linnæus, *Sp. Pl.* 479 (1753).

Malus sylvestris, Miller, *Gard. Dict.*, ed. 8, No. 1 (1768).

Malus acerba, Méral, *Pl. Env. Paris*, 187 (1812); Mathieu, *Fl. Forest.*, 171 (1897).

Pyrus acerba, De Candolle, *Prod.* ii. 635 (1825).

Young branchlets slightly pubescent, soon becoming glabrous. Leaves glabrous above, shining and scattered pubescent beneath; petiole slightly pubescent. Axis of inflorescence and pedicels slightly pubescent; calyx-tube glabrous; sepals glabrous externally, pubescent internally. This is generally supposed to be the variety indigenous in western and central Europe.

2. Var. *pumila*, Henry.

Var. *mitis*, Wallroth, *Sched. Crit.* 215 (1822).

Pyrus pumila, Koch, *Dendrologie*, i. 203 (1869).

Malus pumila, Miller, *Gard. Dict.*, ed. 8, No. 3 (1768); Schneider, *Laubholzkunde*, i. 715 (1906).

Malus paradisiaca, Medicus, *Gesch. Bot.* 78 (1793).

Young branchlets tomentose. Leaves ovate or oval, often cuneate at the base, crenately or sharply serrate, dull and more or less tomentose beneath. Axis of the inflorescence, pedicels, calyx, and both surfaces of the sepals, tomentose.

This variety, though often found naturalised in western Europe, is considered by Ascherson and Graebner and by Schneider to be only truly wild in south-eastern Europe, southern Russia, Siberia, Turkestan, Caucasus, and Asia Minor. It is the

source of most of the cultivated apples, though some of these have arisen from var. *sylvestris*, and others from crosses of the two forms.

It is impossible here to enter into any account of the apples cultivated for their fruits; but the following peculiar varieties may be briefly noticed.

3. Var. *astracanica*, Loudon, *Arb. et Frut. Brit.* ii. 893 (1838).

Malus astracanica, Dumont de Courset, *Bot.* v. 426 (1811).

Pyrus astracanica, De Candolle, *Prod.* ii. 635 (1825).

Leaves large, coarsely serrate and in part bi-serrate, tomentose beneath. Flowers and fruits on long stalks. On account of the length of the peduncles, this is considered by Schneider and by Ascherson and Graebner, to be a hybrid between *P. Malus*, var. *pumila*, and *P. baccata*; but this is very doubtful. A tree cultivated at Kew under this name agrees with a herbarium specimen, which was collected by Schrenk in Songaria. Loudon states that this variety is "a native of about Astrachan, on the testimony of gardeners," and mentions two kinds, one with red fruit, the other with wax-coloured fruit.

4. Var. *Niedzwetzkyana*, Ascherson and Graebner, *op. cit.* 78 (1906).

Pyrus Niedzwetzkyana, Hemsley, in *Bot. Mag.* t. 7975 (1904).

Adult leaves tinged with red on the midrib and nerves. Flowers deep pink. Fruit with a crimson skin and pale purple flesh. Nearly all the other parts of the tree, as the wood and bark, are also coloured red.

This remarkable variety was obtained by Dieck,¹ who introduced it in 1891, from Kashgar and the plateau of Talgar, near Vernoie, in south-west Siberia. Goeze² states that a similar tree is cultivated in the Caucasus. This variety is hardy at Kew, where it flowers and produces fruit.

5. Var. *apetala*, Ascherson and Graebner, *op. cit.* 78 (1906).

Pyrus apetala, Muenchhausen, *Hausv.* v. 247 (1770).

Pyrus dioica, Moench, *Verz. Weissenst.* 87 (1785); Loudon, *Arb. et Frut. Brit.* ii. 892 (1838).

Flowers with two rows of sepals and 10 to 15 styles; without petals or stamens. Fruit seedless.

The origin of this is unknown. It was said by Loudon to have been in continental gardens in his time; but was not introduced in 1838. There is a specimen at Kew, but I have seen no flowers or fruit.³

6. Schneider mentions var. *pendula*, a tree with pendulous branches and branchlets; and var. *aucubæfolia*, in which the leaves are spotted with yellow.

DISTRIBUTION

The common apple is widely distributed throughout nearly all Europe, Asia Minor, the Caucasus, north Persia, south-western Siberia, Turkestan, and the

¹ *Neuh. Offer. Nat. Arb. Zöschchen*, 1891, p. 16, where the name is given as *Malus Medwitskyana*, which was afterwards changed by Dieck to the spelling given above.

² *Gard. Chron.* ix. 461 (1891). Cf. also Graebner, in *Mitt. Deut. Dend. Ges.* 1911, p. 254, who mentions a fine specimen at Karlsruhe. Young plants vary much in the colour of the leaves.

³ Bailey, *Cycl. Amer. Hort.* 1473 (1901), states that it is figured and described in *American Gardening*, x. 244, 279, and xi. 6 (figs.), 624.

north-western Himalayas. In many places it is undoubtedly an escape from cultivation; and its exact distribution as a wild tree cannot be defined with accuracy.

It is apparently indigenous in Europe as far north as lat. $63^{\circ} 49'$ in Norway, and lat. 61° in Sweden. In Russia its northern limit passes through Åbo in Finland, Lake Ladoga, Tver, Jaroslav, and Kazan; and it is said to be common in the forests of the plain in the southern provinces and in the mountains of the Crimea. It reaches in the Caucasus an elevation of 5000 ft., becoming a tree 30 to 40 ft. in height; and extends from there into the Persian province of Ghilan. It appears to be undoubtedly wild in the mountains of Turkestan, where it has been collected by various Russian travellers. Aitchison found the apple only as a cultivated tree in Afghanistan; but, according to Hooker, it is apparently wild in the north-western Himalayas, where it ascends to 9000 ft., and in western Tibet, where it reaches an altitude of 11,400 ft.

In central Europe, according to Ascherson and Graebner, the glabrous variety is scattered throughout the forests, being more common in those composed of conifers and broad-leaved species, and is usually seen in glades and on the margin of woods. In the north-western German plain, the apple is often met with remote from orchards, and is considered to be truly wild. It ascends in the Alps to about 5500 ft. elevation.

In France, Mathieu also is of opinion that the indigenous apple is the glabrous variety, occurring as a scattered tree in the forests of the plains and low hills, except in the Mediterranean region. It ascends in the Jura to about 3000 ft. altitude.

In Britain, the apple¹ is found apparently wild in copses and hedges from the Forth and Clyde southwards; and is undoubtedly wild in many parts of Ireland.

In the eastern United States, it has escaped from cultivation, and is common in woods, thickets, and road-sides, especially in southern New York, New Jersey, and Pennsylvania.²

(A. H.)

We must refer our readers to Loudon and to the *Herefordshire Pomona* for a full account of the cultivated apples, which we have no space to describe in this work. So far as I know, no variety of apple approaches the pear in size or age. Loudon stated that near Hereford some attained 40 ft. in height. The largest cultivated tree that I have seen is a tree in Lady Jenkins's garden at Botley Hill, Hants, adjoining the house where Cobbett once lived. This is of the variety called "Hambledon Deux ans," and in 1906 measured 47 ft. by 7 ft. and appeared sound. I was told that it had borne as much as forty bushels of fruit in one year, and often as much as twelve or fifteen bushels. Some of the last year's fruit was still edible on 21st June though shrivelled and partly rotten.

The wild crab tree seems to attain as great a size as the cultivated apples, though rarely seen under conditions where it has a chance to show its best growth. In an album of sketches by Jukes of trees at Studley Royal, which I have seen

¹ Leighton, *Flora of Shropshire*, 527 (1841), states that the glabrous and pubescent varieties are both equally wild and common. Bromfield, *Flora Vectensis*, 165 (1856), states that the pubescent form is extremely common and truly wild over most parts of the Isle of Wight, in woods, thickets, copses, hedgerows, and rough bushy places.

² Britton and Brown, *Illust. Flora N. United States*, ii. 236 (1897).

in the library there, is an excellent drawing of a crab which grew in the valley known as Mackershaw Trough, and in 1837 was 45 ft. high by 3 feet in girth at three feet from the ground. But this tree was no longer alive when I visited the place in 1905. In the hedgerows of the Cotswold hills it sometimes attains 30 ft. by 5 ft. Near the water tower at Barnsley Park, Cirencester, there is a tree, which in 1911 was about 45 ft. in height by 10 ft. in girth at 3 ft. from the ground, above which it divides into three stems.

Sir R. Christison¹ measured in 1876, at Kelloe, near Duns, Berwickshire, a perfectly healthy crab tree, 50 ft. high and 8 ft. in girth. It produced flowers abundantly and fruit in considerable quantity.

The crab tree comes up from seed pretty freely, but cannot be recommended for cultivation, as both its fruit and flowers are inferior to many of the exotic apples. It is not particular about soil, but seems to grow most freely on soils containing lime.

Though inferior to that of the pear tree, which it resembles in colour, hardness, and size, yet the wood of both wild and cultivated apples has some value for turnery, and was used for cog wheels and country furniture until driven out by wholesale manufacturers who use foreign wood only. I have used it for flooring blocks, for which its hardness and colour makes it very suitable, but the majority of the apple trees are usually decayed at heart before they cease to bear, and when worn out are used, like the pears, for firewood.

(H. J. E.)

¹ *Trans. Bot. Soc. Edinburgh*, xii. 186 (1876).

SECTION AUCUPARIA

Small trees or shrubs, defined in Vol. I. p. 142, as constituting one group of the section Sorbus¹ of the genus Pyrus. They are characterised as follows:—Leaves deciduous, alternate, unequally pinnate, with serrate leaflets and foliaceous stipules. Flowers perfect, in terminal compound corymbose cymes; calyx urn-shaped, with five persistent lobes; petals five, suborbicular, white; stamens about twenty; ovary usually three-celled, and surmounted by three styles, occasionally two- to four-celled, with two to four styles; ovules two in each cell. Fruit a small sub-globose pome, with acid flesh and papery carpels, which are free at the apex; seeds two, or one by abortion, in each cell.

About twenty species of the section Aucuparia are known, widely distributed over the extra-tropical regions of the northern hemisphere. Of these *P. Aucuparia*, which is a native tree, will be described in detail. About six exotic species have been introduced.

I. Buds very glutinous, showing no white tomentum at the tip.

* *Stipules early deciduous.*

1. *Pyrus americana*, De Candolle, *Prod.* ii. 637 (1825).

Leaflets, thirteen to seventeen, 2 to 2½ in. long, ¾ in. broad; under surface pale with scattered pubescence. Fruit, ¼ in. in diameter, said by Sargent² to be bright red, but purplish or bronze-coloured in England. A small tree, widely spread in North America. Introduced in 1782, and said by Loudon to be more tender than the native species; but it appears to thrive at Kew and at Tortworth.

Var. *decora*, Sargent, *Silva N. Amer.* xiv. 101 (1902).

This differs from the type in bearing large scarlet fruit, ½ in. in diameter. It is apparently the tree often known in cultivation as *P. sambucifolia*.³

2. *Pyrus commixta*,⁴ Ascherson and Graebner, *Syn. Mitteleurop. Flora*, vi. pt. 2, p. 90 (1906).

Leaflets, nine to thirteen, 2 in. long, ⅝ in. broad, tapering to a long caudate-acuminate apex, glabrous beneath. Fruit red, ¼ in. in diameter. A small tree, native of Japan.⁵ A specimen at Kew, obtained from Späth in 1900, is about 15 ft. high and very thriving.

¹ *Sorbus* is regarded by many botanists as a distinct genus; but there is no agreement amongst the various authorities as to its limits. Koehne, *Deutsche Dendrologie*, 246 (1893), includes in *Sorbus* only the mountain ashes. Schneider, *Laubholzkunde*, i. 667 (1906), gives it a much wider scope. Ascherson and Graebner, *Syn. Mitteleurop. Flora*, vi. pt. 2, p. 85 (1906), takes another view, which agrees practically with the arrangement given in our Vol. I. pp. 141-142.

² *Silva N. Amer.* iv. 79, tt. 171, 172 (1892). It is described by Sargent, *Trees N. Amer.* 356 (1905), as *Sorbus americana*, Marshall, *Arb. Amer.* 145 (1785).

³ The true *P. sambucifolia*, Chamisso and Schlechtendal, in *Linnaea*, ii. 36 (1827), is a native of eastern Siberia, Saghalien, and Yezo; and has not yet been introduced.

⁴ This was first described as *Sorbus Aucuparia*, var. *japonica*, Maximowicz, in *Mit. Biol.* ix. 160 (1873). It is *Sorbus japonica*, Koehne, in *Gartenflora*, l. 408 (1901) (not Siebold); and is also named *Sorbus commixta*, Hedlund, in *Kgl. Svensk. Vet. Akad. Handl.* xxxv. 38 (1901).

⁵ Var. *rufo-ferruginea*, Shirai, ex Schneider, *Laubholzkunde*, i. 678 (1906), has rusty red pubescence on the rachis and under surface of the leaflets. This was collected by Elwes at Chuzengi at 4000 ft. altitude, and is possibly a distinct species. It has not been introduced.

* *Stipules persistent till the time of fruiting.*

3. *Pyrus discolor*, Maximowicz, *Prim. Fl. Amur.* 103, note (1859).

Leaflets fifteen to seventeen, remotely placed on the rachis, 1½ to 2 in. long, ending in a long acuminate point, pale and glabrous beneath. Fruit pale pink. Readily distinguishable by its palmately cleft or lobed persistent stipules.

A small tree, wild in the neighbourhood of Peking. *Sorbus pekinensis*, Koehne,¹ in *Gartenflora*, L., 406 (1901), which was described from plants raised in Germany, is identified with this species by Schneider.² Small trees at Kew, obtained from Späth and Lemoine, agree with a native specimen in the British Museum, except that the buds are pubescent at the tip and not completely viscid.

II. Buds more or less covered with dense white tomentum.

* *Stipules early deciduous.*

4. *Pyrus tianshanica*, Franchet, in *Ann. Sc. Nat.* xvi. 267 (1883).

Branchlets glabrous. Leaflets eleven to thirteen, 1 to 1½ in. long, ⅔ in. broad, green and glabrous on both surfaces. Fruit ⅔ in. in diameter, bright red.

A shrub, about 10 ft. high, occurring in Turkestan, Afghanistan, and western Kashmir. Introduced³ into Kew in 1896, and described by Sir J. D. Hooker, in *Bot. Mag.* t. 7755 (1901). This does not seem to thrive in England, as the specimens which I have seen are stunted in growth and bear small leaflets.⁴

5. *Pyrus Aucuparia*, Gaertner. See p. 1576.

Branchlets pubescent. Leaflets eleven to fifteen, about 2 in. long, pale and pubescent beneath.

** *Stipules persistent till the time of fruiting.*

6. *Pyrus pohuashanensis*, Hance, in *Journ. Bot.* xiii. 132 (1875).

Leaflets thirteen to fifteen, 2½ to 3 in. long, ¾ in. broad, pale and pubescent beneath. Fruit ⅔ in. in diameter, orange-coloured. The persistent stipules are obovate and shortly toothed.

A small tree, discovered in 1874 on the Po-hua mountain, west of Peking, by Bretschneider, who sent seed to the Arnold Arboretum. The trees which were raised produced flowers and fruit⁵ for several years previous to 1893; and a seedling sent in that year to Kew is now about 20 ft. high and very thriving, producing abundance of handsome fruit.

III. Buds tipped at the apex with reddish hairs; scales glabrous, ciliate in margin.

7. *Pyrus Vilmorini*, Ascherson and Graebner, *Syn. Mitteleurop. Flora*, vi. pt. 2, p. 90 (1906).

¹ Cf. also Koehne, in *Mitt. D. Dend. Ges.* 1906, p. 56.

² *Laubholzkunde*, i. 669 (1906).

³ It appears to have been introduced into the St. Petersburg Botanic Garden in 1889. Cf. *Gard. Chron.* xxv. 389 (1899).

⁴ Schneider, *Laubholzkunde*, i. 668 (1906), describes this species under the name *Sorbus tianshanica*, Ruprecht, in *Mem. Acad. St. Petersburg*, xiv. 46 (1869), and states that the leaflets are 2 in. long and over ½ in. broad.

⁵ Cf. Bretschneider, *Hist. Europ. Bot. Disc.* 1054 (1898). The trees in the Arnold Arboretum were considered for many years to be *P. discolor*, Maximowicz; but Rehder, in *Mitt. Deut. Dend. Ges.* 1901, p. 117, showed that they were the same as Hance's species, and named them *Sorbus pohuashanensis*.

Leaflets, on a winged rachis, nineteen to twenty-nine, very small, scarcely exceeding $\frac{1}{2}$ in. in length, serrate only near the apex. Fruit $\frac{1}{3}$ in. in diameter bright red.

This pretty shrub,¹ which is a native of Yunnan in China, was introduced at Kew from Les Barres² in 1905. (A. H.)

PYRUS AUCUPARIA, MOUNTAIN ASH, ROWAN

Pyrus Aucuparia, Gaertner, *De Fruct.* ii. 45, t. 87 (1791); Loudon, *Arb. et Frut. Brit.* ii. 916 (1838); Ascherson and Graebner, *Syn. Mitteleurop. Flora*, vi. pt. 2, p. 86 (1906).
Sorbus Aucuparia, Linnæus, *Sp. Pl.* 477 (1753); Willkomm, *Förstliche Flora*, 862 (1887); Mathieu, *Flore Forestière*, 181 (1897); Schneider, *Laubholzkunde*, i. 672 (1906).
Aucuparia silvestris, Medicus, *Gesch. Bot.* 86 (1793).

A tree, occasionally attaining 50 ft. in height. Bark thin, smooth, greyish, becoming thicker, darker in colour, and fissured at the base of old trunks. Young branchlets more or less tomentose at first, ultimately glabrescent. Leaves, about 6 in. long, unequally pinnate, with a grooved rachis, tufted with long hairs and glandular at the insertion of the leaflets, elsewhere slightly pubescent; leaflets eleven to fifteen, opposite, subsessile, about 2 in. long, lanceolate-oblong, unequal at the base, acute at the apex, sharply serrate except near the base; upper surface dull green, glabrous; lower surface pale, more or less pubescent.

Flowers in large corymbose cymes, the axis and branches of which are more or less tomentose; calyx and pedicels pubescent; petals white, equal in length or shorter than the stamens; styles usually three, tomentose at the base. Fruit spherical or ellipsoid, $\frac{2}{3}$ in. in diameter, smooth, usually red.

The terminal buds³ are large, ovoid-conic, and covered in greater part with dense white tomentum; the lateral buds are smaller, slightly flattened, and appressed. The leaf-scars, visible in winter, are crescentic, five-dotted, and situated on prominent pulvini.

VARIETIES

I. This species varies in the wild state, as regards the amount of pubescence; and two distinct varieties are recognised:—

1. Var. *glabrata*, Wimmer and Grabowski, *Fl. Schles.* ii. 1, p. 21 (1821).

Buds, branchlets, and leaves glabrous; leaflets smaller than in the type. This is the common form at high elevations in the mountains of central and south-eastern Europe.

¹ Cf. Hutchinson, in *Bot. Mag.* t. 8241 (1909), where it is figured under the name *Sorbus Vilmorini*, Schneider, in *Bull. Herb. Boissier*, vi. 317 (1906).

² This was raised at Les Barres from seeds received from Père Delavay in 1889, and was described as *Cornus foliolosa*, Franchet, in *Vilmorin, Fruct. Vilmorinianum*, 103 (1904); but is not, as was supposed, identical with *Pyrus foliolosa*, Wallich. The latter does not appear to be in cultivation.

³ The stipules are described by Lubbock, in *Journ. Linn. Soc. (Bot.)* xxx. 492, 493 (1895).

2. Var. *lanuginosa*, Ascherson and Graebner, *op. cit.* 88 (1906).

Sorbus lanuginosa, Kitaibel, *Schult. Oest. Fl.* ii. 50 (1814).

Pyrus lanuginosa, De Candolle, *Prod.* ii. 637 (1827).

Buds, branchlets, and leaves very tomentose, the pubescence remaining on the leaflets till autumn, and on the branchlets till the second year. This is prevalent in the plains and on the low hills of south-eastern Europe.

II. Several varieties with peculiar fruit are known:—

3. Var. *dulcis*, Krätzl, in *Wiener Illust. Gartenzeit.* 1885, p. 65.

Var. *moravica*, Zengerling, *ex Dippel, Laubholzkunde*, iii. 367 (1893).

Fruit sweet, larger than in the type. The leaflets are remarkable, being long and narrow, with the serrations confined to near the apex.

This tree was found wild about the year 1800, in a mountain forest of the Spornhau parish in northern Moravia,¹ and was subsequently propagated by grafting. It was introduced² in 1885 in Sweden, where it has proved very hardy, ripening its fruit as far north as lat. 66°, where no other fruit tree can be cultivated. A tree at Kew, about 15 ft. high, was obtained from Späth in 1900.

4. Var. *rossica*, Späth, in *Mitt. Deut. Dend. Ges.*, 1896, p. 196; Koehne, in *Gartenflora*, L., 412 (1901).

Fruit sweet, leaflets as in the type. This is said to be planted in southern Russia, where at Kiev the berries, powdered with sugar and packed in little boxes, are sold and exported. This variety, which I have not seen, was introduced by Späth in 1896.

5. Var. *Fifeana*, Dippel, *Laubholzkunde*, iii. 367 (1893). Fruit yellow. The origin of this tree, which was called var. *fructu luteo* by Loudon, is unknown. There is a handsome specimen at Kew.

III. The following varieties are peculiar in habit or foliage:—

6. Var. *fastigiata*, Loudon, *loc. cit.* Branches upright. This originated in Hodgins's nursery at Dunganstown in Co. Wicklow.

7. Var. *pendula*, Kirchner, *Arb. Musc.* 293 (1864). Branches very pendulous. This when grafted six or eight feet high, makes a graceful tree. Beissner³ describes and figures a remarkable weeping tree in the churchyard of Wiesbaden; the branches are interlaced and twisted to an extraordinary degree.

8. Var. *integerrima*, Koehne, in *Gartenflora*, L., 411 (1901), and *Mitt. D. Dend. Ges.* 1906, p. 55. Leaflets entire in margin, the upper three occasionally united together. This was found⁴ in the Jena Botanic Garden, and is possibly a hybrid, though the flowers differ in no respect from those of *P. Aucuparia*.

9. Var. *asplenifolia*, Koch, *Dendrologie*, i. 189 (1869). Leaflets irregularly and deeply toothed. This is represented at Kew by a tree obtained from Dale in 1899; and appears to differ slightly from var. *laciniata*, Beissner, in *Gartenwelt*, iii.

¹ Cf. Willkomm, *Forstl. Flora*, 863 (1887).

² Cf. Hartman, in *Garden and Forest*, 1895, p. 162.

³ In *Mitt. Deut. Dend. Ges.* 1911, pp. 246 and 247.

⁴ Lange, *Danske Flora*, iii. 370 (1864), describes a similar plant, found wild in the island of Bornholm.

267 (1899). The latter is said to have been found wild in the Erz Mountains; and in a specimen at Kew, obtained from Späth in 1906, the irregular tothing is almost confined to the leaflets on the barren branches.

10. A variety with variegated leaves is mentioned by Loudon; and another with yellowish foliage is occasionally seen, which is named var. *Dirkenii* or var. *Dirkenii aurea*.

HYBRIDS

The following, which were formerly considered to be varieties of *P. Aucuparia*, are of undoubted hybrid origin.¹ They differ from this species, in having the uppermost three or five leaflets united together into one segment:—

1. *Pyrus satureiifolia*, Ascherson and Graebner, *op. cit.* 106 (1906).

Sorbus satureiifolia, Koehne, *Deut. Dendrologie*, 248 (1893).

A small tree. Leaflets nearly glabrous beneath, not decurrent on the rachis; the uppermost three united into one segment.

This appears to be identical with *Sorbus neuillyensis*, Dippel, *Laubholzkunde*, iii. 370 (1893), of which there is a tree at Kew, about 20 ft. high, obtained from Simon-Louis in 1900.

Sorbus saturejæfolia, Koch, *Dendrologie*, i. 189 (1869), is similar in the shape of the foliage, but the leaflets are described as being tomentose on both surfaces. This appears to be identical with *Sorbus subserrata*, Opiz, in *Flora*, vii. suppl. 13 (1824): and is said by Ascherson and Graebner to be inconstant as regards the union of the upper leaflets.

2. *Pyrus decurrens*, Ascherson and Graebner, *op. cit.* 106 (1906).

Pyrus lanuginosa, Hort. (not De Candolle²).

Sorbus decurrens, Hedlund, *op. cit.* 49 (1901).

A small tree. Leaflets tomentose beneath, more or less decurrent on the rachis; the upper three, five, or seven leaflets united into one segment.

This is represented at Kew by a tree about 25 ft. high, which is of considerable age, and apparently less vigorous in growth than *P. Aucuparia*.

DISTRIBUTION

P. Aucuparia is widely distributed throughout almost all Europe;³ but does not occur in Portugal, southern Spain, southern Italy,⁴ Dalmatia, and Greece. It is most common in northern regions, extending as far north as Iceland, the North Cape, and the Kola Peninsula; but is reduced to a low shrub beyond lat. 67° in

¹ *Pyrus pinnatifida*, Ehrhart, described in Vol. I. p. 163, is usually considered to be a hybrid between *P. Aucuparia* and *P. intermedia*; but Schneider, *Laubholzkunde*, i. 691 (1906), who describes it under the name *Sorbus hybrida*, Linnæus, believes it to be a true species, as it comes true from seed.

² Cf. var. *lanuginosa*, p. 1577.

³ The mountain ashes resembling *P. Aucuparia* in the Caucasus, Siberia, and western Himalayas, are considered to be three distinct species by Schneider and by Hedlund.

⁴ *P. pramorsa*, Gussone, *Fl. Sicul. Syn.* i. 561 (1842), is considered by Schneider to be a distinct species, inhabiting Sicily and the Madeira Islands.

Scandinavia and Russia. In Russia, it is widely spread in the forests of the plains, but does not occur south of a line passing through Orenburg, Tambof, Voronej, Kursk, and Podolia. In Germany, it grows on all soils, forming part of both the broad-leaved and coniferous forests, and often ascends to timber line, attaining an altitude of 4000 to 5000 feet. It reaches still higher elevations in the Carpathians and the mountainous districts of the Balkan states. In France it is more common in hilly and mountainous regions, often becoming a bush on elevated precipices; but occurs in a few forests in the plains of the north. In the British Isles it is probably indigenous only in mountainous and hilly districts, though it is seen as a rare tree in woods as far south as the Isle of Wight. It ascends in the Highlands to about 2600 feet. This species has been found in the fossil state,¹ in neolithic deposits at Caerwys, Flintshire. (A. H.)

CULTIVATION

Though the mountain ash in England is usually not over thirty or forty feet high, yet it has a tree-like rather than a bushy habit, and is so beautiful for its fruit and for the elegance and autumnal colours of its foliage, that it should be planted on the edges of all copses, and in hedges and pleasure grounds. No native tree surpasses it in the autumn when laden with its red berries, and though birds are so fond of these that they are mostly eaten before winter, yet where the tree is abundant, it is one of the most beautiful features of the scenery. To see its foliage at its best, one must however, go to more northern regions such as Norway, where I have seen the hillsides absolutely scarlet with it in the first week of October, mixed with the silver bark and golden leaves of the birch and aspen.

It is so easy to raise from seed, which should be sown when ripe, or treated like haws, and so indifferent as to soil and situation that it may be planted almost anywhere, but usually grows best in mountainous and northern regions.

The finest trees which I have seen are at Walcot, Shropshire, where in 1905 I measured a well-shaped specimen 56 ft. by 6½ ft. with a clean bole 20 ft. long, and at Stratton Strawless, Norfolk, where in 1907 I saw a tree 56 ft. by 5 ft., the trunk of which was covered by large burrs. Though Loudon says that the largest trees of this species are in the West Highlands, yet I have never seen or heard of any equal to those mentioned above.

In Norway where it is almost everywhere a common tree, and is called *Rogn*, the bark is the favourite winter food of the elk, and the fruits are very much liked by bears, so that in districts where these animals are found the tree becomes comparatively scarce. The largest that I have seen were rarely 30 to 40 ft., though Schübeler mentions one near Christiania 48 ft. high. He illustrates² a good wild tree at Akureyri, in Iceland, which shows that even in this inhospitable and treeless land the species thrives well.

No tree is more commonly seen as an epiphyte in this country than the mountain ash, whose berries are often dropped by birds on the decaying branches

¹ Cf. C. Reid, *Origin British Flora*, 119 (1899).

² *Vaestlivet i Norge*, 92, fig. 42 (1879).

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or crowns of other trees, where they grow and flourish; sometimes attaining a considerable size and age, and sending their roots down to the ground. The best example I have seen of this is in Glenaffric, Inverness-shire, where an immense old alder tree about 19½ ft. in girth had been split to the ground by a rowan (known in Gaelic as *cuern*), which had commenced life in its head and was 4½ ft. in girth in 1910. Mr. Stephenson Clarke, the lessee of Glenaffric forest, told me of this tree, which he has photographed.

A good many superstitious ideas as to the value of this tree as an antidote to witchcraft are said by Loudon and others to have been formerly prevalent; but these are now dying out except in remote districts.

The wood is hard, heavy, and close-grained, of a grey or whitish colour, and so tough and strong that it was formerly used for bows¹; but though well suited for tool-handles, hoops, and even for chair-making, it is rarely used in this country.

(H. J. E.)

¹ Evelyn, *Sylva*, 68 (1679), who calls it quickbeam or witchin.

MAGNOLIA

Magnolia, Linnæus, *Sp. Pl.* 535 (1735); Bentham et Hooker, *Gen. Pl.* i. 18 (1862); Nicholson, in *Gard. Chron.* xvii. 515 (1895); Rehder, in Bailey, *Cycl. Amer. Hort.* 964 (1900); Schneider, *Laubholzkunde*, i. 328 (1905).

DECIDUOUS or evergreen trees and shrubs, belonging to the order Magnoliaceæ. Leaves alternate, simple, stalked, entire, with pinnate lateral nerves, which unite and loop before reaching the margin; in most species punctate with translucent dots; petiole channelled at the base, marked with two linear scars, continuous with an annular scar around the branchlet, due to the early fall of the two connate stipules,¹ which, adnate to the petiole, formed a cylindrical sheath in the bud.

Flowers perfect, large, solitary, terminal; sepals and petals imbricate in the bud, inserted under the ovary; sepals three, often similar to the petals in size and colour, occasionally smaller and greenish; petals six, nine, or twelve, in two, three, or four rows; stamens and pistils numerous, imbricated, the stamens below the pistils on an elongated receptacle; ovary sessile, one-celled; style short, recurved, stigmatic on the inner surface; ovules, two. Fruit cone-like, composed of numerous coalesced two-seeded follicles, dehiscent on the back; seeds on long stalks, with a red or scarlet outer coat, and a minute embryo, situated at the base of the fleshy albumen.

About twenty-five species of *Magnolia* are known, natives of North America, China, Japan, Assam, and the Himalayas. The following key comprises the species, which are cultivated in the open air in this country:—

I. *Leaves evergreen, coriaceous.*

1. *Magnolia grandiflora*, Linnæus. United States. See p. 1583.

Branchlets rusty tomentose. Leaves obovate-oblong, acuminate at the apex, more or less covered beneath with brownish tomentum.

2. *Magnolia Delavayi*, Franchet. China. See p. 1592.

Branchlets glaucous, minutely pubescent. Leaves ovate-oblong or elliptic, mucronate at the apex, glaucous with scattered pubescence beneath.

II. *Leaves sub-evergreen, falling before the young leaves appear in the following spring, bluish white and pubescent beneath.*

3. *Magnolia glauca*, Linnæus. United States. See p. 1585.

Branchlets glabrous. Leaves elliptic or oblong-lanceolate, rounded or acute at the apex.

¹ Cf. Lubbock, in *Journ. Linn. Soc. (Bot.)* xxx. 466 (1895).

4. *Magnolia Thompsoniana*, Koch. A hybrid. See p. 1585.

Branchlets glaucous, with a few hairs at the insertion of the leaves. Leaves obovate-elliptic, acute at the apex.

III. *Leaves deciduous in autumn.*

* *Leaves cordate at the base.*

5. *Magnolia Fraseri*, Walter. United States. See p. 1590.

Branchlets glabrous. Leaves obovate, deeply cordate and auricled at the base, pale or light green beneath.

6. *Magnolia macrophylla*, Michaux. United States. See p. 1589.

Branchlets densely pubescent. Leaves obovate-oblong, cordate or subcordate at the broad truncate base, bluish white beneath.

** *Leaves not cordate at the base.*

(a) *Leaves large, with more than twenty pairs of lateral nerves.*

7. *Magnolia tripetala*, Linnæus. United States. See p. 1588.

Branchlets glabrous. Leaves membranous, obovate-oblong, tapering towards the base and apex, pale with a scattered minute pubescence beneath.

8. *Magnolia hypoleuca*, Siebold and Zuccarini. China and Japan. See p. 1592.

Branchlets glabrous. Leaves coriaceous, obovate, acute or cuspidate at the apex, bluish grey with scattered white hairs beneath.

- (b) *Leaves moderate or small in size, with less than twenty pairs of lateral nerves.*

† *Leaves pale beneath.*

9, 10. *Branchlets pubescent.*

9. *Magnolia acuminata*, Linnæus. Ontario, United States. See p. 1586.

Large tree. Leaves oval, acuminate at the apex, pubescent on both surfaces; lateral nerves, twelve to fifteen pairs.

10. *Magnolia parviflora*, Siebold and Zuccarini. Japan. See p. 1598.

Shrub. Leaves obovate, acuminate at the apex, glabrous above, minutely pubescent beneath; lateral nerves about nine pairs.

11-13. *Branchlets glabrous.*

11. *Magnolia Campbelli*, Hooker and Thomson. Eastern Himalayas. See p. 1590.

Branchlets glaucous. Leaves narrowly elliptic, acuminate, pale with a bluish tint and glabrous beneath.

12. *Magnolia Watsoni*, Hooker. Japan (?). See p. 1598.

Leaves obovate, acute at the apex, greyish beneath, with scattered appressed hairs.

13. *Magnolia salicifolia*, Maximowicz. Japan. See p. 1595.

Leaves lanceolate, tapering to an acuminate and often curved apex; pale with a bluish tint and minutely pubescent beneath.

†† *Leaves green beneath.*

14. *Branchlets glabrous.*

14. *Magnolia Kobus*, De Candolle. Japan. See p. 1594.

Leaves obovate, cuspidate at the apex, tapering at the base, with axil-tufts of pubescence beneath.

15-17. *Branchlets pubescent.*

15. *Magnolia denudata*, Thunberg. China. See p. 1597.

Branchlets with silvery appressed pubescence at the tip, elsewhere glabrous. Leaves obovate or oval, and broadest at the middle, acute or shortly acuminate at the apex, tapering at the base.

16. *Magnolia conspicua*, Salisbury. China. See p. 1596.

Branchlets more or less covered with appressed pubescence. Leaves obovate, cuspidate at the apex, usually rounded at the base.

17. *Magnolia stellata*, Maximowicz. Japan. See p. 1599.

Branchlets more or less covered with appressed pubescence. Leaves obovate-oblong or oblanceolate, gradually tapering to the base, variable at the apex.

(A. H.)

MAGNOLIA GRANDIFLORA

Magnolia grandiflora, Linnæus, *Syst.* ii. 1082 (1759); Loudon, *Arb. et Frut. Brit.* i. 261 (1838); Sargent, in *Bot. Gaz.* xlv. 226 (1907).

Magnolia foetida, Sargent, in *Garden and Forest*, ii. 615 (1889), *Silva N. Amer.* i. 3, tt. 1, 2 (1890), and *Trees N. Amer.* 316 (1905).

An evergreen tree, attaining in America 60 to 80 ft. high, with a straight trunk occasionally 12 ft. in girth. Bark with thin appressed scales. Young branchlets covered with rusty red tomentum. Leaves coriaceous, persistent two years, 6 to 8 in. long, 2 to 3 in. wide, obovate-oblong or narrowly elliptic, with a short acuminate apex; upper surface dark green, shining, glabrous; lower surface covered more or less with a rusty brown tomentum, or occasionally glabrescent.

Flowers, on stout tomentose stalks, fragrant, 7 to 8 in. across; the three petaloid sepals and six (rarely nine to twelve) petals creamy white, ovate or oval, narrowed at the base. Fruit rusty tomentose.

Several varieties¹ have originated in European nurseries:—

1. Var. *exoniensis*, Loudon. Rather fastigiate in habit, with broadly elliptical leaves, rusty tomentose beneath. It begins to flower when only a few feet high. This variety appears to differ scarcely from var. *lanceolata*, Aiton,² *ex* Sims, *Bot. Mag.* t. 1952 (1818), though Loudon kept it distinct.

2. Var. *angustifolia*, Loudon. Leaves lanceolate, undulate in margin. Introduced from Paris in 1825.

3. Var. *Gallissoniensis*, Simon-Louis, *Cat.* 59 (1869). According to Rehder,³ this variety has proved the hardiest in Europe; and Mouillefert⁴ says that it makes the finest standard tree.

4. A variety with double flowers is known; and this peculiarity has been observed as a sport on a tree of the ordinary kind in England.⁵

M. grandiflora is a native of the south-eastern United States, extending from North Carolina along the coast to Florida, and westward through the Gulf States to

¹ Dr. J. Bedelian of Nikita, in the Crimea, writes concerning the great variability of this species in *Gard. Chron.* xlii. 390 (1907). Cf. also *ibid.* xliii. 83 (1908).

² In Bailey, *Cycl. Amer. Hort.* 968 (1900).

³ *Traité des Arbres*, i. 112 (1892).

⁴ Cf. *Gard. Chron.* viii. 223 (1890).

⁵ Cf. *Gard. Chron.* viii. 223 (1890).

the Brazos river in Texas, ascending in the Mississippi valley to southern Arkansas and the mouth of the Yazoo river. It is best developed in the forests of western Louisiana, where it is one of the most characteristic trees. It usually grows in rich moist soil on the borders of river swamps and of the ponds in the pine-barrens. Plate 353, reproduced from a photograph kindly sent by Miss Cummings, shows the habit of the evergreen *Magnolia* in North Carolina. (A. H.)

The date of introduction is somewhat uncertain, but it is supposed on good authority to have been grown at Exmouth by Sir John Colliton before 1737, and a tree there, of which a long account is given in *Gardener's Magazine*, xi. 70 (1835), was for many years the parent by layering of great numbers of plants, and was cut down by mistake in 1794.

This tree surpasses all others in the temperate zone except perhaps the Himalayan *M. Campbelli*, in the beauty, size, and fragrance of its flowers; but being a native of more southern climates, it only succeeds without protection in the warmest parts of Great Britain, and even then is but a poor and stunted tree compared to what it is in south-western France, Portugal, and Italy.

Though rarely planted as a standard tree we have seen it up to 20 to 30 ft. high in a few places, the best perhaps being at Powderham Castle. It was, however, reported¹ in 1894 to be 36 ft. high by 4 ft. 8 in. in girth at East Cowes Castle, and 50 ft. by 5 ft. at Rozel Bay, Jersey. A tree at Gunnersbury House measured 31 ft. by 2 ft. 8 in. in 1911. There are two trees in the Azalea garden at Kew, about 23 ft. high; and a fine specimen trained against the Museum, which is about 35 ft. high.

On a wall even in cold parts of England it has survived a temperature below zero, though it only flowers after two good seasons, and then often so late that the flowers are cut off by early frosts. Though it sets seeds in hot summers, I am not aware that they ever ripen here; and plants which I have raised from foreign seed grow slowly and want greenhouse treatment for some years.

The largest trees that I have seen in Europe of this species are in the garden of Baron Soutelinho (Mr. A. Tait) at Oporto, one of which, now nearly dead, was 11½ ft. in girth, and another, also showing signs of decay, was 62 ft. by 11 ft. A third with a fine stem clean of branches to 35 ft. was in perfect vigour and 60 ft. by 7 ft. in 1909. In France the largest that I know are in the public gardens of Bordeaux, one of which, that had been transplanted when already an old tree, was 59 ft. by 6 ft. 3 in. in 1909.

On the Isola Madre in Lake Maggiore, I measured a tree in 1906 which was 70 ft. by 6 ft. 9 in. and ripened seed freely.

Sargent says that this species has the hardest, heaviest, and best wood of the American *Magnolias*, but it is little used, even in the United States, and hardly known in commerce. I believe, however, that some of it is mixed with the so-called canary or white wood (*Liriodendron*), and is not easy to distinguish without careful examination. It is a close-grained wood of pale creamy yellow, or brownish yellow colour, showing a minute silver grain, and looks as if it would take a fine polish.

(H. J. E.)

¹ *Gard. Chron.* xvi. 286, 375 (1894).

MAGNOLIA GLAUCA

Magnolia glauca, Linnæus, *Syst.* ii. 1082 (1759); Loudon, *Arb. et Frut. Brit.* i. 267 (1838); Sargent, *Silva N. Amer.* i. 5, t. 3 (1890), and *Trees N. Amer.* 317 (1905).

A tree, occasionally attaining in America 50 to 70 ft. in height and 10 ft. in girth, but usually much smaller. Branchlets slender, glabrous. Leaves remaining on the branches usually throughout the winter till the young leaves appear in spring, but in England some fall earlier; elliptical or oblong-lanceolate, about 4 inches long and 2 in. broad, rounded or acute at the apex; thin in texture; upper surface bright green, shining, glabrous; lower surface bluish white and covered more or less with fine white pubescence.

Flowers, on slender glabrous stalks, creamy white, fragrant, globose, 2 to 3 in. across; sepals membranous and shorter than the nine or twelve obovate petals. Fruit pink, 2 in. long, glabrous.

1. Var. *longifolia*, Loudon. This variety, which I have not seen, is said by Sargent to have lanceolate leaves, and to continue flowering for a period of two or three months. According to Loudon, it originated in Belgium, and was considered to be of hybrid origin.

2. The following is usually considered to be a hybrid, between *M. glauca* and *M. tripetala*:—

Magnolia Thompsoniana, Koch, *Dendrologie*, i. 369 (1869); Sargent, in *Garden and Forest*, i. 269, fig. 43 (1888).

Magnolia glauca, var. *major*, Sims, *Bot. Mag.* t. 2164 (1820).

Magnolia glauca, var. *Thompsoniana*, Loudon, *Arb. et Frut. Brit.* i. 267 (1838).

Magnolia major, Schneider, *Laubholzkunde*, i. 334 (1905).

A small tree. Young branchlets glaucous, glabrous except for a few hairs at the insertions of the leaves. Leaves obovate-elliptic, 6 to 8 in. long, 1½ to 3 in. wide, acute at the apex; upper surface light green, glabrous except for pubescence on the midrib; lower surface whitish, with a greyer tint than *M. glauca*, covered more or less with a fine pubescence. Flowers white, fragrant, 5 to 6 in. across; sepals shorter than the petals, greenish, reflexed as in *M. tripetala* when the flower opens, and not so early deciduous as in *M. glauca*; petals nine, obovate-oblong, contracted into a narrow claw.

According to Sabine,¹ this was raised in Thompson's nursery at Mile End in 1808, in which year the *Magnolias* fruited freely. A tree of *M. tripetala* was growing close to the tree of *M. glauca*, from which the seed was obtained that gave rise to the new plant. The latter has much larger flowers than those of *M. glauca* and in some respects shows the influence of *M. tripetala*.

M. Thompsoniana, like some hybrids, is hardier than either of the parents, being much less liable to injury from spring frosts, and is commoner in cultivation than *M. glauca*. (A. H.)

¹ In *Trans. Hort. Soc.* iii. 205 (1823).

M. glauca is a native of the eastern parts of the United States, where it is known as Sweet or Swamp Bay, being an evergreen tree in the south, and becoming deciduous in the north. It occurs in one or two stations in Massachusetts and Long Island, and is distributed along the coast from New Jersey to Florida, ranging inland to Franklin County in Pennsylvania; and extending through the Gulf States to south-western Arkansas and Trinity River in Texas. It usually grows in swamps and along the borders of the ponds in the pine barrens; and attains its largest size in Florida.

This species was introduced by Banister, who sent it to Bishop Compton, at Fulham, in 1688. Loudon mentions several places in England where it was cultivated in 1838, and states that it frequently ripened seed. It is now a rare tree, seldom seen¹ except in botanic gardens. The finest specimen that we know is at White Knights, an old tree about 30 feet high in 1905. It is said by Sargent to grow better when grafted on stocks of *M. acuminata* than on its own roots. (H. J. E.)

MAGNOLIA ACUMINATA, CUCUMBER TREE

Magnolia acuminata, Linnæus, *Syst.* ii. 1082 (1759); Sims, *Bot. Mag.* t. 2427 (1823); Loudon, *Arb. et Frut. Brit.* i. 273 (1838); Sargent, *Silva N. Amer.* i. 7, tt. 4, 5 (1890), and *Trees N. Amer.* 319 (1905).

A deciduous tree, attaining in America 60 to 90 ft. in height, and 10 to 12 ft. in girth. Bark $\frac{1}{2}$ in. thick, furrowed, scaly. Young branchlets, with dense appressed whitish pubescence towards the base, elsewhere with scattered long hairs. Leaves oval, 6 to 9 in. long, 4 to 5 in. broad, acuminate at the apex, broad and rounded or cuneate at the base; upper surface dark green, dull, with a scattered minute pubescence on the surface, denser on the midrib; lower surface pale, with scattered wavy white hairs; petiole pubescent.

Flowers on pubescent stalks, campanulate, greenish yellow or glaucous green, about 2 to $3\frac{1}{2}$ in. long; sepals membranous, soon reflexed; petals six, ovate or obovate, pointed, upright, those of the outer row much broader than those of the inner row. Fruit glabrous, dark red, 3 in. long.

In winter the branchlets are reddish, glabrous; marked with V-shaped six-dotted leaf-scars, the two apices of which are continuous with a linear scar encircling the stem and indicating the fall of the stipule. Buds surrounded by a single scale, pubescent with silky hairs, the terminal bud much larger than the lateral buds.

1. Var. *cordata*, Sargent, in *Amer. Journ. Science*, xxxii. 473 (1886), *Silva N. Amer.* i. 8, t. 6 (1890), and *Trees N. Amer.* 320 (1905).

Magnolia cordata, Michaux, *Fl. Bor. Amer.* i. 328 (1803); Loudon, *Arb. et Frut. Brit.* i. 275 (1838).

A small tree, with leaves more greyish pubescent beneath than in the type, and rarely cordate at the base. Flowers smaller, bright canary yellow.

¹ Bunbury, *Arb. Notes*, 55 (1889), states that two trees planted at Barton, Suffolk, in 1861, died in a few years.

This variety is said by Loudon to have been brought from America¹ by Lyon in 1801, the original tree in Loddiges' nursery being about 15 ft. high in 1838. No wild tree exactly similar to this variety has been discovered; but forms approaching it in the pubescence and shape of the leaves and in the small size and colour of the flowers have been found on the Blue Ridge in South Carolina, and in central Alabama. We have seen no large specimens in England. Bean² saw at Herrenhausen, Hanover, a tree 35 ft. high by 3 ft. 1 in. in 1908. (A. H.)

DISTRIBUTION AND CULTIVATION

M. acuminata extends from western New York and southern Ontario, where Macoun gives the Niagara Falls as its only natural station, southward along the Alleghany Mountains, to southern Alabama, Kentucky, Tennessee, Arkansas, and Mississippi. It seems to be rare in the north, and attains its greatest size and abundance only in the rich woods of the lower valleys of east Kentucky and Tennessee.

It was introduced into cultivation in England by Bartram, who sent plants to Peter Collinson in 1736.

It is the only Magnolia which as yet has grown to be a large tree in this country, and seems to require less summer heat, and to endure more severe frost than any of the other American species; but it only becomes a fine tree in warm rich soils in the southern half of England. I am not aware that it has ever ripened seed³ in this country; but Loudon says that seedlings are preferable to plants raised from layers, and that they were used as stocks on which to graft other species of Magnolia. Masters says⁴ that it is one of the very best of trees for towns.

Loudon mentions as the largest specimen known to him, one recently cut down at Thorndon Hall, the seat of Lord Petre in Essex, which was nearly 7 ft. in girth; and there was another in the same park 37 ft. by 7 ft., which survived until 1903. He figures one at Syon 49 ft. high in 1838, which may not be the same as one now growing in the Church Walk there, and recorded by Jackson as 51 ft. 5 in. by 3 ft. 7 in. in girth.

The finest tree known to us (Plate 358) grows at West Dean Park, and when I saw it in 1906 was 60 ft. by 7 ft., with a clean trunk about 25 ft. high. There is a much taller but ill-shaped tree branching near the ground at Albury, which was about 75 ft. high in 1905. At Claremont in 1903 I saw a tree about 55 ft. by $6\frac{1}{2}$ ft., which in 1883 was 40 ft. high. In 1910 Mr. Bean⁵ found it to be 60 ft. high. At The Mote, Maidstone, I measured a handsome tree 68 ft. by 4 ft. 9 in. in 1911. Another standing close to it was 56 ft. by 6 ft.

At Heanton Satchville, in North Devon, in 1905 I saw a straight well-shaped pyramidal tree 57 ft. by 5 ft. 3 in. At Arley Castle there are two fine trees 65 ft.

¹ Sargent, in *Garden and Forest*, 1889, p. 338, states that two specimens in the Harvard Botanic Garden are known to have been fully grown trees in 1842.

² *Kew Bull.* 1908, p. 392.

³ Bunbury, *Arb. Notes*, 55 (1889), says that the fruit always dropped off from the tree at Barton, before it was half ripe.

⁴ *Gard. Chron.* vi. 474 (1889).

⁵ *Kew Bull.* 1910, p. 164.

and 62 ft. high by over 6 ft. girth, which were planted in 1820. At Barton, Suffolk, a tree over 70 ft. high in 1904, when it appeared to be dying at the top, was planted in 1826. This tree was not injured by the severe winter of 1860-1861.

At Westonbirt a tree, 62 ft. by 5 ft. 9 in. in 1906, had been split nearly to the ground, but had been so well repaired by hoops round the trunk, that the two parts were growing together. At Chatsworth, Mr. A. B. Jackson measured in 1908 a tree 50 ft. by 4 ft. 6 in. At Essendon Place, Herts, there is a very narrow slender tree, which Henry found to be 56 ft. high by 3 ft. 4 in. in girth in 1907. At Merton Hall, Norfolk, a tree, which was raised from seed in 1862, measured 50 ft. by 4 ft. 4 in. in 1908. At Nuneham Park, Oxon, there is a tree which was 40 ft. by 4 ft. in 1907. At Fawley Court, Henley, a fine specimen was 40 ft. by 5½ ft. in the same year.

In Scotland, the finest tree we have heard of is one recorded by Hunter¹ as growing in the American garden at Dunkeld, which measured 40 ft. by 3 ft. 4 in. in 1883; but I did not see it when I visited this place in 1906. At Biel, East Lothian, I saw a healthy tree about 30 ft. by 5 ft. in 1911.

In Ireland probably the tallest tree is one at Curraghmore, which Henry found to be 60 ft. by 4 ft. 6 in. in 1907. At Narrow Water Castle, Co. Down, Captain Hall informed us in 1907, that there was a remarkable tree, 41 ft. by 5½ ft. This had not grown in height for some years past, owing to the top catching the wind, but it increased enormously below; and the branches, widely spreading and reaching the ground, now cover an area 192 ft. in circumference.

The tallest tree in Europe, if correctly measured, is probably one at Schloss Dyck, near Dusseldorf, in Germany, which was reported² in 1904 to be 30 metres in height and 2.12 metres in girth.

The wood of this tree resembles that of *M. grandiflora*; but, judging from Hough's specimen, is rather darker in colour, and even more like the wood of *Liriodendron*. Hough says that it is largely used for doors and wainscots, and for bowls, troughs, and wooden ware; but I have never seen this wood in England, or heard of its being imported under its own name. (H. J. E.)

MAGNOLIA TRIPETALA, UMBRELLA TREE

Magnolia tripetala, Linnæus, *Syst.* ii. 1082 (1759); Loudon, *Arb. et Frut. Brit.* i. 269 (1838); Sargent, *Silva N. Amer.* i. 13, tt. 9, 10 (1890), and *Trees N. Amer.* 321 (1905).
Magnolia umbrellata, Lamarck, *Encycl.* iii. 673 (1789).
Magnolia frondosa, Salisbury, *Prod.* 379 (1796).

A deciduous tree, attaining in America 30 to 40 ft. in height and 5 ft. in girth. Young branchlets glabrous. Leaves, variable in size, usually 12 to 20 in. long and 6 to 8 in. broad, obovate-oblong, tapering towards the base and apex, the latter ending in an acuminate point; upper surface green, glabrous; lower surface pale, with a scattered minute pubescence, densest on the midrib and nerves. In winter,

¹ *Woods of Perthshire*, 52 (1883). An old tree at Blair, near Dalry, Ayrshire, is said by the gardener to flower annually and to have been 45 ft. high in July 1912.

² *Mitt. Dent. Dend. Ges.* 1904, p. 19.

the glabrous branchlets¹ have broad oval leaf-scars, with numerous dots arranged in two or three series. The buds are glabrous, glaucous.

Flowers on slender glaucous glabrous stalks, cup-shaped, eight to nine inches across, disagreeable in odour; sepals light green, becoming reflexed; petals, six or nine, coriaceous, white, ovate, pointed, those of the outer row much longer and broader than those of the inner rows. Fruit, 2½ to 4 in. long, glabrous, pink.

This species, which has the leaves crowded at the summits of the flowering branches, is widely distributed in the region of the Alleghany Mountains, from the valley of the Susquehanna River in Pennsylvania southwards to Kentucky, Alabama, Tennessee, north-eastern Mississippi, and Arkansas, and extending nearly to the coast in the south Atlantic States. It usually grows on the banks of mountain streams or on the edges of swamps. (A. H.)

This species was introduced into England in 1752, and seems to have been commoner in Loudon's time than it is now. He mentions trees at Cobham (Kent), Syon, Golden Grove, Croome, and Walton House, 30 to 36 ft. high, which cannot now be found; and states that at Deepdene self-sown seeds had produced plants. We have only seen a few small trees, none of which look very thriving, at Kew; Holkham; Stanage Park, Herefordshire; and Canford, Hants. (H. J. E.)

MAGNOLIA MACROPHYLLA

Magnolia macrophylla, Michaux, *Fl. Bor. Am.* i. 327 (1803); Loudon, *Arb. et Frut. Brit.* i. 271 (1838); Sargent, *Silva N. Amer.* i. 11 tt. 7, 8 (1890), and *Trees N. Amer.* 320 (1905).

A deciduous tree, attaining in America 30 to 50 ft. in height and 5 ft. in girth. Young branchlets covered with a dense short pubescence, retained in part in the second year. Leaves, the largest of any of the species in cultivation, 12 to 25 in. long, 6 to 10 in. broad, obovate-oblong, acute or acuminate at the apex, cordate or subcordate at the truncate base; upper surface bright green, glabrous; lower surface bluish white, with a scattered fine pubescence, which is denser on the midrib.

Flowers, on stout tomentose stalks, white, cup-shaped, fragrant, 10 to 12 in. across when expanded; sepals membranous, much narrower than the six ovate concave thick creamy white petals, which become reflexed above the middle. Fruit pubescent, pink, nearly 3 in. long. (A. H.)

This species is a rare tree in the south-eastern United States, occurring from North Carolina and south-eastern Kentucky, southwards to Florida, Alabama, Mississippi, Louisiana, and central Arkansas. It usually grows in sheltered valleys in deep rich soil.

It was introduced into England in 1800. None of the trees at Arley, Chiswick, and White Knights, mentioned by Loudon, can now be found; but there is a fine specimen at Claremont, which, in 1910, was 40 to 45 ft. in height, and 2 ft. 11 in. in girth.² (H. J. E.)

¹ Cf. Foerste, in *Bot. Gaz.* xx. 80, t. 8 (1895).

² Bean, in *Kew Bull.* 1910, p. 163.

MAGNOLIA FRASERI

Magnolia Fraseri, Walter, *Fl. Carol.* 159 (1788); Sargent, *Silva N. Amer.* i. 15, tt. 11, 12 (1890), and *Trees N. Amer.* 322 (1905).

Magnolia auriculata, Lamarck, *Ency.* iii. 645 (1789); Loudon, *Arb. et Frut. Brit.* i. 276 (1838).

Magnolia auricularis, Salisbury, *Parad. Lond.* i. t. 43 (1806).

A tree, attaining in America 40 ft. in height and 4 ft. in girth, often dividing near the base into diverging stems. Young branches glabrous. Leaves 8 to 12 in. long, 5 to 6 in. wide, obovate, acute at the apex, deeply cordate and auricled at the base; both surfaces and petiole glabrous; pale beneath.

Flowers on stout glabrous glaucous stalks, opening after the leaves, cream-white, sweet-scented, 6 to 9 in. across; sepals quickly deciduous; petals six or nine, obovate, acuminate, membranous, contracted below the middle. Fruit glabrous, pink, 4 to 5 in. long, the ripe carpels ending in long subulate persistent tips.

1. Var. *pyramidata*, Nuttall, *Gen. N. Amer. Plants*, ii. 18 (1818).

Magnolia pyramidata, Pursh, *Fl. Amer. Sept.* ii. 382 (1814); Edwards, in *Bot. Reg.* t. 407 (1819); Sargent, *Trees and Shrubs*, iii. 101 (1903), and *Trees N. Amer.* 323 (1905).

Flowers much smaller than in the type, 3 to 4 in. across. Fruit, 2 to 2½ in. long, the ripe carpels ending in short incurved persistent tips.

This variety occurs in rich alluvial soil in the coast region from southern Georgia through western Florida to southern Alabama. It was introduced into Loddiges' nursery by Lyon in 1818.

M. Fraseri is a native of the southern Alleghany Mountains, from southwestern Virginia to northern Georgia and Alabama, eastern Tennessee, and northern Mississippi; most abundant and of its largest size on the upper waters of the Savannah River in South Carolina. The typical form is a native of mountain valleys.

M. Fraseri was introduced into England in 1786; and seems to be very uncommon. A tree at Kew, which belongs to var. *pyramidata*, is about 20 feet high; and produces small flowers freely from the middle of May to the end of June, which are almost yellow at the time of opening, becoming a rich cream colour as they fade. At Leonardslee,¹ it succeeds in a sheltered position. (A. H.)

MAGNOLIA CAMPBELLI

Magnolia Campbelli, J. D. Hooker and Thomson, in J. D. Hooker, *Illustr. Him. Plants*, tt. 4, 5, (1855); J. D. Hooker, *Fl. Brit. India*, i. 41 (1872), and in *Bot. Mag.* t. 6793 (1885); King, in *Ann. Bot. Gard. Calcutta*, iii. pt. 2, p. 208, tt. 51, 52 (1891); Gamble, *Indian Timbers*, 9 (1902).

A large deciduous tree, attaining occasionally in the Himalayas 150 ft. in height, and 12 to 20 ft. in girth. Young branchlets glabrous, glaucous. Leaves

¹ *Gard. Chron.* xli. 223 (1907).

membranous, narrowly elliptic, 4 to 8 (rarely 12) in. long, 2 to 3 (rarely 4) in. broad, shortly acuminate at the apex, slightly pubescent when young, but glabrous on both surfaces when mature, light green above, pale beneath; petioles glabrous.

Flowers appearing before the leaves, globose, 6 to 10 in. across, delicately scented, deep rosy pink¹ externally, cream-white internally; sepals three, similar in shape and colour to the nine or twelve petals, all elliptic-oblong, and rounded at the apex. Fruit about six inches long, cylindrical, with red seeds. (A. H.)

This species is a native of Sikkim and Bhutan, occurring, according to Gamble and Hooker, at elevations of 8000 to 10,000 ft.; but I have seen it in the Rangirun forest, near Darjeeling, below the road leading to Pashok, which cannot be higher than 7000 ft. Hooker² describes it as a large forest tree with black bark, often 80 ft. high and 12 to 20 ft. in girth; and Gamble says that, according to King, specimens 150 ft. high were common in Sikkim in 1849, but that the demand for building timber and tea-box boards has made large trees scarce. Though the tree itself is not a handsome one, it is impossible to exaggerate its beauty when seen in April standing leafless, but covered with its immense rosy flowers among the chestnuts, oaks, and other trees, in one of the most beautiful forests in the world.

Repeated attempts were made to introduce this species by seed; but on arrival the fleshy albumen was always found decayed and the minute embryo killed. Ultimately, about 1880, living plants were sent to Kew from the Calcutta Botanic Gardens.

It is perfectly hardy at Kew, and has attained a considerable size in the milder parts of this country; but apparently requires a greater degree of heat and moisture in summer, and remains usually in a bushy state. It flowered for the first time in Europe in 1885 in Mr. Crawford's garden at Lakelands, Cork, and was then figured in the *Botanical Magazine*. It has since flowered at several places, as in 1898 at Veitch's nursery³ at Exeter, where it had been growing in the open for twelve years, and at Leonardslee⁴ in 1907, when it was about 20 ft. high. At Abbotsbury,⁵ where it was about 25 ft. high in 1903, it is the earliest of all the species in flower, being two or three weeks in advance of *M. stellata* and *M. conspicua*. A specimen at Belgrove,⁶ Cork, produced 147 flowers in 1903; but the late Mr. Gumbleton stated that in other years either no buds were set or the flowers never opened, having been killed by frosts and cold winds. Nicholson mentions⁷ a fine specimen at Fota, 25 ft. high in 1895, which produced beautiful flowers of a much richer tint than those at Lakelands. (H. J. E.)

¹ The flowers are variable in the depth of the pink hue; and are occasionally white.

² *Him. Journ.* i. 125 (1854), where he mentions that *Rhododendron Dalhousiae* often grows epiphytically upon its branches.

³ *Gard. Chron.* xxiii. 89, fig. 33 (1898).

⁴ *Ibid.* xlii. 3 (1907).

⁵ *Ibid.* xxxiii. 174, fig. 73 (1903). This tree was, when I saw it in July 1912, about 30 ft. high and 2½ ft. in girth.—A. H.

⁶ *Ibid.* xxxiii. 172 (1903) and xlii. 33 (1907).

⁷ *Ibid.* xvii. 515 (1895).

MAGNOLIA DELAVAYI

Magnolia Delavayi, Franchet, *Pl. Delav.* 33, tt. 9, 10 (1889); Sprague, in *Bot. Mag.* t. 8282 (1909).

An evergreen tree, about 30 ft. high. Young branchlets glaucous, minutely pubescent. Leaves coriaceous, persistent two years, ovate-oblong or elliptic, 7 to 12 in. long, and 4 to 7 in. wide, rounded and mucronate at the apex; dull green and glabrous above; lower surface glaucous, with scattered fine pubescence; midrib beneath very prominent and, like the petiole, very stout and more or less pubescent.

Flowers creamy white, fragrant, about 7 in. across; sepals three, oblong, reflexed; petals about seven, spatulate-obovate. Fruit about 5 in. long.

This is a native of Yunnan in south-western China, where I saw it growing in rocky situations and woods at 5500 to 7000 ft. above sea-level. It was introduced by Wilson in 1900; and flowered at Kew in 1908. It is scarcely hardy at Kew,¹ though it thrives against a wall; but it will probably succeed better in the milder parts of England, Wales, and Ireland. Both the foliage and flowers are very handsome. (A. H.)

MAGNOLIA HYPOLEUCA

Magnolia hypoleuca, Siebold and Zuccarini, in *Abh. Ak. München*, iv. pt. ii. 187 (1845); Sargent, in *Garden and Forest*, i. 304, fig. 49 (1888); Matsumura, in *Journ. Coll. Sc. Imp. Univ. Tokyo*,² xii. 284 (1899); Shirasawa, *Icon. Ess. Forest. Japon*, i. text 70, t. 39, figs. 13-29 (1900); Skan, in *Bot. Mag.* t. 8077 (1906); Mayr, *Fremdländ. Wald- u. Parkbäume*, 481 (1906).

A deciduous tree, attaining 100 ft. in height and 10 ft. in girth in Japan. Young branchlets glabrous. Leaves coriaceous, often crowded at the ends of the branches, obovate or obovate-elliptic, about 8 to 15 in. long and 6 to 8 in. broad, acute or cuspidate at the apex: upper surface light green, glabrous; lower surface bluish grey, with scattered curved white hairs, often with dense appressed pubescence on the midrib; petiole pubescent.

Flowers, opening when the leaves are nearly fully grown, very fragrant, 6 to 8 in. across, creamy white or white; sepals coriaceous, tinged with red: petals nine, coriaceous, obovate-spatulate, rounded or cuspidate at the apex. Fruit red, 5 to 8 in. long.

M. hypoleuca is a native of China and Japan. In central and western China it is commonly cultivated around dwellings in mountainous districts at elevations between 2500 and 4500 ft. It is known to the Chinese as *hou-p'o*, its bark³ being esteemed as a valuable drug, which is exported to all parts of China. Neither

¹ Cf. *Kew Bull.* 1909, p. 235. A tree in the Temperate House at Kew is about 20 ft. high.

² Recorded as doubtfully wild in the Liu Kiu Islands.

³ Cf. Hanbury, *Sc. Papers*, 266 (1876), and Bretschneider, *Bot. Sinic.* iii. 472 (1895). Père David, *Journ. Trois. Voy. Chine*, ii. 360 (1875), mentions a large plantation of this tree in the province of Kiangsi.

Wilson nor myself ever found the tree in a wild state in China; but it is probably indigenous in some of the unexplored districts. It is mentioned in the earliest Chinese Herbal, which was compiled about 200 B.C.; and it is extremely unlikely to have been introduced from Japan. (A. H.)

This beautiful tree is called *Honoki* in Japan, where it is most common and attains a large size in the forests of Hokkaido. It also occurs in the mountains of Hondo, at elevations of 2000 to 5500 ft. The largest that I saw were about 100 ft. high, usually with tall clean stems. This species requires a rich moist soil and a considerable rainfall in summer; and produces valuable timber. The wood¹ is firm and uniform in texture, and of a yellowish or greenish white colour, and is largely used for drawing-boards, musical instruments, lacquer work, and many other purposes. It seems very similar to the wood of *M. grandiflora*, and is said to be little subject to warping and splitting. Its charcoal is highly prized in Japan for polishing lacquer-ware and metallic mirrors, and for finishing cutlery.

Though introduced² as long ago as 1865 by Thomas Hogg into the United States, where it has proved hardy in the north, it does not seem to have attracted attention in this country till recently; but on account of its large beautiful leaves, sometimes 2 ft. long, and its fragrant flowers, it is well worth cultivation in the south and west of England. Plants which I raised from seed, grew slowly at first, and for the most part died when planted out, owing, I believe, to the presence of lime in the soil. The oldest tree appears to be one at Grayswood, Haslemere, which was obtained from Yokohama in 1884, and flowered in 1905. A tree at Kew, which flowered in the same year, when it was 14 ft. high, was obtained from Japan in 1890. One at Trewidden, Cornwall, which was planted about 1893, is 30 ft. high by 2½ ft. in girth at one foot from the ground; this produces flowers abundantly; and bore ripe fruit in September 1911. Another at Enys, was about 20 ft. high in 1911. Wilson sent seeds to Messrs. Veitch, who now have the Chinese plant growing in their nursery at Coombe Wood.

In Ireland I have seen it growing well at Baronscourt, Co. Tyrone, the seat of the Duke of Abercorn, where the soil and climate seem to be less favourable than in many parts of Ireland.

This species was raised³ in 1877 from seed in the botanic garden at Heidelberg, and flowered there when about 20 ft. high in 1898. Mayr who had a high opinion of it as a forest tree, suitable for producing good timber quickly in central Europe, introduced it in 1890 into the experimental garden at Grafrath near Munich, where a tree attained 20 ft. in height at ten years old. Schwappach⁴ states that the experimental plots of this species at Eberswalde are very thriving, the trees being 42 ft. high after seventeen years' growth. The growth is rapid in youth, like the ash, which it also resembles in its requirement for space. Schwappach recommends planting it, mixed with oak and beech, on soils suitable to these species. Count Von

¹ Figured by Mayr, *op. cit.* t. xviii.

² According to *Garden and Forest*, i. 304, fig. 49 (1888), where the figure is taken from a tree in New York, which was 28 ft. high in 1898.

³ *Semaine Horticole*, 1900, p. 199.

⁴ In *Zeitschr. Forst. u. Jagdwesen*. xliii. 604 (1911), and *Mitt. Deut. Dend. Ges.* 1911, p. 12.

Schwerin, who gives a good account¹ of *M. hypoleuca*, states that the seeds, when sent from Japan, dry up and lose their germinating power, unless they are packed in their fleshy covering in charcoal dust or peat powder. (H. J. E.)

MAGNOLIA KOBUS

Magnolia Kobus, De Candolle, *Syst.* i. 456 (1818); Maximowicz, in *Mél. Biol.* viii. 507 (1872); Shirasawa, *Icon. Ess. Forest. Japon.* i. text 71, t. 39, figs. 1-12 (1899); Matsumura in *Journ. Sc. Coll. Imp. Univ. Tokyo*,² xii. 284 (1899); Masters, in *Gard. Chron.* xxxvii. 265, *Supply. Illust.* (1905); Bean, in *Bot. Mag.* t. 8428 (1912).
Magnolia glauca, var. *a.*, Thunberg, *Flora Jap.* 236 (1784).
Magnolia tomentosa, Thunberg, in *Trans. Linn. Soc.* ii. 336 (1794) (in part).

A deciduous small tree. Young branchlets slender, glabrous. Buds pubescent. Leaves membranous, averaging 3 to 5 in. long, and 2 to 3 in. wide, occasionally up to 6 in. long and 4 in. wide; obovate, gradually tapering to the cuneate base, cuspidate-acuminate at the apex; upper surface green, glabrescent, often pubescent on the midrib; lower surface lighter green, with pubescence on the lateral nerves, forming axil-tufts at their junctions with the midrib; margin ciliate; lateral nerves eight to ten pairs; petiole with scattered long hairs.

Flowers, appearing before the leaves, 4 in. across; sepals very small, narrow, quickly deciduous; petals six, obovate, rounded or emarginate at the apex, white, with a purple median line externally. Fruit, dark brown, 4 in. long, often curved and contorted.

1. Var. *borealis*, Sargent, *Trees and Shrubs*, ii. 57 (1908).

Magnolia Kobus, Sargent, in *Garden and Forest*, vi. 64, fig. 11 (1893), and *Forest Flora of Japan*, 9, fig. 3 (1894) (not De Candolle).

A large tree, attaining in Japan 80 ft. in height and 6 ft. in girth, with a straight trunk, covered with dark slightly fissured bark; leaves larger than in the type; flowers with pure creamy white sepals.

This variety, according to Sargent, is a native of Yezo, where it grows plentifully in the forests of the hills around Sapporo. It also occurs in northern Hondo. So far as we know, it is not in cultivation in England.

The typical form of the species is a small tree, about 20 to 30 ft. high, which is occasionally seen at considerable elevations in the Hakkone and Nikko mountains, and is recorded for Fujiyama by Hayata.³ Shirasawa states that the wood is harder than that of *M. hypoleuca*; but owing to the rarity of trees of a large size, is little used. It is known in Japan as *Kobushi*.

M. Kobus was introduced into the United States by Thomas Hogg, and was distributed from Parsons' nurseries under the name *M. Thurberi*. Sargent states that in New England it is the hardiest, most vigorous, and fastest growing of all the Magnolias. Rehder, however, says that it flowers sparingly, and is not showy. A tree in the Arnold Arboretum flowered when fifteen years old.

¹ In *Mitt. Deut. Dend. Ges.* 1904, p. 1.

² Recorded as doubtfully wild in the Liu Kiu Islands.

³ *Vegetation of Mt. Fuji*, 56 (1911).

M. Kobus was introduced into England by Maries in 1879; and one of the original trees¹ at Coombe Wood, which died in 1906, was about 20 ft. high in 1902. Some of the specimens of *M. stellata* at Kew were grafted on stock of *M. Kobus*, obtained from this source. This species was again introduced² about 1887 by Messrs. R. Veitch and Sons, Exeter, who reported that it proved fast in growth, some of the plants, transplanted two or three times, having attained 12 to 14 ft. in height in seven or eight years.

We have seen no large specimens in England, except one at Abbotsbury, which has borne flowers for the past ten years, and was about 25 ft. high in July 1912. A tree at Kew, obtained from Harvard in 1889, is only 15 ft. high. One in Victoria Park, Bath, about 13 ft. high, produced flowers very freely in 1911, but set no fruit.³ In Mr. Thomas Irvine's garden at Newry, there is a fine specimen, planted about twenty-one years ago, which is 18 ft. high. It produces flowers in abundance every year, and is very thriving. (A. H.)

MAGNOLIA SALICIFOLIA

Magnolia salicifolia, Maximowicz, in *Bull. Acad. St. Petersb.* xvii. 418 (1872), and *Mél. Biol.* viii. 509 (1872); Shirasawa, *Icon. Ess. Forest. Japon.* i. text 72, t. 40, figs. 18-31 (1899); Sargent, in *Garden and Forest*, vi. 65, fig. 12 (1893), and *Forest Flora of Japan*, 10, fig. 4 (1894).
Buergeria (?) *salicifolia*, Siebold and Zuccarini, in *Abh. Akad. München*, iv. pt. ii. 187 (1845).

A small deciduous tree, attaining in Japan, about 30 ft. in height and 4 ft. in girth. Bark smooth. Young branchlets glabrous, slightly glaucous. Leaves membranous, lanceolate, 3 to 4 in. long, 1 to 1½ in. broad, gradually tapering to an acuminate and often curved apex, cuneate at the base; upper surface light green, glabrous; lower surface pale, more or less covered with a minute pubescence; punctate with numerous translucent dots; lateral nerves, about twelve pairs, yellowish, as is also the midrib; petiole glabrous.

Flowers campanulate, 3 to 4 in. across; sepals green, much smaller than the petals, spreading, early deciduous; petals six, white, oblong-spatulate, spreading, slightly reflexed at the apex, about 2½ in. long. Fruit narrowly cylindrical, 3 in. long, pale brown; seeds compressed, triangular, almost black.

This little-known species is a native of Japan, where it grows in mountain forests in Hondo, at 2000 to 5000 feet elevation. It was introduced⁴ in 1892 into the Arnold Arboretum by Professor Sargent, who collected seed on Mount Hakkoda; and is represented at Kew by a small specimen obtained from Yokohama in 1906. This, as well as a shrub at Arley, flowered⁵ for the first time in 1912. The flowers are handsome and fragrant. (A. H.)

¹ Note in Arboretum Herbarium, Kew. It is impossible to say whether Maries's introduction was typical *M. Kobus* or var. *borealis*; but all the specimens which we have seen in cultivation belong to the former.

² *Gard. Chron.* xxxvii. 265, *Supply. Illust.* (1905).

³ It was reported, in *Gard. Chron.* xxxvi. 322 (1904), to have produced fruit, when about 8 ft. high in 1904.

⁴ It is mentioned in Veitch's *Catalogue of Trees and Shrubs*, 1902, p. 45.

⁵ Cf. *Gard. Chron.* li. 222, 245, fig. 99 (1912).

MAGNOLIA CONSPICUA

Magnolia conspicua, Salisbury, *Parad. Lond.* t. 38 (1806); Sims, *Bot. Mag.* t. 1621 (1814); Loudon, *Arb. et Frut. Brit.* i. 278 (1838).

Magnolia precia,¹ Correa, in Ventenat, *Jard. Malm.* 24, note 2 (1803); Schneider, *Laubholzkunde*, i. 331 (1905).

Magnolia yulan, Desfontaines, *Hist. Arb.* ii. 6 (1809).

A deciduous tree, attaining in China 30 to 50 ft. in height. Young branchlets more or less covered with appressed white pubescence. Leaves obovate, or obovate-oblong, about 4 to 6 in. long and 2½ to 4 in. wide, cuspidate-acuminate at the apex, usually rounded and unequal at the base; upper surface light green, more or less covered with a minute pubescence, dense on the midrib and nerves; lower surface lighter green, similarly pubescent with longer white hairs; minutely punctate with translucent dots; network of veins beneath wrinkled and prominent; petiole pubescent.

Flowers, appearing in spring before the leaves, campanulate, sweet-scented, about six inches across, pure white; sepals resembling the petals; petals six, fleshy, concave, oblong-obovate or spatulate. Fruit brownish, 3 to 6 in. long.

Numerous varieties² of this species have arisen in cultivation in Europe, which are supposed to be of hybrid origin.

1. *Magnolia Soulangiana*, Soulange-Bodin, in *Ann. Soc. Hort. Paris*, 1826, p. 90.

Magnolia conspicua, var. *Soulangiana*, Lindley, in *Bot. Reg.* t. 1164 (1828); Loudon, *Arb. et Frut. Brit.* i. 278 (1838).

Leaves similar to those of *M. conspicua*; but usually narrower in proportion to their length, longer acuminate at the apex, and tapering at the base. Flowers, later in opening, fragrant, delicate green at first, the sepals and petals becoming white inside, and purplish outside.

This was raised about 1820 at Fromont, near Paris, from the seeds of a plant of *M. conspicua*, which stood near one of *M. denudata*, in front of the château of M. Soulange-Bodin; the flowers of the former, it was supposed, being fertilised by the pollen of the latter. It resembles *M. denudata* in the later opening and colour of the flowers.

2. *Magnolia Lennei*, Topf, ex Van Houtte, *Flore des Serres*, xvi. tt. 1693, 1694 (1867). Leaves similar to those of *M. conspicua*, broadly obovate-oval, but with a longer acuminate apex, and tapering at the base. Flowers, appearing with the leaves, deep crimson outside, very fragrant.³ This originated in the Salvi Garden at Vicenza in Italy; and was sent from there in 1850 to Topf, at Erfurt, who named it after Lenné, director of the Potsdam Garden. Whether it is a seedling of *M. conspicua* or of *M. Soulangiana* is unknown.

¹ This name was published without any description, and cannot therefore be used, although the earliest.

² Var. *purpurascens*, Maximowicz, in *Mit. Biol.* viii. 509 (1872), is a variety with purple flowers, cultivated in Japan.

³ According to *Gard. Chron.* xxvi. 379 (1899), it produced, in 1893 and 1899, pink fruit with orange seed at Straffan, Kildare. It ripened fruit in 1911 at Enys in Cornwall.

Var. *rosea grandiflora* was raised from a seed of *M. Lennei*, and is one of the most beautiful varieties.

3. Numerous other hybrids are in cultivation, which mainly differ in colour and time of flowering, as var. *Alexandrina*,¹ var. *Norbertiana*, and var. *nigra*.²

M. conspicua is a native of China, where it has been found wild in the mountainous districts of Hupeh and Szechwan. It is cultivated extensively by the Chinese, who call it *yü-lan*; and it is mentioned in their earliest literature. It is not considered to be a native of Japan, where it was probably introduced from China by the early Buddhist monks.

It was introduced into England by Sir Joseph Banks in 1789: and is commonly cultivated for its beautiful flowers, which appear in spring the earliest of all the species, except *M. stellata* and *M. Campbellei*. The flowers are liable to be injured by frosts and cold east winds. The finest specimen is probably one³ at Gunnersbury House, which was 31 ft. high by 2½ ft. in girth in 1911. A tree, said⁴ to be over seventy years old, and about 25 ft. high, was growing at Slocock's Nursery at Woking, in 1898, and bore flowers described as pure white suffused with purple. A fine specimen at La Fantaisie, Jersey, is figured in *Gard. Chron.* xxxvi. 59, fig. 25 (1904). One trained against the wall of Hornby Grange, Northallerton, and 30 ft. high, was reported⁵ to have borne 2000 flowers in 1896. (A. H.)

MAGNOLIA DENUDATA

Magnolia denudata,⁶ Lamarck, *Encycl.* iii. 675 (1789); Schneider, *Laubholzkunde*, i. 330 (1905).

Magnolia obovata, Thunberg, in *Trans. Linn. Soc.* ii. 336 (1794) (Excl. *Icon. Kaempf.* t. 43).

Magnolia purpurea, Curtis, *Bot. Mag.* t. 390 (1797); Loudon, *Arb. et Frut. Brit.* i. 282 (1838).

Magnolia discolor, Ventenat, *Jard. Malm.* t. 24 (1803).

A deciduous shrub, rarely exceeding 10 ft. in height. Young branchlets glabrous except near the tip, where they are covered with silvery appressed pubescences. Leaves membranous, about 4 to 5 in. long and 2 to 3 in. broad, obovate, or oval and broadest at the middle, acute or shortly acuminate at the apex, tapering at the base; upper surface dark green, with scattered appressed hairs, denser on the midrib and nerves; lower surface pale green, glaucescent, with similar pubescence, confined mainly to the midrib and nerves; punctate with minute translucent dots; margined with scattered cilia; lateral nerves eight to ten pairs; petiole with appressed pubescence.

Flowers, appearing before the leaves, without scent, campanulate; sepals small, ovate-lanceolate, greenish yellow, spreading, and slightly reflexed; petals six, purple outside, white inside, about 3½ in. long, broad, ovate, obtuse, slightly fleshy. Fruit brownish.

¹ Cf. Loudon, *Gard. Mag.* xix. 269 (1843), where this variety is said to flower later than *M. conspicua*, and earlier than *M. Soulangiana*.

² According to *Hortus Veitchii*, 370 (1906), var. *nigra* was introduced from Japan by J. Gould Veitch. Cf. Nicholson, in *The Garden*, xxv. 276, fig. 434 (1884). It has dark plum-coloured flowers.

³ Figured in *Gard. Chron.* ix. 591, fig. 5 (1891).

⁴ *Gard. Chron.* xxiii. 262 (1898).

⁵ *Ibid.* xix. 494 (1896).

⁶ This is the oldest name, and Lamarck's description is satisfactory.

1. Var. *gracilis*, Dippel, *Laubholzkunde*, iii. 151 (1893).

Magnolia gracilis, Salisbury, *Parad. Lond.* t. 87 (1806); Loudon, *Arb. et Frut. Brit.* i. 283 (1838).

Branchlets slender; leaves narrower; flowers smaller, dark purple. Introduced from Japan in 1804.

M. denudata is a native of China, where it has not, however, so far as I know, been collected in the wild state. It is mentioned in the earliest Chinese literature under the name *mu-lan*, which it still bears. It is cultivated throughout China and Japan, having been introduced into the latter country at an early period. It was brought to England from Japan by Thunberg in 1790; and is occasionally cultivated, though it is not so ornamental as the hybrids. It produces its flowers just after *M. conspicua*. (A. H.)

MAGNOLIA PARVIFLORA

Magnolia parviflora, Siebold and Zuccarini, in *Abh. Akad. München*, iv. pt. ii. 187 (1846); Maximowicz, in *Mél. Biol.* viii. 509 (1872); J. D. Hooker, in *Bot. Mag.* t. 7411 (1895); Shirasawa, *Icon. Ess. Forest. Japon*, ii. t. 17, figs. 1-5 (1908).

A deciduous shrub,¹ attaining about 10 ft. high in Japan. Young branchlets covered more or less with a minute pubescence. Leaves membranous, 4 to 5 in. long, 2½ to 3 in. wide, obovate or oval, shortly acuminate at the apex, rounded at the base; upper surface shining dark green, glabrous; lower surface bluish white, more or less covered with a scattered minute pubescence, denser and longer on the midrib and nerves; lateral nerves about nine pairs, greenish, as is also the margin; petiole pubescent.

Flowers appearing in June after the leaves, on long stalks; cup-shaped, fragrant, 3½ to 4 in. across; sepals pink, nearly as large as the petals, soon reflexed; petals six, obovate, very concave, white.

This handsome species is a native of Japan, where it occurs in mountain woods at high elevations on the main island and in Kiusiu. It was introduced into Kew from Yokohama in 1893, and flowered in the following year. It is said to be rather tender at Leonardslee²; but thrives at Westonbirt, where a small shrub was bearing flowers on 25th May 1912. (A. H.)

MAGNOLIA WATSONI

Magnolia Watsoni, J. D. Hooker, in *Bot. Mag.* t. 7157 (1891); Masters, in *Gard. Chron.* xvi. 188, fig. 29 (1894); Nicholson, in *Gard. Chron.* xvii. 516, fig. 72 (1895).

A deciduous shrub. Young branchlets glabrous. Leaves slightly coriaceous, about 5 to 6 in. long and 3 to 3½ in. broad, obovate to elliptical, acute at the apex, tapering at the base; upper surface light green, pubescent on the midrib,

¹ Maximowicz, *loc. cit.*, states that this is occasionally a large tree; but Shirasawa gives its height as about 10 feet.

² *Gard. Chron.* xli. 222 (1907).

glabrous elsewhere; lower surface greyish, thinly covered with scattered appressed hairs, dense on the midrib and nerves; lateral nerves about fifteen pairs, with the midrib and margin yellowish; petiole pubescent.

Flowers appearing at the same time as the leaves, shortly stalked, 5 to 6 in. across, highly fragrant, resembling in odour those of *Calycanthus*; sepals oblong, pink, ultimately deflexed; petals six to nine, obovate, concave, spreading, cream-coloured.

This species was described by Sir Joseph Hooker from a shrub, which was purchased in the Japanese Court of the Paris Exhibition in 1889, and which flowered at Kew in the following year. It is unknown in the wild state in Japan, and is possibly a hybrid between *M. hypoleuca* and *M. parviflora*. At Stevenstone, North Devon, there is a fine shrub,¹ 18 ft. high, with seven main branches, which bore about 100 flowers in June 1909. (A. H.)

MAGNOLIA STELLATA

Magnolia stellata, Maximowicz, in *Bull. Acad. Imp. Petersburg*, xvii. 418 (1872) and *Mél. Biol.* viii. 509 (1872); J. D. Hooker, in *Bot. Mag.* t. 6370 (1878); Masters, in *Gard. Chron.* vii. 618 fig. 102 (1890), and xxxix. 260, figs. 108, 109 (1906); Nicholson, in *Gard. Chron.* xvii. 516, fig. 73 (1895).

Magnolia Halleana, Parsons, in *The Garden*, xiii. 572, fig. 132 (1878).

Buergeria stellata, Siebold and Zuccarini, in *Abh. Akad. München*, iv. pt. ii. 186 (1846).

A deciduous shrub or small tree. Young branchlets more or less covered with appressed silvery long hairs. Leaves membranous, about 3 in. long and 1 in. broad, obovate-oblong or oblanceolate, gradually tapering to the base; rounded and emarginate, acute, or shortly acuminate at the apex; upper surface glabrous; lower surface green, glabrous between the nerves, which with the midrib and petiole are more or less covered with appressed pubescence or are glabrescent; lateral nerves about ten pairs; margin non-ciliate.

Flowers opening before the leaves, about 3 in. across, sweet-scented, short-stalked; sepals similar to the petals; petals nine to eighteen, narrow, linear-oblong, at first spreading, then reflexed, white, with a faint pink streak externally. Fruit, about 2 in. long; carpels cuspidate, only a few ripening.

This species is a native of Japan, where it is wild in woods in central Hondo, and is everywhere cultivated. It was introduced into cultivation in the United States by Dr. Hall² in 1862, and was put into commerce by S. B. Parsons of Flushing, New York, under the name *M. Halleana*. It was introduced³ from Japan into England by Messrs. Veitch, and flowered for the first time in this country in their nursery at Coombe Wood in 1878. It is very hardy and produces flowers most profusely, at an early age, when it is hardly 2 feet high; and is now seen in many gardens. (A. H.)

¹ *Kew Bull.* 1909, p. 337.

² An account of the plants introduced by Dr. Hall from Japan, is given in *The Garden*, xiii. 572 (1878), reproduced in *Gard. Chron.* xlv. 275 (1909).

³ Cf. *Hortus Veitchii*, 370 (1906). This form has the petals slightly suffused with pink, and has been named var. *rosea*.

HALESIA

Halesia, Ellis, in Linnæus, *Syst. Nat.* 1044 (1759), and in *Phil. Trans.* li. 931 (1761) (not Browne¹); Bentham et Hooker, *Gen. Pl.* ii. 669 (excl. *Pterostyrax*) (1876); Perkins, in Engler, *Pflanzenreich*, iv. 241, *Styracaceæ*, 94 (1907); Schneider, *Laubholzkunde*, ii. 582 (1911).

Mohria, Britton, in *Garden and Forest*, vi. 434 (1893) (not Swartz²).

Mohrodendron, Britton, in *Garden and Forest*, vi. 463 (1893); Sargent, *Silva N. Amer.* vi. 19 (1894), and *Trees N. Amer.* 754 (1905).

Carlomohria, Greene, in *Erythea*, i. 236 (1893).

DECIDUOUS trees or shrubs, belonging to the order Styracaceæ. Branchlets slender, with chambered pith; one large bundle-scar in the centre of each leaf-scar. Buds all axillary, no true terminal bud being formed, two or three superposed above each leaf-scar, with a few imbricated scales. Leaves simple, alternate, stalked, penninerved, without stipules, denticulate in margin, more or less stellate-pubescent.

Flowers regular, perfect, in fascicles or short racemes, arising from the axils of the leaf-scars of the previous year's branchlet; calyx-tube obpyramidate, four-ribbed, with a short four-toothed limb; corolla epigynous, campanulate, divided into four or five shallow or deep lobes. Stamens, eight to sixteen in one series, adnate to the tube of the corolla, included; filaments nearly free or more or less connate; ovary, two- to four-celled, inferior in greater part, gradually contracted into an elongated style, which is stigmatic at the apex; ovules, four in each cell, two ascending and two pendulous. Fruit, a drupe, crowned by the calyx-tube and the thickened persistent style, dry, indehiscent; with a thick exocarp, produced into two or four wings; containing a thick and bony obovate stone, gradually narrowed at the base into an elongated stipe, one- to four-celled. Seed solitary in each cell.

Halesia comprises three species, natives of the United States, one of which, *Halesia parviflora*³ is a small shrub, not known in cultivation in Europe.

Pterostyrax, Siebold and Zuccarini, *Fl. Jap.* 96 (1835), was included under *Halesia* by Bentham and Hooker, *Gen. Pl.* ii. 669 (1876); but is a distinct genus, comprising three species, shrubs or small trees, natives of China and Japan, with

¹ *Halesia*, Patrick Browne, *Hist. Jamaica*, 205 (1755), was applied to a West Indian tree, which is a species of *Guettarda*, a genus founded by Linnæus in 1753.

² *Mohria*, Swartz, *Syn. Fil.* 159 (1806), is a genus of ferns, with one species, in South Africa.

³ *H. parviflora*, Michaux, *Fl. Bor. Amer.* ii. 40 (1803), is a little-known shrub of southern Georgia and Florida, which has never been properly described. The plant described under this name by Lindley, *Bot. Reg.* t. 952 (1825), and Loudon, *Arb. et Frut. Brit.* ii. 1190 (1838), is *Styrax americana*, Lamarck. Cf. Perkins, *Styracaceæ*, 76 (1907), and also a note by Smith, in Rees' *Cyclopædia*, under the article on *Halesia*.

foliage and stellate pubescence similar to that of the species of *Halesia*. *Pterostyrax* differs from the latter as follows:—Branchlets with solid pith. Flowers numerous in axillary and terminal panicles, arising on the current year's branchlets; corolla five-partite; stamens ten, exerted, unequal. Fruit small, either obovate and five-winged, or cylindrical and ten-ribbed.

Of the three species, one appears to be in cultivation,¹ and deserves a brief mention:—

Pterostyrax hispida, Siebold and Zuccarini, in *Abh. Akad. München*, iv. 3, p. 132 (1846). A small tree, 20 to 30 ft. high, native of the main island of Japan and central China, which was introduced² about 1870. It is perfectly hardy at Kew, coming into flower late in June, and ripening occasionally its seed. It was lately figured in *Bot. Mag.* t. 8329 (1910) from a specimen in Canon Ellacombe's garden at Bitton. (A. H.)

HALESIA DIPTERA

Halesia diptera, Ellis, in *Phil. Trans.* li. 931, t. 22 B (1761); Linnæus, *Sp. Pl.* 636 (1762); Loudon, *Arb. et Frut. Brit.* ii. 1191 (1838); Perkins, *Styracaceæ*, 97 (1907); Schneider, *Laubholzkunde*, ii. 583 (1911).

Halesia reticulata, Buckley, in *Proc. Acad. Sci. Philad.* 1860, p. 444.

Mohria diptera, Britton, in *Garden and Forest*, vi. 434 (1893).

Mohrodendron dipterum, Britton, in *Garden and Forest*, vi. 463 (1893); Sargent, *Silva N. Amer.* vi. 23, t. 259 (1894), and *Trees N. Amer.* 756 (1905).

A large shrub or small tree, not exceeding 30 ft. in height. Young branchlets with a few very scattered stellate hairs. Leaves membranous, ovate, 4 to 5 in. long, 2½ to 3½ in. wide, acuminate at the apex, rounded or cuneate at the base; margin with remote serrations tipped with long cartilaginous points; glabrous on both surfaces, except for scattered stellate hairs on the midrib and nerves; green beneath; petiole about ½ in. long, with slight stellate pubescence.

Flowers on long slender pedicels, in fascicles of three or four; calyx pubescent externally, with four short distinct triangular teeth; corolla white, divided nearly to the base into four or five lobes; stamens usually eight, rarely ten to sixteen with pubescent filaments, which are united together in their lower half; ovary usually two-, occasionally three-celled, tomentose; style tomentose. Fruit oblong, compressed, 1½ to 2 in. long, with two large opposite wings, and two or three additional slight ridges; stone narrowly obovate, conspicuously furrowed; seeds acuminate at the ends.

This is a native of the coast region of the United States, from South Carolina to northern Florida, and westward to Texas, ascending in the Mississippi valley to

¹ The other species, not yet introduced are:—

(1) *Pterostyrax psilophylla*, Diels, ex Perkins, *Styracaceæ*, 103 (1907). A shrub found by Wilson in central China, closely allied to *P. hispida*.

(2) *Pterostyrax corymbosa*, Siebold and Zuccarini, *Fl. Jap.* 96, t. 47 (1835). A shrub, native of Japan.

² Cf. Koch, *Dendrologie*, ii. pt. i. 198 (1872).

central Arkansas. It is usually a large shrub, growing on the borders of swamps and in other wet situations. It is hardy in gardens as far north as Philadelphia.

H. diptera is said by Loudon to have been introduced into England in 1758; and a shrub trained against a wall produced flowers and fruit many years ago in Loddiges' nursery. It appears to be extremely rare in cultivation at the present time, the only specimen which I know being one at Kew, about 15 ft. high, obtained from Meehan in 1896. This has not yet produced flowers or fruit. (A. H.)

HALESIA CAROLINA, SNOWDROP TREE

Halesia carolina, Linnæus, *Syst. Nat.* 1044 (1759); Perkins, *Styracaceæ*, 94 (1907); Schneider, *Laubholzkunde*, ii. 583 (1911).

Halesia tetraptera, Ellis, in *Phil. Trans.* li. 932, t. 22 A (1761); Linnæus, *Sp. Pl.* 636 (1762); Loddiges, *Bot. Cat.* t. 1173 (1827); Loudon, *Arb. et Frut. Brit.* ii. 1190 (1838).

Mohria carolina, Britton, in *Garden and Forest*, vi. 434 (1893).

Mohrodendron carolinum, Britton, in *Garden and Forest*, vi. 463 (1893); Sargent, *Silva N. Amer.* vi. 21, tt. 257, 258 (1894), and *Trees N. Amer.* 755 (1905).

Carlomohria carolina, Greene, in *Erythea*, i. 246 (1893).

A tree, attaining occasionally in America 80 to 90 ft. in height and 9 ft. in girth, but usually much smaller, and often a large bush throwing up several stems from the ground. Bark divided into broad rounded scaly ridges. Young branchlets stellate-pubescent. Leaves oval, 4 to 6 in. long, 2 to 3 in. wide, thicker in texture than those of *H. diptera*, acuminate at the apex, rounded or cuneate at the base; margin minutely serrate, with very short callous points; glabrescent above; lower surface pale or whitish, more or less densely covered with stellate pubescence; petiole about $\frac{1}{2}$ in. long, covered with stellate hairs.

Flowers, opening in spring just after the leaves begin to unfold, on long slender pedicels, in fascicles of three or four; calyx glabrous, four-ribbed, with four minute deltoid ciliate teeth; corolla bronzy red before opening, white when open, with four short lobes, the division between the lobes not exceeding one-third the length of the corolla; stamens, ten to sixteen, with glabrous filaments, connate only at the base; ovary four-celled, glabrous; style glabrous. Fruit, ripening late in autumn, and persisting on the tree in winter; ellipsoid, $1\frac{1}{2}$ in. to 2 in. long, with four broad wings; stone obovate, obscurely ridged; seeds rounded at the narrow ends.

This species as seen in cultivation is very variable; and the following hybrids or varieties are known:—

1. *Halesia stenocarpa*, Koch, in *Wochenschr. Gärtn. u. Pflanzenk.* i. 190 (1858), and *Dendrologie*, ii. pt. i. 200 (1872).

Leaves similar to the type in shape, consistence, and pale colour beneath; but with more distinct serrations, and with sparser stellate pubescence on the lower surface. Flowers: corolla deeply divided to near the base into four lobes; filaments with scattered hairs, connate at the base or at some distance above it; ovary and style glabrous. Fruit with four narrow wings.

This is intermediate between *H. carolina* and *H. diptera*; and, as Koch points out, is probably a hybrid. It has the deeply partite corolla and hairy filaments of the latter species, but resembles the former in foliage. The wings of the fruit are four in number, as in *H. carolina*, but are much narrower than in that species.

This variety or hybrid occurs in the wild state, as shown by specimens from Carolina and Florida in the Kew Herbarium. It appears to be much commoner in cultivation¹ than the species. All the old trees in England, and one in the Botanic Garden at Berlin dating from the time of Willdenow, belong to *H. stenocarpa*.

2. Var. *mollis*, Lange, in *Bot. Tidsk.* xix. 1, p. 258, fig. 2, a-g (1894).

Leaves in shape, colour beneath, and minute serrations, similar to the type, but densely tomentose with stellate hairs on the lower surface. Corolla² deeply divided to near the base into four lobes; filaments pubescent. Fruit as in the type.

This, which mainly differs from the typical form in the deeply divided corolla, is of unknown origin. It is represented at Kew by a shrub about 5 ft. high, which was planted in 1887.

3. Var. *glabrescens*, Lange, in *Bot. Tidsk.* xix. 1, p. 257, fig. 1 (1894).

Leaves narrowly elliptic, up to 6 in. long and 2 in. broad, gradually tapering to a long acuminate apex, sparingly stellate-pubescent beneath. Corolla² with four shallow lobes. Fruit with four very narrow wings.

This, the origin of which is unknown, is represented at Kew by a dense shrub, about 12 ft. high, which suckers very freely, and produces flowers and fruit, as described above.

4. Var. *Meehani*, Sargent, in *Garden and Forest*, v. 611 (1892).

Halesia Meehani, Meehan, in *Garden and Forest*, v. 534, fig. 91 (1892).

A round bush, attaining about 12 ft. in height. Leaves thick, wrinkled, pale, and on young vigorous plants often conspicuously glandular-serrate. Flowers smaller than in the type, with a short calyx-tube, and a cup-shaped corolla not narrowed at the base; pedicels not exceeding $\frac{1}{2}$ in. in length.

This was found in Meehan's nursery at Germantown, Philadelphia, as a solitary plant in a bed of seedlings raised from the seed of a tree of *H. carolina*. It bore fruit abundantly, and one of the seedlings raised from it seemed exactly similar to *H. carolina*. According to Wyman,³ the flowers last longer than in the other kinds of *Halesia*. It is not in cultivation, so far as I know, in England. (A. H.)

DISTRIBUTION

H. Carolina was first described by Catesby in the *Natural History of Carolina*. It ranges from the mountains of West Virginia to southern Illinois, and south-

¹ *Halesia tetraptera*, var. *dialypetala*, Reuber, in *Mitt. Deut. Dend. Ges.* 1907, p. 75, described from a tree in the Arnold Arboretum, is probably *H. stenocarpa*.

² Lange describes the corolla in var. *mollis* as divided to the middle, and in var. *glabrescens* as deeply divided to the base; but in specimens at Kew identical in other respects with these varieties, the corolla is as stated above. It is possible that the flowers may vary in these varieties, when they are raised from seed.

³ In Bailey, *Cyc. Amer. Hort.* 710, fig. 1017 (1900).

ward to Florida, Alabama, and Mississippi. It grows on rich wooded slopes and river banks, attaining its largest size in the forests on the western slopes of the southern Alleghany Mountains, where it sends up tall straight trunks, sometimes 3 ft. in diameter and 50 to 60 ft. high.

Sargent says that the wood is light, soft, and close-grained, of a light-brown colour, but it does not seem to have any special use or value in America, and is not mentioned in Hough's *American Woods*.

This species, or the form *H. stenocarpa*, was introduced in 1756, when John Ellis raised plants from seeds sent from America by Dr. Alex. Graham. The plant figured as *H. tetraptera* by Sims, *Bot. Mag.* t. 910 (1805), shows the petals deeply divided to the base, and is *H. stenoptera*; and all the old trees that we have seen are of this form.

Though one of the most ornamental flowering deciduous trees that we have, the Snowdrop tree has never become common in cultivation, and like many old favourites has been neglected for the numerous new introductions from China and Japan. Though usually seen rather as a shrub than a tree, it has in a few places attained such large dimensions that it may rank with *Arbutus*, *Laburnum*, and *Magnolia* among trees of the third rank in size, but of the first in beauty. It seems to thrive best in a warm sandy loam, free from lime; to require a long and warm summer to ripen its wood properly; and to be proof against the most severe frosts when well established in the south and east of England. It ripens seeds in warm summers only, but I have not succeeded in raising plants from English-grown seeds.

Loudon records the finest trees known to him at Purser's Cross and Syon, 30 ft. high and 4 to 4½ ft. in girth, but these seem to be no longer living. The tallest that we have seen is in an outlying part of the woods at Pains Hill, where a tree, forked at the base and almost prostrate, is 48 ft. from the root to the top. The two stems were 3 ft. 6 in. and 3 ft. 2 in. in girth; and the tree was bearing fruit when I saw it in 1908.

Another very large tree grows in the grounds of Mr. Boardman, Town Close House, Norwich, and when figured by Grigor in 1841 was 29 ft. high and 4 ft. in girth, with a circumference of 33 yards. When I saw it in 1908 it was 32 ft. by 6 ft. 3 in., forking at about 4 ft. from the ground; and one of the limbs was 4½ ft. in girth. Its fruit was nearly ripe in October. There is a handsome tree at Leonardslee, about 25 ft. by 2 ft., with a clean stem 15 ft. long. There is a fine specimen in Colonel Duncombe's grounds at Waresley Park, Herts, which is about 35 ft. high by 4½ ft. in girth. Mr. Wyndham Fitzherbert reports¹ a tree in a garden at Kidderminster, 28 ft. in height and 5 ft. in girth, with a spread of branch of 48 ft. He states that some small trees planted in decomposed peat made astonishing growth, attaining 20 feet in height in twelve years. At Milford Lodge, Craven Arms, there is a fine tree about 30 ft. in height.

We have seen no specimens in Scotland or Ireland. (H. J. E.)

¹ *Gardening Illustrated*, 19th November 1910.

MORUS

Morus, Linnæus, *Gen. Pl.* 283 (1737); Bureau, in De Candolle, *Prod.* xvii. 237 (1873); Bentham et Hooker, *Gen. Pl.* iii. 364 (1880); Bailey, *Cycl. Amer. Hort.* 1033 (1901).
Morophorum, Necker, *Elem. Bot.* iii. 255 (1790).

DECIDUOUS trees and shrubs belonging to the order Moraceæ. Leaves alternate, distichous, simple, stalked, serrate, with or without lobes; palmately three- to five-nerved at the base, pinnately nerved above; stipules lateral, lanceolate, early deciduous.

Flowers monœcious or diœcious, in solitary spikes,¹ which arise on the base of the current year's shoot in the axil of a leaf or of a deciduous scale; calyx deeply divided into four lobes; corolla absent. Staminate spikes elongated, cylindric; stamens four, inserted opposite the rounded calyx-lobes, beneath the minute rudimentary ovary; filaments ultimately exerted, uncoiling like a spring at the moment of dehiscence of the two-celled anthers, and forcibly scattering the pollen. Pistillate spikes short, oblong; ovary sessile, one-celled, with a solitary pendulous ovule; style divided nearly to the base into two stigmatic lobes. Each ovary results in an achene, enclosed in the calyx, which becomes thickened and fleshy. The whole mass of achenes, closely packed together in one spike, forms a multiple fruit, the mulberry superficially resembling a blackberry (*Rubus*), but very different in structure.

In winter, the species of *Morus* show the following characters:—No terminal bud is formed, the tip of the branchlet dying off in early summer, and leaving a scar at the apex of the twig. Buds all axillary, arranged in two ranks, ovoid, acuminate; scales, five to seven, closely imbricated in two ranks, the inner accrescent and falling in spring, marking the base of the shoot with ring-like scars. Leaf-scars on prominent cushions, nearly circular, concave with a slight rim, marked on the surface by an irregular group of dots. Stipule-scars linear, one on each side of the leaf-scar.

About eight species of *Morus* are known, occurring in North America, Central America, Western South America, Western Asia, China, Japan, Indo-China, and the high mountains of the Indian Archipelago. Three species have been long in cultivation which are distinguishable as follows:—

1. *Morus nigra*, Linnæus. Native country uncertain, probably Western Asia.

See p. 1606.

¹ Androgynous spikes have often been observed on *M. alba* and *M. rubra*, growing in the Arnold Arboretum. Cf. *Garden and Forest*, viii. 223 (1895).

Leaves rarely lobed, deeply cordate at the base, shortly acuminate at the apex; margin ciliate; lower surface pubescent throughout.

2. *Morus rubra*, Linnæus. North America. See p. 1608.

Leaves rarely lobed, slightly cordate at the base, contracted above into a long acuminate apex; margin slightly ciliate; lower surface pubescent throughout.

3. *Morus alba*, Linnæus. China, Japan. See p. 1609.

Leaves often lobed, variable in size and shape, thinner in texture than those of the preceding species; margin non-ciliate; lower surface glabrous, except for pubescence on the midrib and nerves.

The following species, lately introduced, may be briefly noticed:—

4. *Morus cathayana*, Hemsley, in *Journ. Linn. Soc. (Bot.)* xxvi. 456 (1894).

A tree, about 20 to 30 ft. high. Young branchlets densely pubescent. Leaves large, 4 to 5 in. long, ovate, cordate, cuspidate-acuminate, usually without lobes, crenate in margin; very scabrous above with minute blackish tubercles; lower surface softly pubescent throughout. Fruit, cylindrical, 1 in. long; styles as long as the ovary.

This was discovered by me in 1888 in the mountain forests of western Hupeh in China. It has lately been introduced by Wilson; and a plant at Kew, obtained from the Arnold Arboretum in 1907, is about 4 ft. high. (A. H.)

MORUS NIGRA, BLACK MULBERRY

Morus nigra, Linnæus, *Sp. Pl.* 986 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1343 (1838); Bentley and Trimen, *Medicinal Plants*, t. 229 (1880); Willkomm, *Forstl. Flora*, 541 (1887); Mathieu, *Fl. Forestière*, 292 (1897).

A tree, attaining about 50 ft. in height. Bark thick, fissured into broad scaly plates. Young branchlets with a scattered downy pubescence. Leaves (Vol. IV. Plate 267, Fig. 1), subcoriaceous, 4 to 6 in. long, 3 to 5 in. wide, broadly ovate, deeply cordate at the base, acuminate at the apex; upper surface dark green, shining, with scattered short pubescence; lower surface pale green, covered throughout with a short downy pubescence; margin ciliate, with coarse triangular serrations; petiole $\frac{3}{4}$ in. long, pubescent. Staminate spikes, $\frac{3}{4}$ to $1\frac{1}{2}$ in. long. Pistillate spikes, $\frac{1}{2}$ in. long, on a short pubescent peduncle; style and stigmas pubescent. Fruit, about 1 in. long, black, very shortly stalked.

Lobed leaves¹ are rarely seen on adult trees, but are usual on root-suckers.

The native country of the black mulberry cannot be ascertained with certainty.² It has been cultivated in southern Europe from a very early period, but there is no evidence that it is indigenous in Italy or Greece. Boissier³ and De Candolle⁴ suppose it to be truly wild in the districts in Persia, bordering on the Caspian Sea; but

¹ Var. *laciniata*, Loudon (*M. laciniata*, Miller, *Dict.* ed. 8, No. 2 (1768)). This is only an individual variation, and cannot be retained as a distinct variety.

² Hehn, *Wanderings of Plants and Animals*, 290 (1888), states, without giving any evidence, that the mulberry is a Medo-Persian tree.

³ *Fl. Orient.* iv. 1153 (1879).

⁴ *Origin of Cultivated Plants*, 152 (1886).

Koch¹ never found it in the wild state in all his travels in the Orient; and Radde² states that it is only naturalised in the Caucasus.

According to Loudon, it was first introduced³ into England in 1548, when a few trees were planted at Syon, one of which still survives. Canon Ellacombe,⁴ however, believes that its introduction was much earlier, and adduces in support of this, that *morat*, a favourite drink in Anglo-Saxon times was a kind of mead, flavoured with mulberries. *Morus*, however, signified blackberry as well as mulberry; and *morat* may have been flavoured with blackberries. (A. H.)

Though the mulberry was often planted in old gardens and the remains of some still exist which may be over 300 years old, we are unable to find a tree of great size or age which is not more or less decayed at present.

The oldest, supposed to have been planted in the sixteenth century at Syon House, by the botanist Turner, was in Loudon's time 22 ft. high, and still exists; and though a wreck is one of the largest we know. Loudon speaks of one at Wardour Castle 40 ft. high, but I could find no trace of it when I was there in 1904. Among the drawings of the late E. Lees, there is one made in 1858 of a tree at the White Ladies, Worcester, partly prostrate, which seemed of unusual size, but I cannot hear whether it still exists. At Wotton House, Gloucester, a fine tree, 11 ft. in girth at 3 ft. from the ground, is said to have been planted by Queen Elizabeth. At Stoke Edith, Herefordshire, I saw in 1905, a very old tree with a prostrate trunk which had thrown up several stems. In front of the headmaster's house at Eton, Henry measured, in 1907, a tree 30 ft. by 8 ft. 3 in. There are old trees at Christ's, Jesus, and Emmanuel Colleges at Cambridge, which may have been planted in obedience to the edict of James I. in 1605, recommending the cultivation of silkworms and offering mulberry seed to all who would sow them. Christ's College purchased 300 trees in 1608. There are old trees at Dunster Castle and at Pembroke College, Oxford. One at Abington Park, Northamptonshire, is said to have been planted in 1778, by David Garrick.

In Scotland it exists on walls, but rarely fruits. In Ireland we have seen no large specimens, but Loudon mentions one in the grounds at Terenure, near Dublin, which was 25 feet high with a head 130 ft. in circumference.

The mulberry is a tree which has lost its former popularity in this country, and is now seldom planted, but as it requires more heat and sun than it usually gets in England, it is better⁵ on a wall than as a standard, if grown for its fruit. It is perhaps best propagated by means of large cuttings, which soon take root, and its fruiting is improved by careful pruning. It ripens seed in hot seasons, but the seedlings are very slow in growth, some that I raised in 1901 from home-grown seeds being now only 2 to 3 ft. high, as their young wood ripens badly.

The wood of the mulberry is very like that of Robinia in texture, colour, and useful properties; but yellow when fresh, it acquires in the course of time a brownish

¹ *Dendrologie*, ii. pt. i. 444 (1872).

² *Pflanzenverb. Kaukasuslând.* 182 (1899).

³ In *Gard. Chron.* 1868, p. 79, it is said that title-deeds, in the possession of Sir Henry Austen, showed that a mulberry tree, which was formerly growing at Shelford, was planted as a sapling in 1537.

⁴ *Plant-lore of Shakespeare*, 176 (1896).

⁵ Cf. Williams, in *Trans. Hort. Soc.* ii. 91 (1817.)

red tint, while that of the Robinia becomes brownish yellow. On a transverse section the pores of the outer part of each annual ring are minute and occur in groups, while in Robinia they are considerably larger in size and scarcely grouped. The sapwood is narrow, only 3 to 5 annual rings, and is white in colour. The wood is used in France for cooperage, wheelwright's work, vine props, and trenails. It takes a good polish and is often used for making furniture. The bark yields a fibre, which is sometimes used for cordage. Mulberries are used medicinally for the preparation of a syrup.¹

(H. J. E.)

MORUS RUBRA, RED MULBERRY

Morus rubra, Linnæus, *Sp. Pl.* 986 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1359 (1838); Sargent, *Silva N. Amer.* vii. 79, t. 320 (1895), and *Trees N. Amer.* 303 (1905).

Morus canadensis, Poirét, in Lamarck, *Encycl.* iv. 380 (1797).

Morus scabra, Willdenow, *Enum.* 967 (1809).

Morus tomentosa, Rafinesque, *Fl. Ludovic.* 113 (1817).

Morus riparia, Rafinesque, *New Fl.* iii. 46 (1836).

Morus reticulata, Rafinesque, *Am. Man. Mulberry Trees*, 28 (1839).

A tree, attaining in America 70 ft. in height, with a short trunk 10 to 12 ft. in girth. Bark dark brown, divided into irregular scaly plates. Young branchlets covered with a dense minute pubescence, glabrous in the second year. Leaves (Vol. IV. Plate 267, Fig. 3) 3 to 5 in. long, 2½ to 4 in. wide, broadly ovate or orbicular, usually abruptly contracted into a long acuminate apex; broad, rounded or slightly cordate at the base; coarsely serrate; dull green with a scattered pubescence above; light green beneath and covered with a soft downy pubescence; petiole ¾ in. long, pubescent. Staminate spikes pendulous, 2 in. long, on pubescent peduncles. Pistillate spikes, 1 in. long, on short pubescent peduncles, densely flowered; style glabrous, short, with long stigmatic lobes. Fruit, about 1 in. long, at first bright red, becoming dark purple or nearly black and sweet when ripe.

The leaves on ordinary branches are usually entire or with one or two lobes; but on vigorous young shoots are often deeply three-lobed with oblique and rounded sinuses.

1. Var. *tomentosa*, Bureau, in De Candolle, *Prod.* xvii. 246 (1873).

Leaves scabrous above, pale and tomentose beneath. Louisiana, Texas. A large-fruited form of this was introduced into cultivation in America by Munson in 1889, as the Lampsas mulberry.²

The Red Mulberry is widely distributed in North America,³ from southern Ontario and Massachusetts southwards to Florida, and westwards to Michigan, Nebraska, Kansas, and the Colorado river in Texas. It is most abundant and of its largest size in the basin of the lower Ohio river and on the foothills of the southern Alleghany Mountains. Sargent gives⁴ a good figure of a tree in Alabama, and

¹ Cf. Flückiger and Hanbury, *Pharmacographia*, 544 (1879).

² Bailey, *Cycl. Amer. Hort.* 1035 (1901).

³ A closely allied species, *M. tiliaefolia*, Makino, in *Tokyo Bot. Mag.* xxiii. 88 (1909) is found in Japan.

⁴ In *Garden and Forest*, vii. 24, fig. 3 (1894).

states that there was one at Augusta, Georgia, 20 ft. in girth at 3 ft. from the ground; but this large size is exceptional.

This species has been tried, but with indifferent success, for feeding silkworms in America. It is occasionally planted in the southern States for its fruit, which is mainly used for feeding pigs and poultry. Bailey,¹ however, states that three of the named varieties of fruit-bearing mulberries belong to this species, as well as a yellow-leaved variety which is cultivated for ornament.

M. rubra is said to have been introduced into England, early in the seventeenth century; but is now scarcely known in cultivation, the only specimen which we have seen being a small tree at Kew, which died two or three years ago.

The timber, according to Sargent, is orange-coloured, with a thick light-coloured sapwood, soft and coarse-grained; but tough and resisting decay in contact with the soil. It is occasionally used in the United States for fencing, cooperage, and boat-building. (A. H.)

MORUS ALBA, WHITE MULBERRY

Morus alba, Linnæus, *Sp. Pl.* 986 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1348 (1838); Willkomm, *Forstliche Flora*, 540 (1887); Hooker, *Fl. Brit. India*, v. 492 (1888); Mathieu, *Flore Forestière*, 290 (1897); Gamble, *Indian Timbers*, 634 (1902).

A tree, usually 30 to 40 ft. in height, but attaining, according to Mayr, much larger dimensions in Japan. Bark thick, fissured into broad scaly plates. Young branchlets with scattered minute pubescence. Leaves (Vol. IV. Plate 267, Fig. 2), thin and membranous, very variable in size and shape, ovate or oval, often with deeply indented sinuses, forming irregular lobes; base rounded, truncate, or widely cordate; apex obtuse, acute, or shortly acuminate; margin non-ciliate, irregularly serrate; upper surface shining, usually glabrous; lower surface dull green, pubescent on the midrib and nerves, elsewhere glabrous; petiole ¾ to 1½ in. long, glabrescent. Pistillate spikes on long slender peduncles; style glabrous or papillose, divided or not divided to the base into stigmatic lobes. Fruit, variable in size, ½ to 1½ in. long, white or reddish.

The seedling² has two cotyledons, raised above the ground, dark green above, pale beneath, about ⅓ in. long, tapering gradually to a short petiole, and faintly veined with a midrib and a few lateral nerves; primary leaves irregularly dentate.

No plant is more variable than *M. alba*; and possibly under this name are included two or three distinct species, natives of China and Japan, where the tree has been so long in cultivation, that it is almost impossible at the present day to distinguish the cultivated and possibly the hybrid forms, from those which are truly indigenous. For a complete account, Bureau,³ who enumerates sixteen main varieties, may be consulted. The following are worthy of note:—

1. Var. *mongolica*, Bureau, in De Candolle, *Prod.* xvii. 241 (1873).

¹ *Cycl. Amer. Hort.* 1034 (1901).

² Tureau, *Samen, Früchte, u. Keimlinge*, 53, 114 (1891).

³ In De Candolle, *Prod.* xvii. 238-245 (1873). Several of these varieties are now considered to be distinct species, as *M. serrata*, Roxburgh, *M. indica*, Linnæus, and *M. laevigata*, Wallich, which are wild in the Himalayas.

Leaves large, with three to seven lobes, and a long acuminate apex; serrations large, triangular, bristle-pointed. Fruit reddish in colour and insipid in flavour. This is common in the mountains around Peking, and was found by David near Jehol.

2. Var. *stylosa*, Bureau, in De Candolle, *Prod.* xvii. 243 (1873); Shirasawa, *Icon. Ess. Forest. Japon.*, ii. t. 6, figs. 1-11 (1908).

Morus stylosa, Seringe, *Desc. Muriers*, 225, t. 22 (1855).

Morus japonica, Audibert, *ex Seringe, loc. cit.*

A shrub rarely exceeding 10 ft. high. Leaves small, about 3 in. long and 1½ in. broad, very polymorphic, on the same individual simple, variously lobed or lacinate; serrations usually ending in long points; upper surface scabrous with short hairs; lower surface pubescent on the midrib and veins. Spikes slender; style twice as long as the ovary, dividing above into two pubescent stigmas. Fruit small, ½ in. long, reddish, with few achenes.

This, which is probably a distinct species, is wild throughout the mountains of central and western China; and also occurs in Korea and Japan. According to Seringe, it is tender in France; and Bailey says that it suffers when young in the northern United States.

3. Var. *tatarica*, Loudon, *Arb. et Frut. Brit.* iii. 1358 (1838).

Morus tatarica, Linnæus, *Sp. Pl.* 986 (1753).

A shrub or small tree, with numerous slender branches; leaves usually without lobes, broadly elliptic, obtuse at the apex, with blunt serrations.

This has been found in Russia, growing on tracts inundated by the Volga and the Don, apparently wild, but probably only naturalised. It is much hardier than the type; and was introduced in 1784 into England, and in 1875 into the United States, where in the western prairie States it is used as a windbreak, and for producing fence-posts and fuel.¹

Numerous varieties have arisen in cultivation:—

4. Var. *latifolia*, Bureau, in De Candolle, *Prod.* xvii. 244 (1873).

Var. *multicaulis*, Loudon, *Arb. et Frut. Brit.* iii. 1348 (1838).

Morus latifolia, Poiret, in Lamarck, *Encyc.* iv. 381 (1797).

Morus multicaulis, Perrottet, in *Ann. Soc. Linn. Paris*, 1824, p. 129.

A shrub, dividing near the base into many stems, and suckering very freely. Leaves large, usually without lobes, minutely tuberculate on the upper surface, which also shows here and there peculiar swellings. This is cultivated for feeding silkworms in southern and central China; and was introduced into France in 1821.

5. Var. *macrophylla*, Loddiges, *ex Loudon, Arb. et Frut. Brit.* iii. 1349 (1838).

This differs little from the preceding, except in habit, having a single stem.

6. Var. *venosa*, Delile, in *Bull. Soc. Agric. Hérault*, 1826, p. 13.

Leaves marked beneath with white prominent veins. This is said to have originated in Europe.

¹ Cf. Pinchot, *U.S. Forest Circ.* No. 83 (1907).

7. Var. *colombassa*, Seringe, *Descrip. Muriers*, 206 (1855). Leaves distant on the branches, small, thin, lobed.

8. Var. *pyramidalis*, Seringe, *Descr. Muriers*, 212 (1855). Branches vertical, similar in habit to the Lombardy poplar.

9. Var. *pendula*, Dippel, *Laubholzkunde*, ii. 10 (1892). Branches pendulous.

10. Var. *constantinopolitana*, Loudon, *Arb. et Frut. Brit.* iii. 1358 (1838).

Morus constantinopolitana, Poiret, in Lamarck, *Encycl.* iv. 381 (1797).

A tree with thick and twisted branches, resembling in habit *Robinia Pseudacacia*, var. *tortuosa*; leaves thick in texture. The origin of this peculiar form is unknown. It is well figured by Seringe, *Desc. Muriers*, 210, t. v. (1855).

The White Mulberry is undoubtedly a native of China, where it is common wild in the mountainous districts of the northern and central provinces. The cultivation of this species and the rearing of silkworms can be traced back to the remotest times of Chinese civilisation.¹ In Japan, where it is called *Kuwa*, several varieties of this species appear to occur wild; but the broad-leaved form, used for rearing silkworms, was probably introduced, with the art of sericulture, from China in the third or fourth century of our era. Mayr² states that *M. alba* grows wild and attains a large size in the virgin forests of central Yezo; and he measured a mulberry tree in the Bonin Isles 100 ft. in height and 10 ft. in girth.³

Complete details of the introduction of this species and the silk-worm industry into the Levant and Europe are given by Loudon, and need not be repeated here. The tree has been widely naturalised in many countries, as in Persia, Armenia, the Caucasus, Asia Minor, and in south-eastern Russia. It is only known in the cultivated state in Greece, Italy, and France.

The White Mulberry was introduced into England in 1596, but has apparently never succeeded in attaining a great size or age, the largest mentioned by Loudon being one at Syon, 45 ft. high and 6 ft. in girth in 1838. This tree no longer exists; but there are two young trees about 20 ft. high. Most trees which I have seen in this country are of small size and growing in botanic gardens, as at Kew, where the varieties are well represented. Elwes found a tree at Henham Hall, which was, in 1909, 20 ft. high with a head twenty paces round. Another at Beauport, Sussex, was 25 ft. by 3 ft. 3 in., and was bearing fruit in October 1911. This species is said⁴ to have set fruit in the open garden at Dalkeith in July 1894.

The finest specimen that I have seen in Europe, was growing on the roadside near Zvornik in the Drina valley in Servia, and measured 65 ft. by 8 ft. in 1909.

(A. H.)

¹ Cf. Bretschneider, *Bot. Sinic.* ii. 328 (1892).

² *Fremdländ. Wald- u. Parkbäume*, 485 (1906).

³ The mulberry of the Bonin Isles, which may be a distinct species (*M. indica*?), is known in Japan as *Shima-guwa*. It produces a rich yellow wood with beautiful markings, which is highly valued, and used for high-class cabinet-making. I purchased a board of this wood at a high price in Tokio, part of which is in the Cambridge Forestry Museum.—H. J. E.

⁴ *Trans. Bot. Soc. Edin.* xx. 237 (1894).

EUCALYPTUS

Eucalyptus, L'Héritier, *Sertum Anglicum*, 18, t. 20 (1788); Bentham and Mueller, *Flora Australiensis*, iii. 185 (1866); Bentham et Hooker, *Gen. Pl.* ii. 707 (1876); F. von Mueller, *Eucalyptographia*, decades i-x. (1879-1884); Naudin, in *Ann. Sc. Nat.* xvi. 337-430 (1883), and *Descript. Emploi Eucalpt. Europe*, 1-72 (Antibes, 1891); Masters, in *Gard. Chron.* xxi. 148 (1884), and ix. 176 (1891); M'Clatchie, *U.S. Dept. Agric. Forestry Bulletin* No. 35, pp. 1-106 (1902); Maiden, *Revision Genus Eucalyptus*, i. 1-24 (1903); Ingham, *Agric. Exper. Station, Berkeley, California, Bulletin* No. 196, pp. 1-114 (1908).

EVERGREEN trees or shrubs, belonging to the order Myrtaceæ. Bark on young trees smooth and peeling off; on old trees variable—(a) remaining smooth; (b) persistent and rugged at the base, but smooth on the upper part of the trunk and on the branches; (c) persistent and fibrous; (d) persistent, very hard, and deeply furrowed; or (e) persistent and dividing into separate scales on the trunk.

Leaves on young plants beyond the seedling stage, and also on suckers, opposite, horizontal, sessile, cordate: variable on adult trees, (a) in some species, remaining always opposite, horizontal, sessile, and cordate; (b) in other species, becoming alternate and stalked, after the first six or eight leaves on the seedling; or (c) in most of the species, remaining opposite for several years, subsequently becoming alternate and stalked. Usually the alternate leaves are similar on both surfaces, with the stalk twisted, so that the blade is placed in a vertical or oblique plane; but in a few species the upper surface of the alternate leaves is darker in colour than the lower surface, the petiole not being twisted, and the blade remaining in the horizontal plane. Leaves nearly always glabrous,¹ odorous, with pellucid or concealed oil-dots; venation pinnate, the branches always converging to an intra-marginal vein, which is either close to or at some distance from the edge.

Flowers usually in pedunculate umbels, rarely reduced to a single sessile flower; peduncles in most species solitary and axillary, or occasionally lateral at the base of the current year's shoot below the leaves, or in some species, clustered in terminal paniced umbels. Calyx of two parts: (a) the tube persistent, adnate to the ovary, and truncate and entire (or rarely 4-toothed) after the fall of the (b) lid or operculum, which covers the stamens in the bud. Petals none, unless represented in a few species by a membrane under the operculum. Stamens numerous,² inserted close to the edge of the calyx in several rows, free or rarely united at the base into four clusters, always deciduous; all fertile or some of the outer without anthers; filaments thread-like, usually inflexed (rarely straight) in the bud; anthers dorsifixed,

¹ In the seedlings of a few species the leaves and branchlets are hairy. In a few species the stalk is inserted above the base of the leaf, so that the blade is peltate; but this condition only persists in the adult foliage of one species.

² Kerner, *Nat. Hist. Plants*, Eng. trans., ii. 107, 449, 782 (1898), points out that the walls of the capsules of the Eucalypti are remarkably thick and strong, to protect the seeds against desiccation during long periods of drought. As, however, no rain occurs when the trees of most species are in flower, the pollen is left quite unprotected. There is no corolla, and the top of the calyx falls off, so that the whole of the stamens, often a hundred or more in number, are completely exposed.

their two cells parallel and distinct or divergent and confluent at their apex, opening usually by longitudinal slits, rarely by terminal pores. Ovary, free at the apex, two to six-celled; style long; stigma convex or flat, undivided; ovules numerous in each cell, the majority remaining unfertilised. Fruit, consisting of the enlarged truncate calyx-tube, enclosing a hard woody resinous capsule, which is provided with three to five valves, which are either wholly or partially exerted or entirely enclosed. Seeds numerous, but very few fertile; minute, polygonal, winged in a few species.

In Tasmania all the species take at least twelve months for the flower-bud to reach maturity, and another year for the fruit to perfect.¹ None of the species at low altitudes have any constant flowering period, and may be found in flower in any month of the year, one tree flowering at midsummer, while another beside it will not flower till winter. The flowers are fertilised by honey-feeding birds.

The leaves of all the species, and often the young branchlets, flowers, and fruits contain numerous oil-vesicles. The leaves of many species are distilled to yield this oil, which is variable in composition, but is volatile and antiseptic and used for pharmaceutical purposes.² The bark of several species exudes a resin,³ called *kino*, which contains tannin in commercial quantities; and it is on account of this resin, that the name gum trees was applied to the genus.

In many species of Eucalyptus and other genera of Myrtaceæ and Proteaceæ, which are natives of Australia, the leaf-blades, as was pointed out by R. Brown,⁴ are not placed horizontally like those of European broad-leaved trees; but are, by the twisting of their stalks, set vertically. This is a provision to lessen evaporation in the dry climate of Australia, since the narrow edge and not the broad surface of the leaf is directed towards the sun. In the Australian species of Acacia, the same adaptation is effected by the non-development of the blade of the leaf, the stalk becoming expanded, simulating the blade and forming a so-called phyllode, which is also directed vertically. In the Australian forests of Eucalypti and Acacias, the linear edges of the leaves and phyllodes cast little shadow, and sunlight streams on the ground. Behr⁵ describes a typical forest in South Australia, as follows: "As a rule a dense meadow sward, in most cases accompanied by a light park-like forest of gigantic Eucalypti, whose crowns, however, never meet. The smooth stems, freed from their outer layers of cortex, stand apart at definite and often regular distances."

The currently accepted opinion that some species of Eucalyptus in Australia are the tallest and largest trees in the world is based on records for *Eucalyptus amygdalina*,

¹ Rodway, *Wild Flowers of Tasmania*, 49 (1910), states, however, that *E. globulus* and many other species take two years from the first appearance of the bud to the fall of the operculum, and another two years to mature fruit. *E. calophylla* of West Australia flowers in a few months, and takes a year to produce ripe fruit. The seeds are retained and remain quite fertile for several years in the capsules, which open their valves often only when exposed to forest fires. Seedlings usually spring up in consequence in burnt-over lands. Most of the species also when killed by fire, rapidly regenerate by suckers from the roots.

² Cf. R. T. Baker and H. G. Smith, *Researches on Eucalypts* (1902). A complete set of oils of 109 species, with herbarium specimens of the timber and bark, are preserved in the Pharmaceutical Museum, Bloomsbury Square, London. Cf. *Pharmac. Journ.* 1904, p. 187.

³ This is called Australian or Eucalyptus kino, and is different from the officinal kino, which is produced by *Pterocarpus Marsupium*, a large deciduous tree of central and southern India. Cf. Flückiger and Hanbury, *Pharmacographia*, 894 (1879).

⁴ *Botany of Terra Australia*, i. 62 (1814).

⁵ *Linnea*, xx. 546 (1847). Schimper, *Plant Geography*, 495, 528, figs. 260, 261, 262 (1903) gives a general account of these forests, with pictures of the various types.

which were accepted as correct by Baron von Mueller, who states in his *Eucalyptographia* that four trees of this species were 415, 471, 410, and 420 ft. in height respectively. Dr. A. S. Ewart of the Melbourne University considers¹ that these measurements were grossly exaggerated; and instances the fact that the tree which many years previously D. Boyle had measured on the Dandenong range as 420 ft., was found by Fuller in 1889 to be only 220 ft. in height, with a girth of 48 ft. at six feet from the ground. Dr. Ewart states that although *E. amygdalina* (including *E. regnans*), is the tallest species in Australia, it rarely exceeds 300 ft. He gives as the maximum heights accurately recorded the following: a tree growing on the edge of a ridge found by Professor Kernot to be 302 ft.; others growing in thick groves, which were found by Perrin, Davidson, and Fuller to be 271, 294, 296½, 297, and 303 ft. The tallest Australian tree that has been correctly measured² appears to be one of *E. regnans*, on Mt. Baw-Baw, Gippsland, 91 miles from Melbourne, which Maiden³ gives as 326 ft. in height, and 25 ft. 7 in. in girth.

About 150 species of Eucalyptus are known, the greater part of which are natives of Australia and Tasmania, only three or four species occurring in New Guinea, the Moluccas, and Timor, and one species⁴ in the Bismarck Archipelago (New Britain) and the Philippine Islands.

The following notes deal shortly with some of the tender species,⁵ which have seemed to succeed in the British Isles for a time; but which we do not consider worthy of a lengthened notice.

Eucalyptus alpina, Lindley, a shrub confined to the summit of Mt. William, 5000 ft. altitude, fifty miles north of Melbourne. Planted out in Arran⁶ in 1884, it attained 14 ft. in height in eleven years, and seemed to be very hardy, flowering in the spring of 1888. It was, however, ultimately killed in 1894. At Kinloch Hourn, the seedlings which were planted out did not long survive.

E. amygdalina,⁷ Labillardière, a large tree abundant in Tasmania, and occurring in many localities in Victoria and New South Wales. There are three trees 20 ft. high, probably of this species, at Menabilly. Seedlings raised at Kinloch Hourn in 1890 were all killed in the winter of 1894-95, except one in a sheltered valley, which was cut to the ground, and died subsequently. Another batch of seedlings raised in 1895 were killed in 1899-1900. Planted at Cromla in Arran⁸ in 1895, it grew rapidly, and was 20 ft. in 1905. Mr. John Paterson, who sent a specimen branch, states that this tree was 30 ft. high in June 1911. We have a specimen from Brodick of a young tree planted out in 1909. At Abbotsbury, it was killed in 1908, when 20 ft. high, by 16° of frost. Mueller says that near Lake Maggiore in

¹ In *Phil. Trans. Roy. Soc. Series B*, vol. 199, p. 367 (1908). Cf. Hemsley, in *Gard. Chron.* xlvii. 69 (1910).

² The tallest tree in the world, that has been accurately measured, was the Redwood on Eel River, California, which was found by Sargent in 1896 to be 340 feet in height. Cf. our Vol. III. p. 692, and also p. 690, note 3.

³ Maiden, *Forest Flora*, ii. 161-165 (1907), gives accurate measurements of several trees that Ewart does not mention.

⁴ *E. Naudiniana*, Mueller. Cf. Maiden, *Revis. Gen. Eucalypt.* ii. 79 (1910). The distribution of this species is remarkable.

⁵ Some of these may be hardy in Mr. Heard's garden at Rossdohan in Kerry, and also in the Scilly Isles; but the climate of these localities is exceptionally free from frost.

⁶ Landsborough, in *Trans. Bot. Soc. Edin.* xx. 522 (1896). In *ibid.* xxiii. 147 (1905), Landsborough mentions a tree at Cromla in Arran, planted in 1895, which was 20 ft. high in 1905.

⁷ The tree recorded in *Gard. Chron.* xxvi. 790 (1886) under this name, as 60 ft. high at Fota, is *E. pauciflora*. Cf. p. 1632. The tree at Dalkeith, mentioned under this name in *Journ. Roy. Hort. Soc.* xviii. 76 (1895) was probably incorrectly named.

⁸ Landsborough, in *Trans. Bot. Soc. Edin.* xxiii. 148 (1905).

Italy, it endured a temperature of 18° Fahr., proving hardier than *E. globulus* or *E. rostrata*; and grew astonishingly fast, attaining a height of 60 ft. in nine years.

E. regnans, Mueller, closely allied to, if not a variety of, *E. amygdalina*, did not prosper in Arran¹; and seedlings were speedily killed at Kinloch Hourn.

E. Beauchampiana, Treseder, ex Masters, in *Gardeners' Chronicle*, xxxviii. 3, fig. 3 (1905), and xxxix. 174 (1906). This species was raised at Truro by Messrs. Treseder and Co., who inform us that they obtained the seed direct from New South Wales. They consider it to be hardier than the other species in their nursery, having withstood 20° of frost without injury. Their largest specimen is 30 ft. high and 18 in. in diameter; but has not yet flowered. This species was identified by Maiden, to whom I sent specimens, with *E. Stuartiana*,² Mueller, the Apple Eucalyptus of the cool tablelands of Victoria and New South Wales. Coming from this region, it is unlikely to prove very hardy; and was killed³ in the severe winter of 1908-1909, both at Wisley, where the temperature fell to 7.5° Fahr., and at Myddelton House, Herts, where the thermometer placed on the grass registered -1° Fahr. There is, however, a tree at Tregothnan, planted eight years, which was bearing fruit and measured 25 ft. high in February 1911. Another at Mount Usher, which was raised from seed obtained from the Sydney Botanic Garden in 1904, was 20 ft. high and bearing flowers in October 1911. There are two small trees about 15 ft. high at Menabilly, which are labelled *E. Stuartiana*; but differ from *E. Beauchampiana* in having glaucous foliage.

E. botryoides, Smith, the Bastard Mahogany of Queensland, New South Wales, and Victoria. A specimen of this planted⁴ in Arran in 1896 grew well for several years, but was ultimately killed by drainage from a manure heap. According to Mr. Birkbeck, this species bears more frost in winter than *E. globulus*, but less in spring. It was, however, killed at Abbotsbury in 1908.

E. citriodora, Hooker, a native of Queensland. According to Mr. Birkbeck, this only survived a few years out of doors at Menabilly; and seedlings were soon killed at Kinloch Hourn. It attained 25 feet at Tregothnan; but was killed to the ground in a severe winter.

E. ficifolia,⁵ Mueller, a native of New South Wales. This was reported⁶ to have flowered in the open air at Cove House, Tiverton, Devon; but Mr. W. North-Row informs us that this was an error, as the plant is growing in the border of a cool greenhouse. At Monreith, where it was growing on a south-east wall, it was killed⁷ in the severe winter of 1908-1909.

¹ Landsborough, in *Trans. Bot. Soc. Edin.* xx. 522. In *ibid.* xxiii. 149 (1905), a tree planted in 1892 is reported to have been, though cut by frost, 13 ft. high in 1905. The Rev. Dr. Landsborough informed Mr. Birkbeck that the tree at Roseneath, referred to *E. regnans* in *Gard. Chron.* xxvi. 715 (1886), was *E. viminalis*.

² *E. Beauchampiana* is erroneously referred by Masters to *E. cinerea*, Mueller. It is doubtful if the name *E. Stuartiana*, Mueller, can be retained for the "Apple Eucalyptus," as it was first applied by Mueller to another species. Cf. p. 1645, note 2.

³ *Journ. Roy. Hort. Soc.* xxxvi. 374 (1910).

⁴ *Trans. Bot. Soc. Edin.* xxiii. 149 (1905).

⁵ Figured by J. D. Hooker in *Bot. Mag.* t. 7697 (1900), from a specimen which flowered in a cool greenhouse at Arbroath, Scotland. There are two good trees in the Temperate House at Kew.

⁶ *Gard. Chron.* xlii. pp. 376, *Suppl. Illust.* and 418 (1907).

⁷ *Journ. Roy. Hort. Soc.* xxxvi. 374 (1910).

E. hæmastoma, Smith, a large timber tree of New South Wales and Queensland. Seedlings planted at Kinloch Hourn and in the Isle of Arran¹ were soon killed.²

E. leucoxydon, Mueller, the Iron-Bark of New South Wales, Victoria, and South Australia. This was killed at Abbotsbury in the severe weather of 1908. A tree at Rosssdohan, Kerry, of this species, as well as it can be identified from a barren branch, was 33 ft. by 2 ft. 3 in. in 1910.

E. obliqua, L'Héritier, the Stringy Bark, an immense tree, abundant in Tasmania and forming the great part of the hill forests, ascending, according to Sir J. D. Hooker, to 4000 feet; also common in Victoria, New South Wales, and South Australia. We have specimens, without flowers or fruit, from two trees at Menabilly, which are probably this species. The largest is reported to have been 40 ft. by 2 ft. 8 in. in January 1911; the smaller one being 26 ft. by 1 ft. 11 in. A tree at Tregothnan, planted about five years and 20 ft. high in 1911, may also be referred to this species. Seedlings did not survive at Kinloch Hourn; but Mr. T. A. Dorrien-Smith informed Mr. Birkbeck in 1894 that he had a thriving tree at Tresco, Scilly Isles, which was 30 ft. high and twenty years old. This species was killed at Abbotsbury in the severe weather of 1908. As it ascends to a high elevation in Tasmania, seeds from there should produce hardy plants; but it appears to be rare in collections, and possibly only lowland forms have been tried.

E. resinifera, Smith, a tall tree, occurring in New South Wales and Queensland, where it is known as Red Gum. This was recorded³ as one of the plants uninjured at Ventnor, Isle of Wight, in the severe winter of 1879-1880; but it is very doubtful if the tree was correctly named; and we have not seen or heard of any specimens of this species in the open air in the British Isles.

E. rudis, Endlicher, a native of West Australia. Planted out in 1887 at Cromla in Arran,⁴ it had attained 15 ft. high in 1895, when it lost all its branches and leaves. Afterwards it sprouted from the root, and was 22 ft. high in 1905. Seedlings planted out at Kinloch Hourn were speedily killed. At Bradfield, Devon, it was reported⁵ to have been cut to the ground in 1885; but it afterwards sent up strong shoots. It was killed at Abbotsbury in the severe winter of 1908.

E. stellulata, Sieber, a small tree, occurring in Victoria and New South Wales. This has produced flowers and fruit at Rosssdohan, Kerry; but it is unlikely to prove hardy anywhere except in the extreme west of Kerry or in the Scilly Isles. It has not been tried, so far as we know, except at Rosssdohan.

The following key, based on the characters of the foliage, will serve to distinguish the species in cultivation in the open air in Great Britain and Ireland, and includes only those which have attained a considerable age, and have borne flowers and fruit:—

¹ Landsborough, in *Trans. Bot. Soc. Edin.* xx. 524 (1896).

² A tree cultivated under this name at Abbotsbury is *E. urnigera*; and another so-named at Leonardslee is apparently a form of *E. Gunnii*, which has survived 26° of frost. Sir E. G. Loder has tried *E. globulus*, *E. coccifera*, *E. urnigera*, *E. pulverulenta*, *E. amygdalina*, and *E. viminalis*: but these are always killed by 20° to 24° of frost.

³ By Ewbank, in *Journ. Roy. Hort. Soc.* viii. 10 (1887).

⁴ Landsborough, in *Trans. Bot. Soc. Edin.* xx. 520 (1896), and xxiii. 149 (1905).

⁵ J. W. in *Gard. Chron.* xxvi. 754 (1886).

I. *Leaves on adult trees, opposite, sessile, cordate at the base.*

1. *Eucalyptus cordata*, Labillardière, Tasmania. See p. 1620.

Young branchlets quadrangular, glaucous, roughened with oil-glands. Leaves suborbicular or broadly ovate, 2½ in. long, 2 in. broad; both surfaces glaucous and roughened with numerous raised oil-glands; crenate in margin.

2. *Eucalyptus pulverulenta*, Sims. New South Wales, Victoria, and Queensland.

See p. 1622.

Young branchlets terete or angled, smooth. Leaves ovate, 1½ in. long and broad; glaucous, smooth; entire or slightly undulate in margin.

II. *Leaves on adult trees, alternate, stalked.*

* *Leaves 5 in. or more in length.*

3. *Eucalyptus globulus*, Labillardière. Tasmania, Victoria, and New South Wales. See p. 1623.

Young branchlets green, quadrangular. Leaves thick, lanceolate, very falcate, 6 to 9 in. long, 1 to 1½ in. wide.

4. *Eucalyptus pauciflora*, Sieber. Tasmania, South Australia, Victoria, and New South Wales. See p. 1631.

Young branchlets usually more or less covered with a glaucous bloom. Leaves thick, lanceolate, about 5 in. long and ¾ in. broad, usually falcate; main lateral veins longitudinal.

5. *Eucalyptus viminalis*, Labillardière. Tasmania, Victoria, South Australia, and New South Wales. See p. 1633.

Young branchlets green, very slender, with four linear ridges. Leaves narrowly lanceolate, 5 to 6 in. long, ½ to ¾ in. broad, falcate, tipped at the apex with a long slender curved or twisted filamentous point.

** *Leaves less than 5 in. long.*

(a) *Leaves and branchlets glaucous.*¹

6. *Eucalyptus coccifera*, J. D. Hooker. Tasmania. See p. 1635.

Young branchlets covered with a thick whitish bloom. Leaves lanceolate, 2½ to 3 in. long, ⅔ to ¾ in. wide, thick in texture, green or glaucous, tipped with a long slender curved point.

7. *Eucalyptus Gunnii*, J. D. Hooker. High altitudes in Tasmania, Victoria, and New South Wales. See p. 1638.

Young branchlets more or less glaucous. Leaves ovate-lanceolate, 2 to 2½ in. long, ⅝ to ⅞ in. broad, thick in texture, shining green, tipped with a short point.

(b) *Leaves and branchlets not glaucous.*

† *Leaf margin entire.*

8. *Eucalyptus whittinghamensis*, Nicholson. A hybrid, probably originating in Tasmania. See p. 1642.

Young branchlets¹ usually green, terete. Leaves lanceolate, 3 to 3¾ in. long, ⅝ to ¾ in. wide, usually straight, greyish green, entire in margin.

¹ Some of the descendants of *E. whittinghamensis* have glaucous branchlets.

9. *Eucalyptus acervula*, Miquel. Tasmania, Victoria, New South Wales, South Australia, and Queensland. See p. 1645.

Young branchlets green, terete. Leaves lanceolate, or ovate-lanceolate, 4 in. long, $1\frac{1}{4}$ in. broad, usually straight, dull green, often undulate in margin.

10. *Eucalyptus vernicosa*, J. D. Hooker. Tasmania. See p. 1646.

Young branchlets green, angled. Leaves alternate or sub-opposite, narrowly ovate or elliptical, $\frac{1}{2}$ to 2 in. long, $\frac{1}{2}$ to 1 in. broad, very thick and coriaceous, shining as if varnished on both surfaces.

†† Leaf-margin distinctly crenate.

11. *Eucalyptus Muelleri*, T. B. Moore. Tasmania. See p. 1647.

Young branchlets reddish. Leaves usually straight, lanceolate, 3 to 4 in. long, $\frac{3}{4}$ to 1 in. wide, thick in texture, shining polished green on both surfaces.

12. *Eucalyptus urnigera*, J. D. Hooker. Tasmania. See p. 1649.

Young branchlets green, tinged with red. Leaves ovate-lanceolate, 3 to $3\frac{1}{2}$ in. long, 1 to $1\frac{1}{2}$ in. broad, often falcate, thick in texture, dull yellowish green.
(A. H.)

CULTIVATION

If one may judge from the numerous references in horticultural literature to this genus, none has been more persistently tried in various parts of the country; and yet when we come to record the small number of trees which have endured our climate for more than a few years, it must be acknowledged that none has proved more disappointing. Even in those parts of the south and west where the thermometer only falls to 15° or 20° Fahr. at long intervals, not more than a few species have long endured, and possibly the absence of summer heat is the cause, quite as much as the cold and damp of winter. Though the Eucalypti seem indifferent as regards soil, and grow for a few years with great rapidity, yet with some exceptions they are short-lived, and die off suddenly after an inclement season, or blow down, when they become tall enough to be exposed to gales.

No one in England seems to have tried to graft the more tender species on stocks of the hardier ones, though, judging from experience in other genera, it might be possible to do this successfully.¹ On account of their leaves, flowers, bark, scent, and habit, all so unlike those of any European trees, they form an attractive feature in gardens and pleasure grounds; and are so easy to raise from seed, that the certainty of their death after a few years will not deter gardeners from planting them.

A great many species have been tried at different times in the open in the British Isles; but only a few have proved hardy even in the mild climate of the south and west; and the only really large and old trees which have survived are those at Powderham, Penmere, Garron Tower, and Whittingehame. The Whittingehame hybrid is perhaps the hardiest of all, and is the only species which has succeeded out of doors at Kew.

¹ In *Gard. Chron.* xxv. 145 (1899) an interesting article on this question will be found, largely taken from a paper by M. Felix Sahut in the *Annales de la Société d'Horticulture de l'Herault*, which should be consulted by any one wishing to propagate Eucalypti by budding or grafting.

Mr. Robert Birkbeck, to whom we are much indebted for information concerning the cultivation of this genus, has tried forty or fifty species at Kinloch Hourn, on the west coast of Scotland, and sums up his experience as follows:—" *E. vernicosa* is the hardiest of all the species; *E. Gunnii*, *E. coccifera*, *E. cordata*, and *E. urnigera* may be considered quite hardy; *E. globulus* will stand 15° of frost only; and *E. amygdalina* about the same. Both *E. viminalis* and *E. pauciflora* are more tender than *E. globulus*. *E. alpina* is slightly hardier, but is killed by 20° of frost." Mr. Birkbeck gives a long list¹ of species which completely failed at Kinloch Hourn, and tells us that *E. alpina*, *E. amygdalina*, *E. viminalis*, and *E. globulus* were killed at Inveraray.

At no place have more species been tried in the open air than at Lady Ilchester's garden at Abbotsbury, in Dorsetshire; and Mr. Kempshall, head gardener there, sent us a list of forty species, all of which succumbed in the cold winters of 1907 and 1908, except the following:—*E. coccifera*, *E. cordata*, *E. Gunnii*, *E. Muelleri*, *E. vernicosa*, and *E. urnigera*, the last named being in his opinion the hardiest species.

Mr. Birkbeck gives the following rules for their propagation and planting:—Raise them from seed under glass; pot when 2 or 3 in. high; repot often as they never do well after their roots are pot-bound. Give them some bone-meal, keep under glass till 3 ft. high, and plant out in good soil in May or June, when they are about two years old. Keep them well staked, as they are easily blown down, but keep the fastenings loose, as they increase in girth quickly.

When planting has to be done on a large scale, seedlings should be treated exactly like pines and other conifers, *i.e.* they should, when about 6 in. high, be transplanted in the nursery to promote the formation of lateral rootlets, which will render easy their establishment in the ground where they are to remain permanently. Seedlings should not be dried up when being moved, and ought to be transplanted in cool cloudy weather, and watered for some days afterwards.

With regard to economic planting of the Eucalypti in warmer parts of the world than our own islands, we cannot enter into any details concerning the selection of the proper species; and must refer our readers to the excellent papers of Naudin,² which deal with their cultivation in the south of France, and to those of M'Clatchie² and Ingham,² which give a complete account of the results already obtained in California, where many species have been tried. The admirable report³ on Cyprus by Mr. D. E. Hutchins, whose long experience in South Africa enables him to speak with authority, may also be consulted. (H. J. E.)

¹ A list of thirty-five species tried at Kinloch Hourn is given in *Trans. Bot. Soc. Edin.* xx. 525 (1896). Mr. Birkbeck wrote a further account of his experience in *Gard. Chron.* xxv. 84 (1899).

² See the titles of these papers at the beginning of this article. Cf. also *U.S. Forest Service Bull.* No. 87, pp. 1-47 (1911), which gives an account by Zon and Briscoe of the species which are planted in Florida, with notes on their cultivation.

³ D. E. Hutchins, *Report on Cyprus Forestry*, pp. 64-67 (London, 1909); cf. also the same author, in Flint and Gilchrist, *Science in South Africa*, 395-396 (Cape Town, 1905).

EUCALYPTUS CORDATA, TASMANIAN HEART-LEAVED GUM

Eucalyptus cordata, Labillardière, *Pl. Nov. Holl.* ii. 13, t. 152 (1806); J. D. Hooker, *Fl. Tasm.* i. 132 (1860), and *Bot. Mag.* t. 7835 (1902); Bentham and Mueller, *Fl. Austral.* iii. 224 (1866); Mueller, *Eucalyptographia*, Dec. viii. (1882); Masters in *Gard. Chron.* iii. 798, fig. 111 (1888); Maiden, in *Rep. Austral. Assoc. Advance. Science, Hobart*, 1902, p. 374; R. T. Baker, in *ibid.* p. 344; Rodway, *Tasmanian Flora*, 58 (1903); Parsons, in *Gard. Chron.* xlvii. 168, *Suppl. Illust.* (1910).

A small tree, rarely exceeding 30 ft. high in Tasmania. Bark smooth, the older bark being shed in scales. Young branchlets quadrangular, glaucous, roughened with reddish oil-glands. Leaves (Plate 365, Fig. 1) on adult trees, opposite, in decussate pairs, sessile; suborbicular or broadly ovate, averaging $2\frac{1}{2}$ in. long and 2 in. broad; cordate and clasping at the base; rounded or acute, rarely emarginate, at the apex, which is usually tipped with a short triangular point; similar in colour on both surfaces, green, or more or less covered with a whitish bloom; margin reddish, revolute, distinctly crenulate; oil-glands very numerous, unequal, pellucid, the larger ones roughening the surface as minute protuberances; lateral nerves few, slender, spreading from the midrib at an angle of 80° .

Flowers in axillary umbels of threes, usually glaucous; peduncle stout, glaucous, $\frac{1}{4}$ in. long; calyx-tube campanulate, sessile, $\frac{1}{3}$ in. long, covered with oil-glands, usually with two lateral ridges; operculum cap-shaped, rounded, with a short conical umbo; stamens all perfect, inflexed in the bud; anthers ovate, with distinct parallel cells. Fruit hemispheric, but slightly contracted at the summit, where it is about $\frac{1}{2}$ in. in diameter; glaucous and slightly roughened with oil-glands; rim narrow, slightly elevated; capsule deeply enclosed, the four valves when open scarcely reaching the level of the rim.

Seedling,¹ with a terete tuberculate stem; cotyledons slightly emarginate, three-nerved, transversely oblong; primary leaves sub-sessile, opposite, acute, followed by crenate sessile leaves.

This species was discovered in 1792 by Labillardière near Recherche Bay in Tasmania, and appears to be confined² to this island, where it is rare and local, being recorded also for Mount Brown, Huon Road, Campania, and the Tasman Peninsula. It is without any economic value, and has no popular name in the colony; but Rodway calls it Heart-leaved Gum. It sometimes remains shrubby, and bears flowers and fruit when only 3 ft. high; but is usually a small erect tree, occasionally attaining 30 ft. in height, according to Mueller, who adds that Mr. Coombs found a tree 50 ft. high and 18 inches in diameter on the Sandfly river.

E. cordata appears to have been early introduced, as Sir J. D. Hooker knew

¹ Lubbock, *Seedlings*, i. 531 (1892).

² It is said by Deane and Maiden, in *Proc. Linn. Soc. N.S. Wales*, 1901, p. 126, to occur at Rockley Road, near Bathurst in N.S. Wales; but the specimen, which I have seen from that locality in the Cambridge Herbarium, is *E. pulverulenta*; and R. T. Baker, in *Rep. Austr. Assoc. Advance. Sc. Hobart*, 1902, p. 344, considers that the Bathurst tree is certainly the latter species.

about sixty years ago a plant trained on a wall at Kew, of which there is a specimen in the herbarium, gathered in 1851. This tree was eventually killed by frost. This species often flowers under glass at Kew, forming a pyramidal tree,¹ about 15 ft. high, and is much used in the young state for bedding out.²

At Menabilly there is a fine tree, which Mr. Bennett reported to be 50 ft. high by $2\frac{1}{2}$ ft. at three feet from the ground in 1909. Colonel Trefusis tells us that at Porthgwithen,³ in the same county, it produces flowers and is 28 ft. high and 1 ft. 2 in. in girth. A. B. Jackson saw a tree at Heligan 30 ft. high in 1909. It is also growing at Redruth and at Pencarrow in Cornwall, and at Exeter, where it has frequently flowered; but is ultimately killed by 20° of frost.⁴ At Abbotsbury this species is very thriving, surviving the severest winters and freely producing seed from which seedlings have been raised.

At Myddelton House,⁴ Waltham Cross, Herts, it produces flowers, and, though killed every ten years or so, is so beautiful that it is well worth growing. There is a specimen in the Arboretum Herbarium, Kew, sent some years ago from Vicar's Hill, Lymington, by Mr. E. H. Pember; but this does not appear to be now living, and was probably killed by frost.

On the west coast of Scotland this is one of the hardiest species. It has thriven at Kinloch Hourn,⁵ where, planted in 1894, a tree which had twice lost its top in a storm, was 34 ft. by 1 ft. 10 in. in 1905. At Cromla,⁵ in Arran, a tree planted in 1894, was 26 ft. by 13 in. in 1905. Here the flower buds form in August, and expand early in March of the following year, this tree being one of the first to flower in spring. At Inverewe on the west coast of Ross-shire this species is very thriving, and of all the species which flowered early in 1910, this was the only one which was in fruit in December of that year. The trees here were raised by Mr. Osgood H. Mackenzie from seed ripened at Abbotsbury; and one of them in 1911 was 33 ft. high by 18 in. in girth, at ten years old.

In Ireland, Elwes saw a tree in flower at Castlewellan,⁶ about 20 ft. high in 1908. At St. Anne's, near Dublin, a specimen,⁷ which was planted out in 1904, has passed through one or two severe winters, and was 20 feet high in 1909. There are trees at Rostrevor of the same size, which flower freely. (A. H.)

¹ Raised from seed received from Hobart in 1888.

² *Gard. Chron.* xxiv. 191 (1898) and xlvii. 422 (1909).

³ *Ibid.* xlv. 403 (1909) and xlvii. 168, *Suppl. Illust.* (1910).

⁴ *Ibid.* xlv. 422 (1909), and *Journ. R. Hort. Soc.* xxxi. p. xci. (1906).

⁵ Landsborough, in *Trans. Bot. Soc. Edin.* xx. 520 (1896), and xxiii. 147 (1905). Mr. John Paterson, who sent a branch, informed me that this tree was 30 feet by 23 in. in June 1911.

⁶ The late Earl Aunesley sent a branch with flower buds to Dr. Masters in 1889. Cf. *Gard. Chron.* xxv. 58 (1889).

⁷ *Gard. Chron.* xlv. 403 (1909).

EUCALYPTUS PULVERULENTA, AUSTRALIAN HEART-LEAVED GUM

Eucalyptus pulverulenta, Sims, *Bot. Mag.* t. 2087 (1819); Bentham and Mueller, *Flora Austral.* iii. 224 (1866); Mueller, *Eucalyptographia*, Dec. viii. (1882); Howitt, in *Rep. Aust. Assoc. Advance. Sci.*, Sydney, 1898, p. 517, pl. xxvi.-xxix.; Deane and Maiden, in *Proc. Linn. Soc. N.S. Wales*, 1899, p. 465, and 1900, p. 110; Maiden, in *Proc. Linn. Soc. N.S. Wales*, 1901, p. 547; R. T. Baker, in *Rep. Aust. Assoc. Advance. Sci.*, Hobart, 1902, p. 345.

Eucalyptus cordata, Loddiges, *Bot. Cab.* t. 328 (1819) (not Labillardière).

Eucalyptus pulviger, A. Cunningham, in Field, *Geog. Mem. N.S. Wales*, 350 (1825).

A tree, attaining in Australia 50 ft. in height and 10 ft. in girth; but flowering when in a shrubby state. Bark light brown, persistent, somewhat fibrous. Young branchlets, terete or slightly angled towards the tip, covered with a white glaucous bloom. Leaves (Plate 365, Fig. 3) on adult trees, opposite, sessile, in decussate pairs, ovate, about $1\frac{1}{2}$ in. long and broad; cordate and clasping at the base; rounded or acute at the apex, which is tipped with a short triangular point; similar in colour on both surfaces, which are more or less covered with a whitish bloom; lateral veins slender, spreading from the midrib at an angle of 60° ; margin reddish, entire or slightly undulate; oil-glands numerous, mostly pellucid, not prominent or roughening the surface as in *E. cordata*.

Flowers glaucous, in axillary umbels of threes; peduncle stout, glaucous, $\frac{1}{8}$ in. long; calyx-tube sessile, turbinate, dotted with oil-glands, about $\frac{1}{8}$ in. long; operculum conic, tipped with an acuminate point; stamens all perfect, inflexed in the bud; anthers ovate, with distinct parallel cells. Fruit turbinate, about $\frac{1}{3}$ in. broad at the summit, glaucous, dotted with oil-glands; rim thick and convex; capsule slightly included, the three or four valves when open protruding beyond the orifice.

This species has thinner and smoother leaves than *E. cordata*, with their margin not crenate; the operculum of the flower bud is conical and long, while that of *E. cordata* is shorter and slightly convex; the fruits are smaller with more protruding valves than in the last-named species. The bark of the two trees is quite different, that of *E. pulverulenta* persistent and fibrous, while that of *E. cordata* is deciduous, smooth, and peeling off in ribbons.

1. Var. *lanceolata*, Howitt, in *Austr. Assoc. Advance. Sci.*, Sydney, 1898, p. 518.

Eucalyptus cinerea,¹ Mueller, in Bentham, *Fl. Austral.* iii. 239 (1866).

Eucalyptus nova-anglica, Deane and Maiden, in *Proc. Linn. Soc. N.S. Wales*, 1899, p. 616.

Eucalyptus Stuartiana, Mueller, var. *cordata*, Baker and Smith, *Researches on Eucalypts*, 105 (1902).

Leaves on old trees, lanceolate, 4 in. long, usually opposite, occasionally alternate.

E. pulverulenta is a native of Australia, where it was discovered by A. Cunningham on the Lachlan and Cox's rivers in New South Wales. The typical form of the species is widely diffused in the southern mountainous part of this colony from

¹ The type of *E. cinerea* comprises Cunningham's specimen from Lachlan river near Bathurst, and Mueller's specimen from Lake George, both localities in New South Wales. These specimens are, I think, intermediate between the typical form of *E. pulverulenta* and var. *lanceolata*.

Tumut to Berrima, and thence westerly to the Bathurst district. It also occurs near Lake George, and in Argyle and Camden counties; and is common in the Goulburn district. The lanceolate-leaved variety, which is known as Black Peppermint, is common over the greater portion of New England, and also occurs on the summit of Ben Lomond. Both the typical form and the variety occur in Gippsland in Victoria, at Buchan, near Walhalla, around Lake Omeo, and between the Avon and Mitchell's rivers.

Specimens of the lanceolate-leaved variety have been collected at Killarney and Stanthorpe in Queensland. This species appears to be always a small tree, of no economic value.

E. pulverulenta was introduced some years before 1819, when it was figured as *E. cordata* by Loddiges, who states that it only requires ordinary greenhouse protection in winter. It is, however, cultivated in the open air at Abbotsbury,¹ where it produces fruit freely, and is said to be hardy. It is also grown at Menabilly, where the best of five specimens is 32 ft. by 1 ft. 3 in.

E. pulverulenta has been much confused with *E. cordata*; and the trees recorded² at Braxted Park, Essex, which were said to have been 30 to 40 ft. high, and flowering freely in 1849-1851, were in all probability *E. cordata*.

E. pulverulenta did not succeed at Kinloch Hourn; and the tree³ planted in 1856 at Pirmill, Isle of Arran, must have died, as Dr. Landsborough does not mention it in his list of the Arran species in 1895.

Sir F. W. Moore tells us that a small plant at Kilmacurragh in Co. Wicklow appears to be perfectly hardy; and another at Mount Usher, about eight years old, was thriving and producing flowers in 1911. At Castlewellan,¹ Elwes collected a specimen from a tree 20 ft. high in 1908. (A. H.)

EUCALYPTUS GLOBULUS, BLUE GUM

Eucalyptus globulus, Labillardière, *Relation Voyage Recherche La Pérouse*, i. 153, *Atlas*, t. 13 (1799); J. D. Hooker, *Fl. Tasm.* i. 133 (1860); Bentham and Mueller, *Fl. Austral.* iii. 225 (1866); Mueller, *Eucalyptographia*, Dec. vi. with two plates (1880), and in *Gard. Chron.* xiv. 137, 213, 233 (1880); Bentley and Trimen, *Medic. Plants*, ii. t. 109 (1880); Hemsley, in *Gard. Chron.* ii. 784, *Supply. Illust.* (1887); Maiden, in *Austr. Assoc. Advance. Science*, Hobart, 1902, p. 372; Rodway, *Tasmanian Flora*, 58 (1903); Pinchot, *U.S. Dept. Agric. Forest Service*, *Circ.* No. 59 (1907).

Eucalyptus cordata, Miquel, in *Nederl. Kruidk. Arch.* iv. 140 (1859) (not Labillardière).

Eucalyptus diversifolia, Miquel, *loc. cit.*

Eucalyptus gigantea, Dehnhardt, *Cat. Pl. Hort. Camald.* 20 (1832) (not J. D. Hooker); Mueller, in *Nuovo Giorn. Bot. Ital.* xii. 47 (1880).

A tree, commonly attaining in Australia about 200 ft., rarely nearly 300 ft. in height. Bark smooth, greyish or bluish white, the outer layer peeling off in long ribbons. Young branchlets green, quadrangular, with four prominent ridges; older

¹ Both at Abbotsbury and Castlewellan, where both species occur, it was wrongly labelled *E. cordata*.

² *Gard. Chron.* xi. 469 (1892).

³ Landsborough, in *Trans. Bot. Soc. Edin.* xx. 524 (1896).

branchlets terete, reddish brown. Leaves (Plate 365, Fig. 10), on adult trees, alternate, lanceolate, about 6 to 9 in. long and 1 to 1½ in. broad, but often greater or less than these dimensions; falcate, thick and leathery, unequal and cuneate at the base, gradually tapering to an acuminate apex, which ends in a long curved slender point; margin revolute, whitish, undulate; both surfaces pale green and slightly shining; lateral veins numerous, arising at an angle of about 45°, with the circumferential vein regularly distant about $\frac{1}{16}$ in. from the margin; oil-dots scattered, unequal, mostly concealed; petiole twisted, flattened above, $\frac{3}{4}$ to 1½ in. long. Leaves on young plants and suckers, opposite, decussate, with a short and not twisted petiole; 2 to 5 in. long, 1 to 2½ in. broad; ovate, cordate at the base; acute or rounded at the apex, which is tipped with a cuspidate point; circumferential vein $\frac{1}{2}$ to $\frac{1}{8}$ in. distant from the white revolute crenate margin; both surfaces more or less covered with a glaucous bloom, which is also present on the slender four-angled branchlets.

Flowers¹ axillary, solitary or rarely two or three in an umbel, borne on a short laterally compressed stalk; flower-buds large and covered with a glaucous bloom; calyx-tube pyramidal, nearly $\frac{1}{2}$ in. long, $\frac{3}{4}$ in. wide at the distal end, with four longitudinal ridges, the lateral pair of which are very prominent; operculum hemispherical, exceeding the calyx-tube in breadth and length, very tuberculate on the surface, with a short triangular umbo; stamens all fertile; anthers ovate, with parallel cells; filaments inflexed in the bud. Fruit hemispheric or obpyramidal, glaucous, $\frac{3}{4}$ to 1 in. in diameter, with four longitudinal ridges, and an overhanging very broad rim, separated from the calyx by a furrow; capsule not sunk, the valves being nearly level with the rim.

The seedling² has a stem, terete at the base, and quadrangular towards the tip, warty on the surface and covered with a glaucous whitish bloom. Cotyledons deeply bifid, with obovate diverging lobes, about $\frac{1}{2}$ in. long and $\frac{2}{3}$ in. wide, three-nerved, the middle nerve ending in the sinus. Primary leaves, opposite, decussate, sessile, the first and second pairs linear-lanceolate and acute, tapering at both ends; third and fourth pairs lanceolate-oblong; fifth to eighth pairs oblong. Leaves on the subsequently developed branches, oblong, and subcordate at the base.

VARIETIES

According to Mueller,³ most of the Victoria specimens have smaller flowers and fruits, the latter more convex than those in Tasmania. According to Rodway,⁴ the common form in eastern Victoria bears three-flowered umbels; while in Tasmania the flowers are usually solitary. In cultivated specimens, however, the number of flowers in the umbel appears to be an inconstant character, though solitary flowers are usually borne in England. Rodway further states⁴ that in Tasmania, where this

¹ This species frequently flowers when very young. In *Gard. Chron.* xi. 180 (1892), a specimen three years old and 7 ft. high is said to have flowered in Thomson's nursery at Sparkhill, Birmingham.

² Lubbock, *Seedlings*, i. 530, fig. 339 (1892).

³ *Fl. Austr.* iii. 225 (1866).

⁴ In J. C. Penny, *Tasmanian Forestry*, 15 (905).

species and *E. viminalis* are mixed, a form is occasionally found, in which the flowers are in threes, with the operculum and fruit quite smooth, the latter only $\frac{1}{3}$ to $\frac{1}{2}$ in. in diameter, with the valves much protruding. This is possibly a hybrid.

DISTRIBUTION

The Blue Gum is a native of Tasmania, Victoria, and New South Wales. In Victoria, it occurs in valleys as well as on ridges and mountain slopes, chiefly in the humid southern and eastern districts from Cape Otway to Wilson's promontory, and extending northwards to the Hume and Tumut rivers in the southern part of New South Wales, where it is also met with between Braidwood and Araluen. It appears, however, to be very rare in New South Wales, as J. V. De Coque states¹ that he only knows of it in this colony in the Tumberumba district at 2500 to 3000 ft. elevation. There it is called *Eurabbie*, a purely local name, and is highly valued, and largely used for mining purposes, and for bridge-decking and girders. Except in the above district, it is little known in New South Wales, where it does not attain anything like the size and height that it does in Victoria or Tasmania; and recently fell into disrepute, owing to *E. amygdalina*,² which lacks strength and durability, having been mistaken for it. In Tasmania, it appears to be almost confined to the south-eastern part of the island near the coast, extending inland, according to Sir J. D. Hooker, from Hobart about forty miles. Rodway describes it as a tall erect tree, even in exposed situations, with few and acutely diverging branches. A tree of full growth will average 7 feet in diameter at the butt, 100 ft. to the lowest branch, and from 200 to 250 ft. in extreme height. In youth it grows rapidly; but when approaching maturity the growth is almost imperceptible; and Rodway supposes that the tree takes 300 to 400 years to attain its full dimensions. The Rev. J. E. Tenison-Woods says³ that in Tasmania the forests of blue gum are limited in extent, and are confined to a few localities, from sea-level to about 1000 ft. altitude. It is only on steep slopes in the deep mountain valleys and gorges that the trees attain a great height. He states that experiments have shown that the trees make two rings of growth each year; and that Mr. Hill, who cut up thousands of trees at his saw-mills at Honeywood, affirmed that he never found one over 75 years old; but this statement seems doubtful.

HISTORY

E. globulus was discovered in 1792 by Labillardière in Tasmania, and was described by him in 1799. It was introduced into continental conservatories early in the 19th century, where, on account of its different foliage in the young state it was known under several names.⁴ It appears to have been first cultivated out of

¹ In *Journ. Proc. Roy. Soc. N.S. Wales*, xxviii. 212 (1894).

² *E. Maidenii*, Mueller, another species also known as Blue Gum, has until recently been often confused with it.

³ In *Journ. Roy. Soc. N.S. Wales*, xii. 17-28 (1879). Cf. also *Gard. Chron.* xiv. 179 and 187 (1880).

⁴ *E. glauca*, De Candolle, *Prod.* iii. 221 (1828); *E. pulverulenta*, Link, *Enum. Pl. Berol.* ii. 31 (1822) (not Sims); *E. perfoliata*, Noisette, *ex Steudel, Nomencl.* 320 (1821); and possibly *E. perfoliata*, Desfontaines, *Cat. Hort. Paris*, 408 (1829).

doors in Europe at Camaldoli, near Naples, where the German gardener, Dehnhardt, employed at the Naples Botanic Garden, published it as *E. gigantea* in 1832. The tree, however, was only known as a curiosity, till Mueller sent large quantities of seed, gathered at the base of Mount Butler in 1853, to nearly all the botanic gardens of Europe. Probably from this seed, most of the earliest plants¹ were raised in Algeria, where the blue gum produced flowers for the first time in 1863. M. Prosper Ramel began in 1858 to extend the cultivation of this tree in the south of France, receiving large quantities of seed from Mueller.

The well-known plantations in the Campagna near Rome were commenced in 1879 by the Trappist monks of Tre Fontana, who received the first seed in that year from Mueller, through Dr. Goold, R.C. Archbishop of Melbourne. The blue gum was introduced in 1865 into Spain, where it became known as the fever tree, because it was believed in Spain, as in Italy, "to purify marshy regions that engender fever." The tree is also largely planted in the Nilgiri hills in India, where it is said to have been introduced as early as 1843. According to Mr. M'Clatchie, it was the first species of Eucalyptus planted in California, and the one that has been most successfully grown. The date of introduction there appears to have been 1856, when Mr. Walker planted fourteen species; but the cultivation of Eucalypti on a large scale in California is due to Mr. Nolan, a nurseryman of Oakland, who received a large supply of seed of several species from Australia in 1861. It is commonly planted in Chile, where in some parts of the country it has attained a great size, and is an important timber and shade tree.

With regard to the growth of the blue gum in foreign countries, Mueller states,² that a tree at Gaeta, planted in 1854, was 100 ft. high and 11 ft. in girth at the base in 1878. Dr. W. von Hamm of Vienna saw larger trees on Lake Maggiore, one³ of which, supposed to be twenty-eight years old, was 120 ft. high in 1878. At Hyères, a tree raised from seed in 1857, had attained in 1875 a height of 67 feet with a girth of 7 ft. near the base. Farther south, the growth is still more rapid, a tree at Malaga having attained 65 feet in six years. The greatest rapidity of growth occurs at considerable altitudes on the mountains of the tropics, where the climate is temperate and equable, combined with continuous humidity of the atmosphere. At Arambi, near Ootacamund in the Nilgiris in India, the blue gum attains a height of 107 ft. in nineteen years, and yields 8696 cubic feet per acre, equal to 457 cubic feet annually per acre at 7426 feet above sea-level in lat. 11° N.⁴ In California, according to M'Clatchie,⁵ trees about thirty years old have attained 150 ft. in height and 3 to 6 ft. in diameter. He gives a plate of an avenue at Santa Barbara, where the trees, planted thirty years ago, range from 3 to 5 ft. in diameter. M'Clatchie also says there are many instances of blue gums attaining 50 to 75 ft. in from five to ten years; and adds that it is without doubt the fastest-growing tree in the world.⁶

¹ Planchon, according to Mueller, states that the first plants in Algeria were raised in 1854, from seed sent by the Jardin des Plantes, Paris, which may have come from Hohart direct.

² *Eucalyptographia*, dec. vi. (1880).

³ Sir D. Brandis, quoted in *Kew Bull.* 1895, p. 3.

⁴ Ingham, in *Agric. Exp. Sta. Berkeley, Calif., Bull.* No. 196, p. 77 (1908), gives equally remarkable records; a plantation of 319 trees, set out 8 ft. apart on medium loam at Vacaville, averaged, at twenty-five years old, 125 ft. high and 14½ in. in diameter at breast height.

⁵ We are unaware of the existence of any such trees now.

⁶ *Eucalypts cultivated in the U.S.* p. 61, fig. 21 (1902).

The Eucalyptus was first planted in the Campagna and in other malarious districts on account of its supposed febrifuge action. At that time, it was not known that malaria is due to a parasite in the blood, which is carried to man by the bites of mosquitoes. The Eucalyptus plantations have indirectly, however, done good in two ways, by drying up the pools in which the mosquitoes breed, and by forming a screen, which hinders their flight.¹

Hutchins² says that it is not worth planting in Cyprus, as it will not succeed in the drier parts, and is second rate for its timber in wetter soils. Its wood burns badly in an open fireplace. (A. H.)

REMARKABLE TREES

E. globulus is perhaps not absolutely hardy in any part of Britain or Ireland; but it may survive many years and attain large dimensions in favourable localities.

The largest tree of which we have any record, grew at Rozel Bay, Jersey, about 200 yards from the sea on rock covered with little soil, but in a warm and dry situation. It was planted in 1862, and was reported³ by Mr. T. Sharman to have been 110 ft. high and 10 ft. 3 in. in girth in 1892. It produced flowers and fruit freely, from which seedlings were raised several times. It was killed⁴ by the severe frost of 1894-1895.

The oldest tree was one at Tresco, Scilly Isles, which was planted about 1850. It never reached more than 40 ft. in height, as the top was blown off from time to time, but it was 9 ft. in girth in 1891, when it was blown down.⁵ One of the best that I have seen in England is at Coombe Royal, Devonshire. Though only twelve years old in 1906, it was a tall straight tree, about 50 ft. by 2½ ft.⁶

At Menabilly, Mr. Bennett tells us of a tree, which was 75 ft. high by 3 ft. in girth in January 1911. There are two well-shaped trees in Sir Thomas Bazley's garden at Kilmorie, Torquay, which in October 1910 measured 58 ft. by 2 ft. 9 in. and 53 ft. by 4 ft. The latter is figured (Plate 359) from a photograph taken by Sir Thomas Bazley, who informed me that they were planted in 1897.

At Penmere, near Falmouth, the residence of Mr. Horton Bolitho, there is a remarkably fine tree⁷ (Plate 360) which I measured in 1911, as 95 ft. high by 7 ft. 9 in. in girth, with the bole clear of branches for about 40 ft. Mrs. W. L. Fox informs me that this tree was planted between 1864 and 1867.

At Trevarno, Cornwall, a tree about eight years old was 25 ft. high in 1890, and bore flowers for the first time, in great profusion.⁸ Trees flowered and produced

¹ Cf. Sir W. T. Thiselton-Dyer, in *Kew Bull.* 1903, pp. 1-10.

² *Report on Cyprus Forestry*, 65 (1909).

³ *Gard. Chron.* xi. 468, and xii. 408 (1892).

⁴ *Ibid.* xxxix. 281 (1906). In *Gard. Chron.* xxv. 145 (1899), it is stated that the genus Eucalyptus was practically exterminated from Jersey in the severe winter of 1894-1895.

⁵ T. A. Dorrien-Smith, in *Gard. Chron.* x. 737, fig. 107 (1891).

⁶ The statement in *Gard. Chron.* xxxiv. 292 (1903), that the blue gum flourishes at Powderham, and makes a growth of 60 ft. in ten years, is erroneous, as the only species cultivated there now is *E. coccifera* (cf. p. 1636). *E. globulus* was killed at Powderham in 1878-79, by 12° of frost, according to *Gard. Chron.* xii. 113 (1879).

⁷ In *Gard. Chron.* xiii. 268 (1893), Mr. Howard Fox reported several trees at Penmere, 50 to 70 ft. high and 7 ft. in girth in 1893, which were flourishing in exposed positions. Mr. Fox says that at his own garden at Rosehill, which is sheltered, the trees grow too fast for their roots, and are blown down by a strong gale.

⁸ *Gard. Chron.* viii. 138 (1890).

fruit in 1898 at Polgwin,¹ Cornwall, and at Huntly,² Bishops Teignton; and in 1888 at Beaconhill House, Exmouth.³

In the Isle of Wight, according to the Rev. H. Ewbank,⁴ the blue gum was very early planted, and had attained a large size at Ryde and elsewhere; but all these trees were killed in the severe winter of 1881. The same applies, he says, to Bournemouth, where the trees thrive for a time, but are ultimately killed by a severe frost. At Ventnor, however, there were said⁵ to be specimens 40 ft. high in 1890, which produced flowers and fruit regularly.

At Kew, seed was obtained⁶ from Tasmania in 1888, which had been gathered from a few trees⁷ growing in a sheltered gully near Tullochgorum, the only spot in Tasmania where this species occurs naturally in a cold climate. The seedlings which were raised did not prove as hardy as those from the ordinary form of the species; and all died in 1889, though they were protected by canvas screens.

At Tan-y-bwlch, North Wales, several trees⁸ had attained 50 feet in height at nine years from seed, and flowered freely, but were seriously injured in 1890-91. Seedlings were reported to have been raised from their seed, when they were only seven years old.⁹ At Colwyn Bay, a tree was reported¹⁰ to be 33 ft. high in 1894. Another, at Cefnamwich, Nevin, North Wales, sown in the spring of 1894 by Mr. Hugh G. Jones, was 59 ft. by 4 ft. 8 in. in December 1909.

At Belvoir Castle, this species¹¹ was killed when 12 ft. high on 8th February 1900, when the thermometer fell to 10° Fahr.

In Scotland, the tree only lives for a few years, even in the warmest places. The Rev. Dr. Landsborough, in his account¹² of the Eucalypti in Arran, says that the severe winter of 1880-1881 killed all the blue gums on the mainland of Scotland, including those at Stonefield, Loch Fyne, and all in Arran, except a tree at Lamlash, which, however, was blown down in 1892, when it was more than 40 ft. high. A tree,¹³ however, at Tighnabruaich, Kyles of Bute, which was cut to near the ground in 1894-95, when the temperature fell to 19° Fahr., made fresh growth, and was 54 ft. by 3 ft. 9 in. in 1905. At Logan House, near Stranraer, a tree¹⁴ planted against the south wall of the house, in 1884, had covered the whole wall in 1899; and produced flowers and fruit in 1894, from which numerous seedlings were raised. Two trees planted here in the woods in 1897 were reported to be thriving, although 17° of frost was registered in November 1898. At Castle Kennedy, I saw in 1906 a tree about

25 ft. by 2 ft., which had grown from the stump of one killed by frost in 1895-1896. At Kinloch Hourn, *E. globulus*, when planted out, speedily succumbs, as, according to Mr. Birkbeck, it is always killed by 15° of frost.

In Ireland, the tallest specimen is at Dinas Island, Muckcross, Killarney, and measured in 1909 about 77 ft. by 6½ ft. The gardener informed me that it was severely injured by cold in 1879; but it was, when I saw it, a healthy tree in full flower in August. A finer tree, planted about 1870, grows on the lawn of the Marquess of Lansdowne's house at Derreen, Co. Kerry, and measured about 60 ft. by 7¼ ft. in August 1910. At Rossdohan, Mr. S. T. Heard reports a tree, 50 ft. by 5 ft. 8 in. in 1910.

At Garron Tower, on the coast of Antrim, near Larne, at 250 ft. elevation above the sea, a tree,¹ planted in 1857, was 60 ft. high and 12 ft. in girth at a foot from the ground in 1897; and 75 ft. high by 13 ft. at four feet from the ground in 1911. It branches at five feet up into two main stems; and produces flowers and fruit regularly, and from its seed numerous seedlings have been raised.

Sir Jocelyn Coghill, Bart., sent to Kew a branch from a tree grown at Glen Barrahan, Castle Townsend, Co. Cork, which, at fifteen years old, was about 40 ft. high in 1889. In Co. Wicklow Henry found a tree at Clonmannon about fifteen years old, which was 53 ft. by 4 ft. in 1905; and another at Dunran, 49 ft. by 4 ft. 4 in., and in flower in August 1904.

The largest tree that I have seen in Europe is in a sheltered ravine in the forest of Bussaco, Portugal, a little below the hotel. It measured in 1909 about 140 ft. by 12 ft.

TIMBER

In an account² of the forests of Tasmania, compiled by Mr. J. C. Penny, it is stated that the blue gum is the most valuable timber tree of Tasmania, having wood of great durability, hardness, and weight. It is said to be superior to anything produced in the Australian States for wharf and bridge construction. A specimen of this timber 146 ft. long, 18 in. wide, and 6 in. thick, sawn clear of heart and sap, was sent to the Exhibition of 1851 from Long Bay, Tasmania.

Mr. Harold J. Shepstone, in an article in the *Scientific American*,³ says: The erection of the great national harbour at Dover has called attention to the wonderful properties of the Tasmanian blue gum. It is at once one of the strongest timbers in the world, as well as the densest and most durable. It is so heavy that it will sink like a piece of lead, whilst also practically immune from the attacks of the sea-worm (*Teredo navalis*). It has a specific gravity of 75 lbs. to the cubic foot, and being heavier than water, piles 100 ft. long and 18 to 20 in. square can be sunk in deep water, without weighting them at the bottom, which is necessary in the case of Oregon piles (Douglas fir) weighing only 48 lbs. to the cubic foot. Tests

¹ G. Porteous, in *Gardening*, 13th November 1897. In *Journ. Roy. Hort. Soc.* viii. 189 (1887), the tree was reported to have been about 50 ft. high and quite uninjured by the severe winter of 1879-1880.

² *Tasmanian Forestry*, 3 (Hobart, 1905).

³ *Scientific American*, Jan. 21, 1905, quoted by Penny, *Tasmanian Forestry*, 36 (1905).

¹ *Gard. Chron.* xxiv. 322 (1898).

² *Ibid.* xxiii. 346 (1898). The large trees at Huntly, being too near the house, have been cut down. Mrs. Carpenter tells us that they flowered three times.

³ *Ibid.* iv. 133 (1888).

⁴ *Ibid.* xxv. 19 (1899). In *Gard. Chron.* xi. 212 (1892), *E. globulus* is said to have flowered abundantly in the shrubberies at Bournemouth when only 12 to 15 ft. high. These were all destroyed, when six to ten years old, by the severe winter of 1890-91.

⁵ *Ibid.* viii. 694 (1890).

⁶ Cf. *Kew Bull.* 1889, p. 61, and *Gard. Chron.* xii. 728 (1892).

⁷ From a letter to Kew from the Botanic Garden, Hobart, which gives these particulars, it appears that the seed behaved differently in Tasmania, as seedlings planted at Tullochgorum grew into large trees, when native to the district; whilst those raised from seed from the warmer part of the island all died.

⁸ *Gard. Chron.* xi. 247 (1892).

⁹ *Ibid.* vii. 170 (1890).

¹⁰ *Ibid.* xvi. 74 (1894).

¹¹ W. H. Divers, *Spring Flowers of Belvoir Castle*, 83 (1909).

¹² *Trans. Bot. Soc. Edin.* xvii. 23 (1889), and xx. 523 (1896). An account is given in *ibid.* xvi. 162 (1886) of a tree at Colintrave on the Kyles of Bute, which was 47 ft. high in 1881, when it succumbed to the severe frost of that winter.

¹³ *Ibid.* xxiii. 148 (1905).

¹⁴ *Gard. Chron.* xxv. 138 (1899).

carefully made have shown that it will bear about double the weight of English oak, and will remain sound under water for a very long period. These particulars have been confirmed; but I think the statement as to the comparative strength of English oak requires some explanation.

An instance is quoted of an old ferry-boat built of blue gum in 1818, that has been lying a wreck on the banks of the Derwent in Tasmania for more than fifty years, between high- and low-water mark, the timber of which is still quite sound.

For mining purposes, Mr. Griffen, Inspector of Mines at Launceston, Tasmania, says that it should occupy the first place; whilst Mr. Dudley of Hobart, who has forty years' experience of its use for bending and general wheelwrights' purposes, says that it is unsurpassed for felloes, spokes, shafts, and body-work. He prefers the timber of young trees, but states that it requires careful seasoning in closed sheds for two years after sawing, as it is very liable to crack and split if exposed to sun and wind when freshly cut. A diagram, showing the results of experiments made in 1899 for Messrs. Pearson by D. Kirkaldy and Son of London, is given by Penny in *Tasmanian Forestry*.

Experiments carried out¹ at Berkeley University, California, on the wood of the Eucalypti grown in that state, show that the fastest-growing species produce the strongest timber. Thirty-year-old blue gum proved stronger than hickory. In California the wood of *E. globulus* is hard, strong, and tough. It has competed with Robinia for insulator pins, and is used locally for waggon axles, spokes, hubs, and felloes.

With regard to the timber of trees grown in Europe, it is difficult to give a fair opinion, as reports of users vary extremely. Judging from what I saw in Portugal, however, the timber of *E. globulus*, in common with that of several other species, is extremely subject to split, warp, and twist, and requires a great deal of experience to season and convert it without great waste. None of the species² seem at present likely to produce timber of any commercial value in Great Britain, and it is therefore unnecessary to go into details.

(H. J. E.)

¹ Ingham, *Berkeley Cal. Agric. Exp. Stn. Bull.* No. 196, pp. 111-112 (1908).

² *E. Muelleri*, T. B. Moore, is possibly an exception.

EUCALYPTUS PAUCIFLORA, WEEPING GUM

Eucalyptus pauciflora,¹ Sieber, in Sprengel, *Syst. IV. Cur. Post.* 195 (1827); Mueller, *Eucalyptographia*, Dec. iii. (1889); Rodway, *Tasmanian Flora*, 55 (1903).

Eucalyptus coriacea, A. Cunningham, ex Schauer in Walpers, *Rep.* ii. 925 (1843); J. D. Hooker, *Fl. Tasm.* i. 136 (1860); Bentham and Mueller, *Fl. Austral.* iii. 201 (1866); Maiden, in *Rep. Austr. Assoc. Advance. Science, Hobart*, 1902, p. 353, and *Revision Genus Eucalyptus*, i. 133, plates 26-28 (1904).

Eucalyptus submultiplinervis, Miquel, in *Nederl. Kruidk. Arch.* iv. 138 (1859).

Eucalyptus phlebophylla, Mueller, ex Miquel, in *Nederl. Kruidk. Arch.* iv. 140 (1859).

A tree, attaining in Australia and Tasmania, 100 ft. in height and 12 ft. in girth. Bark peeling off, smooth and white. Young branchlets green or more or less covered with a whitish bloom. Leaves (Plate 365, Fig. 7) on adult trees, alternate, lanceolate, about 5 in. long and $\frac{3}{4}$ in. wide, usually falcate, unequal and cuneate at the base, gradually tapering to an acuminate apex, which is tipped with a long slender hook-like curved point; green and shining on both surfaces, thick and firm in texture; margin entire or undulate; main lateral nerves apparently longitudinal, arising near the base, and running for a considerable distance parallel to the midrib; petiole twisted, about $\frac{1}{2}$ in. long.

Flowers in axillary umbels of five to fourteen; peduncles $\frac{1}{4}$ to $\frac{1}{3}$ in. long, slender; flower-bud with pedicel about $\frac{2}{3}$ in. long; calyx-tube obconic gradually passing into the terete or quadrangular pedicel; operculum hemispheric or shortly conic, and ending at the apex in a short point; stamens usually all perfect; anthers reniform, with short divergent cells confluent at the apex. Fruit, on short slender pedicels (less than $\frac{1}{2}$ in. long), pyriform, smooth, narrowed near the summit, $\frac{1}{8}$ to $\frac{5}{16}$ in. long and wide, with a broad rim and a narrow orifice; capsule included, with the valves when open extending nearly to the orifice.²

This species occurs in Tasmania, Victoria, New South Wales, and South Australia. In Tasmania, where it is known as weeping gum, on account of its pendulous branches and branchlets, it is a small tree, usually much branched, and attaining in favourable situations only 60 or 70 ft. in length. Mueller says that it grows both on the ridges of the lowlands and on the highlands.

In Australia it is known either as white gum from the colour of its bark, or cabbage gum on account of the softness of its timber. In Victoria, where it occurs in the south, north-east, and east, it appears to be essentially an alpine species, ascending in the Gippsland Alps, where it forms forests, to 5000 ft.; yet it is able to maintain itself to some extent in localities but little elevated above sea-level. In South Australia it only occurs in patches close to the sea-coast in the south-eastern district.

In New South Wales, it grows usually in the undulating grassy country in the

¹ Sieber's name, being the earliest and accompanied by a clear description, must be adopted, though it is not very appropriate, this species producing copious flowers.

² The cotyledons are figured by Kerner, *Nat. Hist. Plant.* Eng. Trans. i. 621, fig. 148 (1898).

mountains and high table-lands, frequently forming timber-line, which is about 6500 ft. on Mount Kosciusko. In the Braidwood district, however, it occurs at all levels up to the highest point, 5000 feet, and attains 80 ft. in height and 5 ft. in diameter; and Maiden states that all reports from this district agree in stating that the timber is soft, durable underground, but of no use above it. De Coque says¹ that the timber is inferior, being only used locally for fencing purposes; and recommends that it should be avoided by architects for use in work of any description. Cattle browse on the foliage in seasons of drought.

Mueller says that "the chief interest of this species concentrates in its quality to cope with rather severe frosts; indeed, together with *E. Gunnii*, it constitutes miniature forests up to 5500 feet in the mountains, growing close to glaciers, which on the shady sides of glens do not wholly melt in Victoria, wherever situated over 6000 ft. high,—though in the cooler latitudes of Tasmania, the limit of eternal snow descends 1000 ft. lower,—it being understood, only in the wide crevices of chasms of rock, or in other places where the sun cannot exercise any direct effect. Thus the bare crests may be free of snow in the height of summer even at nearly 7000 feet; and we have therefore nowhere in summer an absolute permanent snow-line in the strict sense of the word."

I am unaware of the date of the first introduction of this species, which has been tried only in a few places. It has very pendulous branches, and is an elegant tree producing abundance of flowers. At Abbotsbury, it was killed in 1908 when 16 ft. high. At Colwyn Bay, N. Wales, Mr. A. O. Walker says² that a tree about fifteen years old, had its leaves slightly injured by 19° of frost in January 1894.

The Rev. Dr. Landsborough states³ that in Arran the species has borne 21° of frost without injury, producing flowers every year, and equalling *E. coccifera* in hardiness. A tree at Craigard, Lamlash, sown in 1879, was 25 ft. high after being topped in 1895, when it produced seed, from which plants were raised in the Edinburgh Botanic Garden. It is one of the species that Mr. Osgood H. Mackenzie cultivates at Inverewe.

At Fota, in the south of Ireland, there is an old tree, about 50 ft. by 6 ft. 8 in., which was blown down in 1903, and then replaced in position. The stem is now partially decayed. At Rossdohan, Kerry, Mr. Heard has several trees, the largest about 31 ft. by 1 ft. 8 in. He says that all his species of *Eucalyptus* grow as well in peat as on gravel, being more easily blown down in the latter soil.

(A. H.)

¹ *Journ. Proc. Roy. Soc. N.S. Wales*, xxviii. 214 (1894).

² *Gard. Chron.* xvi. 74 (1894). According to *Journ. Roy. Hort. Soc.* viii. 120 (1887), and *Gard. Chron.* ii. 784 (1887), this tree was not injured in the severe winters of 1878-1879 and 1879-1880.

³ *Trans. Bot. Soc. Edin.* xx. 519 (1896), and xxiii. 147 (1905).

EUCALYPTUS VIMINALIS, MANNA GUM

Eucalyptus viminalis, Labillardière, *Pl. Nov. Holl.* ii. 12, t. 151 (1806); J. D. Hooker, *Fl. Tasm.* i. 134 (1860); Bentham and Mueller, *Fl. Austral.* iii. 239 (1866); Mueller, *Eucalyptographia*, Dec. x. (1884); Masters, in *Gard. Chron.* iv. 596, fig. 82 (1888); Deane and Maiden, in *Proc. Linn. Soc. N.S. Wales*, xxvi. 137 (1901); Deane, in *Rep. Austral. Assoc. Advance. Science, Hobart*, 1902, p. 378; Rodway, *Tasmanian Flora*, 57 (1903).

A tree, usually of moderate size, but occasionally attaining 200 ft. in height. Bark variable, sometimes peeling off in ribbons, and smooth and white from the base upwards, and sometimes persistent and scaly even to the upper branches. Young branchlets very slender, with four projecting ridges, green and not glaucous; older branchlets terete, reddish brown. Leaves (Plate 365, Fig. 8) on adult trees, alternate, narrowly lanceolate, averaging 5 to 6 in. long, and $\frac{1}{2}$ to $\frac{3}{4}$ in. wide; but often larger or smaller than these dimensions; falcate; unequal and cuneate at the base; gradually tapering to a long acuminate apex, prolonged into a long slender curved or twisted filament-like tip; margin whitish, undulate, revolute; equally light green and not glaucous on both surfaces; oil-dots numerous, unequal, pellucid on young leaves, not conspicuous on old leaves; lateral veins numerous, arising from the midrib at an angle of 45°, the circumferential vein being regularly distant $\frac{1}{2}$ in. from the margin; petiole slender, twisted, about $\frac{1}{2}$ in. long.

Flowers in axillary umbels, usually in threes, rarely six to eight; peduncle $\frac{1}{5}$ in. long; pedicels about $\frac{1}{2}$ in. long; calyx-tube hemispherical, about $\frac{1}{8}$ in. long, crowned by an operculum, equal in length, conical, and tipped with a short point; stamens all fertile, inflexed in the bud; anthers ovate, with parallel distinct cells. Fruit turbinate, about $\frac{1}{8}$ in. long, and $\frac{1}{8}$ in. in width at the distal end, on short pedicels; rim broad and convex; capsule not sunk, with usually four valves, protruding when open beyond the orifice.

This species is very variable; but typical Tasmanian specimens have three-flowered umbels, and very small fruits. Forms occur in which the flowers are more numerous, four to eight in the umbel, and with long pedicels; and such trees are said to have rough scaly bark. Forms also occur with three-flowered umbels and large fruits. The leaves are also sometimes very narrow, almost quite linear.

This species occurs in Tasmania, Victoria, South Australia, and New South Wales. In Tasmania, it is very abundant throughout the island, where it is known commonly as white gum, according to Rodway,¹ who states that it seldom exceeds the dimensions of a small tree, with a much-branched and spreading habit. In Australia, where it is widely distributed, it occasionally reaches a great height, being perhaps in rare cases as tall as any other species. It is usually known as manna gum, owing to its being the chief species which produces mellitose manna. This exudes from the bark in minute drops, and is supposed to be due to the punctures of species of cicada, though often no trace of insect attack can be found.

¹ In J. C. Penny, *Tasmanian Forestry*, 15, 18, 20 (1905).

This peculiar substance encrusts the bark like a coating of white sugar, and falls off in lumps. It is not known to possess any medicinal value; and is called "lerp" by the aborigines, who eat it as an article of food.

According to De Coque,¹ the timber possesses no durability, and is of no utility to architects; but is used extensively throughout New South Wales for cheap rough fencing. It is not mentioned amongst the species with useful timber enumerated by Mr. Penny in his account of the Tasmanian forests.

Manna gum appears to be rare in collections in the British Isles, the only large specimens being two trees at Rosdohan, Co. Kerry, the larger of which produced flowers and fruit in 1910. Mr. Heard informs us that it is now, after losing 15 ft. of the top, 37 ft. high by 4 ft. 3 in. in girth.

It is reported² to have stood the severe winter of 1885-1886 at Bradfield, Collumpton, Devon; but it was killed at Abbotsbury in 1905. Mr. G. F. Heath reports that at Silverton, Devon, a young plant now 10 ft. high bore in 1909-1910 over 12° of frost. At Menabilly, a tree of this species was 15 ft. high in 1910.

At Colwyn Bay,³ North Wales, it was 33 ft. high in January 1894, when it was killed back to the trunk by a severe frost, the temperature registered being 13° Fahr.; but it afterwards sent out shoots.

In Scotland this species did not succeed out of doors at Kinloch Hourn, as all the seedlings raised in 1894 and 1895 had perished in 1899. In Arran, a tree⁴ raised from seed in 1871, and planted at Cromla in 1874, flowered in 1886 and subsequent years, and had attained 40 ft. by 2 ft. 7 in. in 1895, when it was killed by severe frost, the temperature falling to 22° Fahr. on the 9th February. A tree⁵ at Roseneath, planted in 1876, suffered severely in 1880-1881, and was killed in 1894-1895. In Ireland, this species has grown very fast at Mount Usher, where a tree raised from seed in 1904, was 28 ft. in height and bearing fruit in October 1911.

At Pallanza in northern Italy, it is reputed to be the hardiest species; and I measured in 1909 a fine specimen in Rovelli's nursery as 70 ft. by 5 ft. Elwes saw a very large tree of *E. viminalis* in April 1909, growing on the west lawn at Monserrat in Portugal, which measured 100 ft. by 16½ ft. In California,⁶ this species nearly equals the blue gum in rapidity of growth, and has been extensively cut for fuel.

(A. H.)

¹ In *Journ. Proc. Roy. Soc. N.S. Wales*, xxviii. 214 (1894).

² *Gard. Chron.* xxvi. 754 (1886).

³ *Ibid.* xvi. 74 (1894).

⁴ Landsborough in *Trans. Bot. Soc. Edin.* xx. 521 (1896). This is the tree called *E. amygdalina regnans* by the same author, *ibid.* xvii. 25 (1887). It is referred to in *Gard. Chron.* iv. 596, fig. 82 (1888).

⁵ Called *E. amygdalina regnans* in *Gard. Chron.* xxvi. 715 (1886), but Dr. Landsborough informed Mr. Birkbeck that it was *E. viminalis*.

⁶ M^cClatchie, *U.S. Forestry Bull.* No. 35, p. 37 (1902).

EUCALYPTUS COCCIFERA, MOUNTAIN PEPPERMINT

Eucalyptus coccifera,¹ J. D. Hooker, in *London Journ. Bot.* vi. 477 bis (1847), and *Fl. Tasm.* i. 133, t. 25 (1860); Lindley, in *Journ. Hort. Soc.* vi. 221 (1851); W. J. Hooker, *Bot. Mag.* t. 4637 (1852); Bentham and Mueller, *Fl. Austral.* iii. 204 (1866); Masters, in *Gard. Chron.* xiii. 395, fig. 69 (1880), ii. 784, fig. 151 (1887), and iii. 798, figs. 108, 109 (1888); Rodway, *Tasmanian Flora*, 56 (1903); Maiden, in *Rep. Aust. Assoc. Advance. Science, Hobart*, 1902 p. 365, and *Revis. Genus Eucalyptus*, i. 142, pl. 28 (1904).

A small tree, attaining in the high mountains of Tasmania 20 ft. in height. Bark smooth, white. Young branchlets terete, glabrous, glaucous, covered with a dense whitish bloom. Leaves (Plate 365, Fig. 9) on adult plants, alternate, lanceolate, about 2½ to 3 in. long, and ¾ to ¾ in. wide, unequal and tapering at the base, acuminate at the apex, which is tipped with a long slender curved hook; margin entire, whitish, revolute; equally green or glaucous on both surfaces; oil-dots numerous, pellucid, very unequal in size; thick in texture; lateral veins, arising at an acute angle (30°) from the midrib, not conspicuous; petiole twisted, ¾ to 1½ in. long. Leaves on young plants and on suckers, opposite, sessile, elliptical, about 1½ in. long and 1 in. broad, rounded at the base and apex, the latter tipped with a short sharp point; entire in margin; green or glaucous. Branchlets reddish, with numerous elevated globose oil-glands.

Flowers, in axillary umbels of three to seven; peduncles glaucous, thicker towards the distal end, ½ to ½ in. long; flower-buds sessile, glaucous, wrinkled, ½ in. long; calyx-tube turbinate, compressed on the back and front, with the two sides narrow and sharply winged; operculum short, nearly flat, depressed in the centre and with a warty margin; stamens all perfect, inflexed in the bud; anthers reniform with diverging cells. Fruit obconic, glaucous, about ½ in. long, and ¾ in. broad at the slightly contracted distal end; nearly smooth externally, the angles of the calyx having disappeared; rim ⅓ in. broad, flat or convex; valves slightly included, three to five.

The seedling² has a terete scabrous dark purple stem; cotyledons obcordate, cuneate at the base and retuse at the apex; leaves ovate-lanceolate, thin, entire.

Our cultivated trees of *E. coccifera* in England agree³ well with the type

¹ This species is named, not from the actual presence of insects on the tree, but because the branchlets have a conspicuous whitish bloom, like the waxy secretion of some species of *Coccus*.

² Lubbock, *Seedlings*, i. 532 (1892).

³ *E. coccifera* has been confused with the following forms in Tasmania, which have been studied by Maiden, who calls them "gum-top stringy barks," i.e. trees with smooth bark above and stringy bark near the base of the trunk; but very variable in the amount of each kind of bark on individual trees. I suspect that the following are natural hybrids; there is no reason to suppose that they are in cultivation in England.

A. *Eucalyptus Risdoni*, Hooker, var. *elata*, Bentham, *Fl. Austral.* iii. 203 (1866); Maiden, in *Rep. Aust. Assoc. Adv. Sc. Hobart*, 1902, p. 361, and *Rev. Genus Eucalyptus*, i. 69 (1903) and i. 144 (1904); Rodway, *Tasmanian Flora*, 56 (1903).

This name was given by Bentham to two specimens, both numbered 1095, which were collected by Gunn in 1847 on the west side of Lake St. Clair, where tall trees formed pure forest close to the water's edge. One specimen has glaucous branchlets, with alternate and very falcate leaves, unequal at the base, and ending at the apex in a hooked point; flower-buds, six to seven in an umbel, like those of *E. obliqua*, but glaucous and with conspicuous oil-dots. The other specimen has branchlets and flowers, which are not glaucous. These specimens which have leaves and flowers like *E. obliqua*, and glaucous branchlets

specimens of the species, which were collected in Tasmania on the summit of Mount Wellington by Gunn, and on the western mountains by Lawrence; but have larger leaves, and are usually more glaucous in all their parts.¹

E. coccifera is confined to Tasmania, where it is common on the summits of the mountains at 3000 to 4000 ft. elevation. Rodway describes it as a small erect tree, 8 to 12 ft. high; but it attains much larger dimensions in this country, and doubtless owes its small size in Tasmania to the exposed situations in which it is found. It is known as mountain peppermint, and has no economic value in its own country.

E. coccifera was discovered in 1840 by Gunn, and was probably introduced in the same year, as in 1851 there was a plant, said to be eleven years old, growing in Veitch's nursery at Exeter, which was then 20 ft. high and producing flowers. In the Chiswick Garden, according to Lindley, it lived for many years against a south wall, without being injured by frost; but plants growing in open borders dwindled away and died.

(A. H.)

REMARKABLE TREES

The finest Eucalyptus in Britain is the noble tree² of this species, which grows in the American garden at Powderham Castle, Devonshire (Plate 361). When I last measured it in 1907, it was 75 to 80 ft. high and 13 ft. in girth at 5 feet; but the gardener, Mr. Bolton, informs us that in January 1911 it was exactly 16 ft. in girth at 4 ft. from the ground; the spread of the horizontal branches being about 90 ft. It is perfectly sound and healthy, and regularly bears ripe fruit, from which seedlings have been raised. One of these, when planted out under a warm wall at Colesborne was almost killed in the winter of 1908-1909; and died in 1912. This tree probably dates from the original introduction of the species in 1840, as it produced flowers and fruit in 1852, from which the plate in the *Botanical Magazine*, t. 4637, was drawn. It grows in sandy loam on the Red Sandstone formation on a fairly high river bank, about ten yards from the water, and doubtless owes its vigour to this situation. It was not injured in 1878 or 1879, when the temperature fell to 16° and 9° Fahr. respectively. Masters³ states that this tree has changed its time of flowering, as it was reported to have produced flowers in December and January, 1880; while in 1883, it was in full flower in the month of June.

(H. J. E.)

and flower-buds like *E. Risdoni* and *E. coccifera* in all probability are hybrids. Rodway, *Notes on E. Risdoni* in *Proc. Roy. Soc. Tasman.* 367-369, plates 10-12 (1910), should be consulted on the varieties of this species.

B. *Eucalyptus radiata*, Sieber, var. 4, J. D. Hooker, *Fl. Tasman.* i. 137 (1860).

This name was given by Hooker to specimens 1100 and 1110, collected by Gunn in 1840 at Hobart and Grass Tree Hill. These two specimens are not identical, and are different from *E. Risdoni*, var. *elata*, from Lake St. Clair. They are close to *E. Risdoni*, and are probably hybrids of it with some other species.

Note.—*E. Risdoni*, Hooker, the "drooping gum," a small tree abundant in the dry hills of the southern parts of Tasmania, bears on the adult plant opposite sessile leaves; and seems to be entirely distinct from *E. Risdoni*, var. *elata*. *E. Risdoni* does not seem to have ever been tried in cultivation in England.

¹ Maiden, to whom I sent specimens of the Powderham and other trees, agrees with me that they are undoubtedly *E. coccifera*.

² Figured in *Gard. Chron.* xii. 113, fig. 18 (1879), and ii. 784, fig. 152 (1897). It was reported to be 58 ft. high and 7 ft. 4 in. in girth at 3½ ft. from the ground in 1879. Cf. also *Gard. Chron.* xxxiv. 291 (1903) and xxxix. 411 (1906).

³ *Gard. Chron.* xix. 730 (1883), and ii. 784 (1887).

At Tresco, Scilly Isles, this is reported to be the hardiest species, but dwarf in habit, a specimen, 35 years old, being only 12 ft. high in 1894.

At Menabilly the best specimen,¹ planted in 1884, was, according to Mr. Bennett, 65 ft. by 6 ft. 5 in. at 4 feet from the ground in 1911. This was 56 ft. by 5 ft. 8 in., when measured by Mr. A. B. Jackson in 1908. An older tree planted in 1879, was only 40 ft. by 4 ft. 8 in. At Coombe Royal, a tree thirty-five years old, was 30 ft. by 2½ ft. in 1904. Trees raised at Vicar's Hill, Lymington, from seed sent to Mr. E. H. Pember in 1896 by Sir Charles Barrington from trees grown by him near Limerick, were 31 ft. by 13 in. in girth in 1910. At Killerton, a tree, planted in 1891, was 33 ft. by 3 ft. 1 in. in 1911. At Osborne, a bushy specimen, in an exposed position, survived the winter of 1884, when 20° of frost were registered; but was only 10 ft. high in 1911, having lost its leader. At Tregothnan, there are trees about 20 to 25 ft. high, which were planted ten years ago. At Cuffnells, Lyndhurst, there is a tree about 35 ft. high, which bears fruit. At Abbotsbury, there are specimens, 20 to 30 ft. high, raised from an older tree, which are very hardy and thriving. At Bradfield, Devon, it² bore well the severe winter of 1885.

There is a tree, planted in 1896, which attained 16 ft. high in 1906, in a sheltered spot at The Holt, Harrow Weald, Hampshire. This tree is much frequented by blue tits; but Mr. A. Kingsmill could not find any insect on it to attract them.

It is said not to be quite hardy at Kew; but Nicholson says³ that young plants protected by a wall were not injured in the severe winter of 1879-1880. Seed was sent to Kew, which was gathered in 1888 from trees growing on the summit of Mount Wellington in Tasmania, where the branches were covered with icicles a foot long; but the seedlings raised succumbed in the winter of 1889, though they were protected by a canvas screen.⁴ It stood out of doors three years at Coombe Wood,⁵ but succumbed to the winter of 1909. *E. coccifera* is, in Mr. Birkbeck's opinion, one of the four hardy species; but we have not seen any trees of it in the eastern counties.

At Wimbledon, some plants⁶ endured without injury several cold winters, and attained 12 to 15 ft. in height; but becoming broken by a fall of snow, they were killed by a subsequent severe frost in 1893.

Mr. W. H. Divers, reports⁷ that at Belvoir Castle there are two trees, planted in 1899, which have proved quite hardy, and were 25 ft. high in 1909. This is the only one, of about eighteen species that were tried out-of-doors at Belvoir Castle, which has survived.

At Wansfell House, Windermere, a dozen trees⁸ had withstood the severe weather of the preceding five winters, and were 15 to 20 ft. high in 1893. Of these, three survive, and measured in February 1911, 38 to 45 ft. in height, and 19 to 22 in. in girth.

¹ This tree appears to have been incorrectly known at Menabilly as *E. Gunnii*, till 1900, when specimens were sent to Kew; and is probably the tree figured under that name in *Gard. Chron.* xi. 787, fig. 113 (1892) and xxxiii. 234, 97 (1903). ² *Gard. Chron.* xxvi. 754 (1886). ³ *Journ. Roy. Hort. Soc.* viii. 208 (1887).

⁴ *Kew Bulletin*, 1889, p. 61, and 1892, p. 309; and *Gard. Chron.* xii. 728 (1892).

⁵ It was stated in *Gard. Chron.* xxvi. 306 (1886) to be hardy at Coombe Wood. Mr. Harrow informs me that "none of the species prove in any degree hardy at Coombe Wood."

⁶ *Gard. Chron.* xiii. 237 (1893).

⁷ *Spring Flowers of Belvoir Castle*, 83 (1909).

⁸ *Gard. Chron.* xiii. 237 (1893).

At Nant-y-Glyn Hall, Colwyn Bay, North Wales, there is a tree about 20 ft. high. At Cefnamwich, Nevin, Mr. Hugh S. Jones informs us that he has a tree, 45 ft. high, which he raised from seed sixteen years ago.

On the west coast of Scotland this is one of the most successful species. A tree¹ at Stonefield, Loch Fyne, the residence of C. G. P. Campbell, Esq., was reported by the forester, Mr. R. Stewart, to be 47 ft. by 2 ft. 8 in. at 4 feet from the ground in 1910, and had never been injured by frost. At Castle Kennedy, there is a healthy young tree, which was raised from seed of a tree erroneously named *E. amygdalina*, which died some years ago. At Monreith, a young tree received from Mr. Birkbeck in 1899, is about 17 ft. high, and produces flowers and fruit regularly. At Dalkeith, this species,² growing in a sheltered spot, bore without injury the severe frost of 7th January 1894, when the thermometer fell to 4° Fahr.

At Kinloch Hourn,³ this species is very hardy, and there are several fine specimens, none of which were touched by the severe frost in 1893-1894. It was killed, however, in 1895 at Kilmarnock and at Whittingehame, where the tree was ten years old. At Roseneath,³ a tree planted in 1886, flowered in July 1891, when only 6½ ft. high, and was 19½ ft. high in 1905. In Arran,³ where it was planted in 1886 in a very exposed site at 250 feet above sea-level, it was 14 ft. in 1895, but succumbed in the following winter. At Gadgirth,³ Ayrshire, it also died, when about 5 ft. high. At Inverewe, this species is reported to be very successful.

In Ireland, this species has not been tried extensively; but it is perfectly hardy and thriving at Kilmacurragh and Mount Usher in Wicklow, and at Rossdohan in Kerry. At Coolfin, near Portlaw, Co. Waterford, the residence of Rev. W. W. Flemyng,⁴ there is a fine specimen, which was planted quite small in 1898, and measured no less than 35 ft. high in 1907.

(A. H.)

EUCALYPTUS GUNNII, CIDER GUM

Eucalyptus Gunnii, J. D. Hooker, in *Lond. Journ. Bot.* iii. 499 (1844), *Fl. Tasm.* i. 134, t. 27, (1860), and *Bot. Mag.* t. 7808 (1901); Bentham and Mueller, *Fl. Austral.* iii. 246 (1866); Mueller, *Eucalyptographia*, Dec. iv. (1879); Hemsley, in *Gard. Chron.* ii. 784, fig. 150 (1887); Deane and Maiden, in *Proc. Linn. Soc. N.S. Wales*, xxvi. 134 (1901); Maiden, in *Proc. Linn. Soc. N.S. Wales*, xxvi. 561 (1901), and in *Rep. Austr. Assoc. Advance. Sci., Hobart*, 1902, p. 377; Rodway, *Tasmanian Flora*, 57 (1903).

Eucalyptus Gunnii, var. *montana*,⁵ J. D. Hooker, *Bot. Mag.* t. 7808 (1901).

Eucalyptus Gunnii, var. *glauca*,⁶ Deane and Maiden, in *Proc. Linn. Soc. N.S. Wales*, xxiv. 464 (1899), and xxvi. 134 and 561 (1901).

¹ Dr. Landsborough, in *Trans. Bot. Soc. Edin.* xx. 518 (1896) and xxiii. 145 (1905), states that it was sown in 1881; flowered in 1895, when it was 21 ft. high; and was 27 ft. by 2 ft. 4 in. in 1905.

² *Journ. Roy. Hort. Soc.* xviii. 76 (1895).

³ Cf. Landsborough, in *Trans. Bot. Soc. Edin.* xx. 518 (1896), and xxxiii. 145 (1905).

⁴ Cf. *The Garden*, lxxi. 591, fig. (1907).

⁵ As Maiden points out, in *Proc. Linn. Soc. N.S. Wales*, xxvi. 588 (1901), this differs in no respect from the typical form of the species.

⁶ Maiden, in *Rep. Austr. Assoc. Advance. Sci., Hobart*, 1902, p. 377, suppresses var. *glauca*, which is only the typical form of the species.

A small tree, usually 20 to 30 ft. high in Tasmania, but occasionally attaining in sheltered places a height of 80 ft. Bark smooth and whitish, the outer layers peeling off in thin strips. Young branchlets slender, terete, more or less covered with a glaucous bloom. Leaves (Plate 365, Fig. 5) on adult trees, alternate, averaging 2 to 2½ in. long, and ⅕ to ⅔ in. broad, ovate-lanceolate, thick and firm in texture, rounded or cuneate and equal-sided at the base, usually straight and not falcate, gradually tapering to an acute apex, tipped with a short point; margin entire, revolute, whitish; equally greyish or glaucous green on both surfaces; oil-dots numerous, unequal, often concealed; lateral veins few, inconspicuous, arising at an angle of 70°; circumferential vein undulate, distant about ⅓ in. from the edge of the blade; petiole stout, twisted, about ⅓ in. long.

Young plants¹ have glaucous branchlets and foliage; leaves sessile, opposite in decussate pairs, oval or ovate, cordate at the base; rounded or acute at the apex, which is tipped with a short point; crenate in margin. As the plants grow older, and on suckers, the leaves become thicker in texture, and more ovate in outline.

Flowers in axillary umbels of threes; peduncle slender, ¼ in. long; pedicels distinct, about ⅓ in. long; flower-buds glaucous; calyx-tube campanulate, ⅓ in. long; operculum nearly hemispheric, much shorter than the calyx-tube, tipped with a short umbonate point; stamens all perfect, inflexed in the bud; anthers ovate, with parallel distinct cells. Fruit glaucous, pear-shaped, distinctly pedicellate, ⅓ in. long, ⅓ in. wide at the distal end, where it is contracted; rim narrow; capsule sunk, with three to four valves, which when open scarcely reach the orifice.

This species has scarcely any of the pungent odour, so common in many other species; and Mueller says that it is liable on this account to have the foliage browsed by cattle and sheep.

The typical form of *E. Gunnii* was discovered by Sir J. D. Hooker in 1840, "forming a forest of small trees in a swampy soil² at elevations of 3000 to 4000 ft. in the centre of Tasmania, where it is known to stock-keepers as yielding abundantly an agreeable sap; and hence is called cider tree or swamp gum." Rodway, who calls it cider gum, states that it is found in the midlands and lake country of Tasmania as a small tree seldom exceeding 20 ft.; but rarely in sheltered places attaining 80 ft. high.

It was subsequently found by Mueller on the summit of Mount Baw Baw in Victoria; and the same tree, according to Maiden, also grows in the Tingeringi and Snowy mountains of New South Wales at about 5000 ft. elevation.

This tree is considered by the colonists in Tasmania to be different from *E. acervula*, which is known as red gum, and only occurs at low levels. Both Sir J. D. Hooker and Rodway consider these two species to be quite distinct; and I see no reason for uniting them together under the same name (*E. Gunnii*), as has been done by Maiden and some other botanists. The transitional forms noticed by Maiden, of which I have seen no specimens, are more likely to be hybrids than varieties.

¹ Figured in *Gard. Chron.* xix. 437, fig. 65 (1883).

² Rodway, in a letter to Elwes, says *E. Gunnii* is almost entirely confined to exposed moorland at an altitude above 2000 ft., and will not live at low elevations.

This species was introduced, shortly after its discovery, into Kew Gardens, where a tree¹ lived for many years, being the first Australian tree that was cultivated in the open air in England. It was cut almost to the ground by cold in several severe winters; but as often, sent up from the base one or more stems, which grew to be 10 to 20 ft. in height. It died only three or four years ago. (A. H.)

REMARKABLE TREES

The most remarkable plantation of Eucalyptus that we know of in England, was made by the late John Bateman, Esq., of Brightlingsea Hall, Essex, who raised seeds of *E. Gunnii*, which² were sent to him from southern Argentina in 1887, by Mr. Shennan, who had naturalised there the Tasmanian *E. Gunnii*. Planted in an exposed situation in light sandy soil within a mile of the estuary of the Colne, some of the trees (Plate 362) have now attained a height of 40 to 50 ft. with a girth of 3 or 4 ft., and are quite uninjured by wind or frost, the lowest temperature recorded for the locality being 5° Fahr. When I saw them on 9th December 1906, some were in full flower, and many were covered with capsules of different ages. Mr. Bateman told me that they ripened seed every year, which he sowed in the open ground in April. The seedlings attain a height of about a foot in the first year, and 3 to 6 ft. in the second year. A self-sown seedling growing behind the coach-house was about 12 ft. high at three years old. Mr. Bateman found the tree somewhat difficult to transplant, and preferred to do this in September after a heavy rain. This species also seems to like a wet soil; and a great number of seeds had germinated in the gutter of the coach-house. Though the value of the timber³ is as yet unproved in England, this tree might be used for planting marsh land on the coast, where, owing to its evergreen character, it would afford excellent shelter to other trees. Seedlings from these trees, though showing no variation in their botanical characters, have varied considerably in their hardiness at Colesborne. Some were killed to the ground by a frost in December 1904, and grew again from the root; whilst others were little affected.

Mr. Bateman informed me that this species grows equally well on sandy upland, on loam, or on heavy marshy clay soil, if trenched. The trees do badly, if they have not moisture at the roots, at least till they are well established; or if they are planted in sheltered corners under the shade of other trees; or if planted close to a wall; or if nibbled by rabbits, hares, or stock. They can be safely planted up to the 1st May. At Brightlingsea, bees swarm on the flowers which are produced from May to January; but those opening after 15th September set no fruit.

¹ Cf. Hemsley, in *Gard. Chron.* ii. 784, fig. 150 (1887). Smith, *Records of Kew Gardens*, 265 (1880), states that it was 20 ft. high in 1863. Smith calls it *E. polyanthemos*, the erroneous name by which this specimen was known for many years at Kew.

² Cf. Bateman in *Gard. Chron.* xxv. 202 (1899). In an article, which he wrote in *The Garden*, lxi. 110 (1902), he states however that he received the seed from the extreme south of Tasmania in 1887, and planted out sixty seedlings in the autumn of the same year. These, when five years old, were 15 ft. high and produced flowers and seed.

³ The timber, according to Mr. Bateman, who used it for posts and rails, is very heavy. The wood of *E. Gunnii* is of no value in Tasmania, owing to its small size; and that of the allied species, *E. acervula*, seems to be little used except for firewood.

Mr. Llewellyn Lloyd tells us that numerous seedlings of the Brightlingsea trees have been planted in Essex,—as in his own garden at Kirby, and in that of Mr. J. B. Hawkins at Wyvenhoe. A tree at the Rectory, Frating, planted twenty-eight years ago in light sandy soil, is over 30 ft. high and about 2 ft. in girth. There are also some trees about eighteen years old and 30 ft. high at Birch Hall, Colchester, from which the Right Hon. James Round has lately raised seedlings. Messrs. Abbott, nurserymen at Ardleigh, near Colchester, are said to have a stock for sale.

At Menabilly, there was a tree of this species, from which the figure in *Bot. Mag.* t. 7808, was drawn¹ in 1901. It is doubtful if this is the same as a tree which was 38 ft. by 1 ft. 4 in. in January 1911.

At Borde Hill, Sussex, there is a tree in a sheltered corner close to the house, which flowered in July 1909, and bore fruit in the previous year. It measured 56 ft. by 3 ft. 9 in.; and Mr. Stephenson Clarke says that it has endured 22° of frost without injury. At Hemsted Park, Kent, a healthy tree was 33 ft. high in 1911. In Miss Breton's garden at Sandhurst, a tree eighteen years planted, was 48 ft. high by 2 ft. 5 in. in girth in 1911; and a seedling from this is 20 ft. high. At Colesborne I planted a tree which was raised by the late Sir Charles Strickland in 1903, under a high wall facing north, and here it grew to 15 feet high in four years. In the severe winter of 1908-1909, when the thermometer went below zero, the top of this tree was killed as far down as the sun struck it, but the remainder continued healthy, and flowered in August 1910. After its top was frozen it threw out many shoots at ground level. The buds on this tree are formed about August and remain unopened for about twelve months.

At Putley Court, Ledbury, there is a handsome tree, planted about 1887, which in 1910 measured 48 ft. by 2½ ft., and produced flowers and fruit.

Mr. J. P. Rogers sent us in 1910 a branch from a tree at Penrose, near Helston in Cornwall, which is about 45 ft. high, and 2 ft. 11 in. in girth at three feet from the ground. This was raised from seed about sixteen years ago; and about thirty seedlings from the same batch were planted out in the woods; but Mr. Rogers says that only two survived, and only one of these grew properly. This species is not rare in Cornwall, as it is growing also at Enys and Penjerrick.

This species is apparently quite hardy in the eastern counties, even at a considerable distance inland, where severe frost is not unusual. A tree in the Cambridge Botanic Garden, obtained from Dicksons of Chester in 1898, is very thriving and about 25 ft. high. Another, growing in a sheltered position in an old quarry at Furze Hill, North Walsham, which was planted, according to Mrs. Petre, in 1899, is now about 40 ft. by 2 ft. 9 in., and is thriving, though occasionally a few twigs are cut by severe frosts.

Mr. A. R. Wallace has written² an article on this species, which he cultivated in his garden at Parkstone, Dorset. Planted in 1889, it was 30 ft. high by 3½ ft. at a foot from the ground in 1902; but was cut down soon after.

¹ According to notes on a specimen in the Kew Herbarium, the tree mentioned in the text of the *Bot. Mag.* t. 7808, never existed. The tree, figured as *E. Gunnii* at Menabilly, in *Gard. Chron.* xi. 787, fig. 113 (1897), and xxxiii. 234, fig. 97 (1903), was not this species, but apparently *E. coccifera*. See p. 1637, note 1.

² *The Garden*, lxi. 57, and lxii. 47 (1902).

At Wisley, where several species, including *E. urnigera*, *coccifera*, *cordata*, and *Beauchampiana*, have lately been tried, Mr. Chittenden informs us that the only one which has survived is *E. Gunnii*, a small specimen of which is four years old. At Myddelton House, Herts, where the same species and some others were tried, *E. Gunnii* and *E. Whittingehamensis* were the only ones that bore without injury the winter of 1908-1909. The former was about 15 feet high in 1911.

In Scotland, this species has been considerably planted on the west coast, and thrives as far north as Inverewe, where there are several trees, 30 to 40 ft. high. At Kinloch Hourn, trees raised from Tasmanian seed are perfectly hardy, and did not suffer in the least in the severe winter of 1894-1895, when the temperature fell to 0° Fahr., and some of the branches of the Whittingehame seedlings were browned. In Arran, according to the Rev. Dr. Landsborough,¹ the species did not succeed very well, as one planted at Lamlash in 1884 was blown down in 1894, and another in an exposed situation at Whiting Bay had the twigs and leaves injured by frost. At Whitefarland, a tree was 19 ft. high in 1905.

Mr. R. Lindsay says² that in 1899 he raised at Kaimes Lodge, Midlothian, two trees from seed which he received from Mr. Bateman. These are now over 20 ft. high and have produced seed, from which he raised seedlings. In 1909-1910, these seedlings were completely killed, and the old trees were severely injured, but the latter have now recovered. At Dalkeith, it is reported³ to have borne without injury, growing in a sheltered place, the severe frost of 7th January 1894, when the temperature fell to 4° Fahr.

At Kilmacurragh, Co. Wicklow, this species is about 15 ft. high and perfectly hardy.
(H. J. E.)

EUCALYPTUS WHITTINGEHAMENSIS, WHITTINGEHAME GUM

Eucalyptus whittingehamensis, Nicholson, in *Kew Hand-List Trees*, 395 (1902).

Eucalyptus whittingehamei, Landsborough, in *Trans. Bot. Soc. Edin.* xx. 516 (1896).

Eucalyptus urnigera,⁴ Masters, in *Gard. Chron.* iii. 460, figs. 64, 65, and 798, fig. 110 (1888) (not J. D. Hooker).

A tree, raised at Whittingehame, Scotland, from seed, which was probably obtained in Tasmania. This differs usually from typical *E. Gunnii* in the absence of glaucous bloom on the branchlets and leaves of the adult plant. The leaves (Plate 365, Fig. 4) are lanceolate, longer in proportion to their width than those of *E. Gunnii*, and never ovate as in that species, about 3 to 3½ in. long and ½

¹ In *Trans. Bot. Soc. Edin.* xx. 517 (1896), and xxiii. 144 (1905). The tree, reported by Dr. Landsborough to be *E. Gunnii* at Stonefield, is *E. urnigera*.

² *The Garden*, lxxiv. 286 (1910).

³ *Journ. Roy. Hort. Soc.* xviii. 76 (1895).

⁴ The identification of the Whittingehame tree with *E. urnigera* is inexplicable, as the foliage and flowers of the latter are very different, and its fruits are much larger. Naudin, in *Desc. et Empl. Eucalpt.* 35 (1891), followed Masters; but he had not seen adequate material of the Whittingehame tree. According to Mr. Birkbeck, the cotyledons of the Whittingehame seedlings are quite different from those of *E. urnigera*; and he adds that no one who has seen both in the young state could possibly confuse them.

to ¾ in. wide, straight or occasionally slightly falcate, cuneate at the base, and gradually tapering to an acuminate apex, tipped with a short point; greyish green on both surfaces; thick and firm, with most of the oil-glands concealed; entire in margin; venation as in *E. Gunnii*; petiole twisted, ¼ to ½ in. long.

Flowers in umbels of threes, slightly glaucous, and with a more conical calyx-tube than in *E. Gunnii*. Fruit slightly larger than that of *E. Gunnii*, urn-shaped, with the rim overhanging the contracted part of the fruit just below it; capsule sunk, with three valves not extending when open to the orifice.

This tree is considered by Maiden,¹ who has seen branches both of the parent tree and of its seedlings, to be *E. Gunnii*; but it does not match any of the specimens in the Kew Herbarium, either of that species or of *E. acervula*, which is united with *E. Gunnii* by Maiden. It resembles *E. acervula* in the absence of glaucous bloom on the branchlets and in the size and shape of the leaves; but has only three flowers in each umbel and bears different fruit. It is certainly not *E. urnigera*. Seedlings of the parent tree show considerable variation in the foliage, which in some specimens, together with the branchlets and flowers, is glaucous; and this points to a hybrid origin. Moreover, some of the seedlings at least are considerably hardier than the parent. I have not been able to make a study of the seedling trees in a fruiting stage; but I suspect that the Whittingehame tree is a hybrid, with *E. Gunnii* as one of the parents. The peculiar urn-like shape of the fruit suggests the probability of *E. urnigera* being the other parent, though the tree at Whittingehame does not resemble the latter in foliage. (A. H.)

This remarkable tree is growing at Whittingehame,² the seat of the Right Hon. Arthur Balfour in East Lothian, where it was planted about sixty years ago, and is believed to have been raised from seeds brought by the late Marquess of Salisbury from Australia or Tasmania. Lady Gwendolen Cecil informs me that her father made his voyage round the world in 1851-1852³ and visited both Tasmania and New Zealand, as well as Australia, in which country she believes that his stay was very brief; so that there is little doubt that the tree is of Tasmanian origin. In February 1904, when I measured it, it was 60 to 63 ft. high and 13 ft. 5 in. in girth at two feet from the ground, where it divides into three stems, which afterwards divide into six main limbs of which the largest is over 5 feet in girth (Plate 363). I was informed by the late Mr. John Garrett, the gardener, that after the severe frost of 1861 it was killed down to 9 feet from the ground; but in 1894 it endured a temperature⁴ of -2° without serious injury. It ripens seed almost every year about September, and the seeds germinate and grow equally well if sown in autumn or spring. The bark of the old tree is more or less scaly and can be heard cracking in hot weather, and it remains green all the winter.

¹ In a note on a specimen at Kew, Maiden wrote in 1901: "*E. Gunnii*, varying a little from the type under cultivation." I sent in 1908 a number of specimens to Maiden, some of which he identified as *E. Gunnii*, whilst others he named *E. Whittingehamensis*.

² Whittingehame is three and a half miles from the sea, and 384 ft. altitude. The subsoil is gravel.

³ The Rev. Dr. Landsborough states that the seed was sown in 1845, but this is erroneous; 1852 is the probable date.

⁴ Dr Landsborough, in *Trans. Bot. Soc. Edin.* xxiii. 144 (1905) quotes a letter from Garrett, stating that "in the year 1894-1895, when on two nights the mercury sank at Whittingehame to zero, the young plants did not lose a leaf, while all those of the parent tree were destroyed."

Mr. Garrett informed me that of the numerous other species of *Eucalyptus* tried at Whittingehame, all perished in the severe winter of 1894-1895, with the exception of *E. vernicosa*, which was only damaged to a slight extent. None of the seedlings of *E. Whittingehamensis* were in the least injured. Of these he raised hundreds, which were distributed over the United Kingdom, the earliest dating from 1887, one of which at Whittingehame was 45 ft. high in 1903, while another raised from seed in 1886 was 29 ft. high and 14½ in. in girth in 1904. The true *E. Gunnii*, which he considered to be the species most like it, differed in producing seed freely, when only four years old, at Whittingehame. There is a thriving seedling raised in 1888 from seed of the Whittingehame tree, in the rose garden near the pagoda at Kew, which was planted in 1896, and is now about 40 ft. high. It has never suffered in the least from frost; and flowered for the first time in 1911. Two seedlings which were kindly sent me by Miss Balfour in 1905 were uninjured by the severe frost of that autumn, though one of them has died since, and the survivor does not seem to like the calcareous soil of Colesborne.

At Blackmoor, Liss, Hants, there are two trees, which were received from Whittingehame as one year seedlings in 1903. One is about 22 ft. high. The other, which was pollarded a year ago, is about 15 ft. high, and was bearing flower-buds in January 1911. At Leonardslee, Sussex, there is a tree which was 40 ft. by 3 ft. in January 1911, and was also bearing flower-buds. Sir E. G. Loder¹ received it from the Edinburgh Botanic Garden in 1889. At Terling Place, Essex, three seedlings were planted in 1895-1896, of which two were killed by a severe frost in 1909. The third was killed to within five feet of the ground, but is producing new shoots. At Hatfield House, Herts, four seedlings were planted in 1890, the best of which, growing in an open and exposed position, is now 40 ft. by 1 ft. 8 in., but has not yet flowered. A smaller one sheltered from the north was bearing flower-buds in January 1911. At Sandhurst, a Whittingehame seedling in Miss Breton's garden, planted thirteen years, was 35 ft. by 1 ft. 11 in. in 1911. At Abbotsbury, one four years old was 20 ft. high in 1911.

At Kinloch Hourn, Mr. Birkbeck planted the first seedlings of this in 1890 and 1891, and these had their leaves slightly browned in the severe winter of 1894-1895, when the temperature fell to 0° Fahr.; but have thriven since. In Kilmarnock² the Whittingehame seedlings were uninjured in the same winter, when *E. coccifera* was killed. A seedling at Monreith, planted when 2 ft. high in 1908, is now about 13 ft. high. Another at Inverewe, planted in 1896, was 45 ft. high by 2 ft. in girth in 1911.

(H. J. E.)

¹ Sir E. G. Loder says that his tree is much hardier and not the same as *E. urnigera*, several plants of which were killed at Leonardslee, although 20 ft. high, by a severe winter.

² Dr. Landsborough in a letter to Mr. Birkbeck.

EUCALYPTUS ACERVULA, SWAMP GUM

- Eucalyptus acervula*, Miquel, in *Nederl. Kruidk. Arch.* iv. 137 (1859) (not Sieber¹); J. D. Hooker, *Fl. Tasm.* i. 135 (1860); Rodway, *Tasm. Flora*, 57 (1903).
Eucalyptus Stuartiana, Mueller,² ex Miquel, in *Nederl. Kruidk. Arch.* iv. 131 (1859); Mueller, in Bentham, *Fl. Austral.* iii. 243 (1866) (in part).
Eucalyptus persicifolia,³ Miquel, in *Nederl. Kruidk. Arch.* iv. 137 (1859).
Eucalyptus Gunnii, J. D. Hooker, var. *acervula*, Deane and Maiden, in *Proc. Linn. Soc. N.S. Wales*, xxvi. 136 (1901).
Eucalyptus Gunnii, var. *elata*, J. D. Hooker, *Bot. Mag.* t. 7808 (1901).

A tree,⁴ attaining in Tasmania and Australia a height of 200 ft. in very favourable situations, but usually not more than 100 ft. Bark peeling off and smooth, except on old trunks, which are scaly near the base. This species differs from *E. Gunnii* in its larger size, and in the branchlets, leaves, flowers and fruit being never glaucous. Leaves larger than in that species, up to 4 in. long and 1¼ in. broad, lanceolate or ovate-lanceolate, dull green on both surfaces, often undulate in margin, usually straight, and not falcate, commonly equal but sometimes oblique at the cuneate base, tapering to the acuminate or cuspidate apex, which ends in a short point; thick and firm in texture; venation and oil-dots inconspicuous; petiole twisted, ½ to ¾ in. long.

Flowers, axillary or lateral, 4 to 8 in the umbel; peduncle ¼ to ⅝ in.; pedicels usually short and thick; calyx-tube conical, shining, ⅓ in. in diameter at the widest part; operculum shorter than or as long as the calyx-tube, conical, ending in a long point; stamens all perfect, inflexed in the bud; anthers ovate with parallel distinct cells. Fruit obconic, about ¼ in. long and ¼ in. broad at the distal end, with a narrow rim and a wide orifice; capsule scarcely sunk, with four valves protruding when open.

This is one of the most widely diffused species,⁴ occurring abundantly at low elevations in Tasmania, Victoria, and New South Wales; and by no means rare in South Australia and Queensland. It is known in Tasmania as red gum, in Victoria as swamp gum, and in New South Wales as white gum, swamp gum, or hickory. De Coque referring to it, under the name *E. Gunnii*, says⁵ that the swamp gum in New South Wales produces worthless timber, which is soft and spongy, open in the grain, and retentive of moisture. Totally unfit for any work whatever, it should never be used in any circumstances.

¹ *E. acervula*, Sieber, in De Candolle, *Prod.* iii. 217 (1828), is identified with *E. piperita*, Smith, by Bentham, *Fl. Austr.* iii. 207 (1866).

² *E. Stuartiana*, Mueller, was founded on a Tasmanian specimen collected by Stuart, which is *E. acervula*, Miquel. The name *E. Stuartiana*, Mueller, is now applied by Maiden to another species, the "Apple Eucalyptus" of Victoria and New South Wales. Cf. p. 1615.

³ *E. persicifolia*, Loddiges, *Bot. Cab.* vi. t. 501 (1821) is, I think, correctly referred to *E. viminalis*, Labill., by Bentham and Mueller, *Fl. Austral.* iii. 240 (1866); but Maiden, in *Proc. Linn. Soc. N.S. Wales*, xxvi. 556 (1901) considers it to be *E. acervula*, Miquel.

⁴ Maiden mentions several varieties, as *ovata* and *maculosa*, occurring in Australia, which it is not necessary further to allude to, as they would not be hardy in Britain.

⁵ *Journ. Proc. Roy. Soc. N.S. Wales*, xxviii. 213 (1894). Mueller, however, speaking of this species as a form of *E. Gunnii*, says that the wood is hard, good for many purposes, if straight stems are obtainable; as a rule not splitting well, but fair for fuel.

The only specimens which we know in England are three trees at Menabilly,¹ the largest of which was 29 ft. by 1 ft. 8 in. in January 1911; and another at Holkham, about nine years old, which was 30 ft. high in 1911. This species did not succeed at Kinloch Hourn, where all the seedlings were killed in 1894-1895.

(A. H.)

EUCALYPTUS VERNICOSA, DWARF GUM

Eucalyptus vernicosa,² J. D. Hooker, in *Lond. Journ. Bot.* vi. 478 bis (1847), and *Fl. Tasm.* i. 135 (1860); Bentham and Mueller, *Fl. Austral.* iii. 232 (1866); Rodway, in *Proc. Roy. Soc. Tasmania*, 1898-1899, p. 104, and *Tasmanian Flora*, 58 (1903); Maiden, in *Rep. Austr. Assoc. Advance. Sc., Hobart*, 1902, p. 376.

An erect shrub, with smooth bark, usually 4 to 6 ft., rarely 12 to 20 ft. in height in Tasmania. Young branchlets green and angled towards the top, reddish brown and terete elsewhere. Leaves (Plate 365, Fig. 2) on adult shrubs, alternate, opposite, or sub-opposite, narrowly ovate or elliptical, $\frac{1}{2}$ to 2 in. long, and $\frac{1}{2}$ to 1 in. wide, rounded or slightly tapering at the equal-sided base, rounded or acute at the apex, which is tipped with a short triangular sharp point; margin entire or faintly undulate; very thick and coriaceous in texture; equally green and shining as if varnished on both surfaces; oil-dots few, scattered, unequal, concealed in the thicker older leaves; lateral veins arising at an angle of 45° from the midrib; petiole $\frac{1}{8}$ to $\frac{1}{2}$ in. long.

Flowers in axillary umbels of three, two, or one; peduncle very short, not exceeding $\frac{1}{2}$ in. long; flower-buds sessile, $\frac{1}{4}$ to $\frac{1}{2}$ in. long, shining dark brown; calyx-tube turbinate, with two lateral ridges; operculum conical, shorter than the calyx-tube; stamens all perfect; anthers ovate, with closely contiguous but parallel and distinct cells. Fruit hemispheric, $\frac{1}{4}$ in. long, sub-sessile; rim narrow, flat or convex; capsule slightly sunk, with three to four valves protruding when open.

This species is confined to Tasmania, where it grows on the summits of the higher mountains, as on Mount Fatigue, where it was discovered by Gunn in 1842 at 4000 ft. altitude, on Mount La Perouse, Mount Sorell near Macquarie Harbour, Mount Geikie, and Mount Direction (2409 ft. altitude). It is called dwarf gum by Rodway, who says that it seems to occur only on the sub-alpine plains of the west and south-west of the island. He adds that on Mount La Perouse, where it attains 20 ft. in height, the leaves are all opposite and the flowers solitary; whereas on the west coast, where it remains bushy, the leaves are opposite and the flowers in threes; while taller plants on Mount Geikie bear large alternate leaves with flowers in threes. All these forms occur on the specimens raised from the same seed at Kinloch Hourn.

¹ A specimen branch of apparently another tree was sent from Menabilly to Kew in 1903, when it was reported to have been 33 ft. high. This tree cannot now be found.

² Apparently this is the *E. verrucosa*, mentioned by Landsborough in *Trans. Bot. Soc. Edin.* xx. 518 (1896). Mr. Birkbeck says in his notebook, that "they have two sorts at Edinburgh, one labelled *E. vernicosa*, the other *E. verrucosa*; except that the former has larger leaves, I see no difference." *E. verrucosa* is evidently a misprint, as no species has been described under that name.

We are unaware, when the species was first introduced.¹ Mr. Birkbeck considers it to be far the hardiest of the Eucalypts, forming a beautiful shrub, and not developing into a tree.

At Kinloch Hourn, it was planted in 1891, and had attained 13 ft. high in 1905, and has never been injured by frost. At Whittingehame, when about 5 ft. high it bore 26° of frost without injury, in February 1894; but it was killed to within three feet from the ground in the following severe winter.² It produced several shoots in the following year, one of which was preserved; Elwes found this 20 ft. high and very thriving in February 1905. It ripens seed freely at both Kinloch Hourn and Whittingehame. It is one of the species which is cultivated successfully at Inverewe on the west coast of Ross-shire. We have seen no specimens in England or Ireland, but, Mr. Kempshall states that at Abbotsbury it has passed through the last three severe winters without injury.

There is no specimen at Kew, a seedling, which was planted out in 1907, having died in 1910 without any apparent cause. (A. H.)

EUCALYPTUS MUELLERI, MUELLER'S RED GUM

Eucalyptus Muelleri, T. B. Moore, in *Proc. Roy. Soc. Tasm.* 1886, p. 208 (not Miquel,³ not Naudin⁴); Mueller in *Proc. Roy. Soc. Tasm.* 1886, p. 209; Maiden, in *Rep. Aust. Assoc. Advance. Sci., Hobart*, 1902, p. 376; Rodway, in *Proc. Roy. Soc. Tasm.* 1898-1899, p. 105, and *Tasm. Flora*, 58 (1903).

A tall erect tree, attaining in Tasmania in favourable situations a height of 200 ft.; but in some localities much smaller. Bark smooth from the base, greenish, blotched with reddish brown. Young branchlets glabrous, reddish, with prominent oil glands. Leaves (Plate 365, Fig. 6) alternate, thick and firm in texture, lanceolate, averaging 3 to 4 in. long and $\frac{3}{4}$ to 1 in. wide, straight or slightly falcate, unequal at the cuneate base, gradually tapering to an acuminate apex, ending in a short blunt point; margin white with remote and very shallow crenations; equally shining green on both surfaces; oil-dots numerous, irregular in size, mostly not pellucid; lateral nerves inconspicuous, arising from the midrib at an angle of 30°; petiole twisted, $\frac{1}{2}$ to $\frac{3}{4}$ in. long.

Flowers in umbels of threes; peduncle $\frac{3}{8}$ in. long; flower-buds sessile; calyx-tube angled; operculum cap-shaped, tuberculate, with an umbonate point; anther-cells parallel. Fruit-peduncle short, stout, $\frac{1}{4}$ to $\frac{1}{2}$ in. long, thickened at the distal

¹ Mr. Birkbeck received his first plant from the Edinburgh Botanic Garden in 1891.

² Landsborough, in *Trans. Bot. Soc. Edin.* xxiii. 145 (1905), who states that a seedling was planted at Cromla, Ayr, in 1906.

³ *E. Muelleri*, Miquel, in *Ned. Kruidk. Arch.* iv. 130 (1859), is a synonym of *E. incrassata*, Labillardière, a species occurring in Victoria.

⁴ *E. Muelleri*, Naudin, in *Rev. Hort.* lvii. 406 (1885), and in *Descrip. Eucalypt.* 45 (1821), described from a tree cultivated at Antibes, is unknown to me, and is a synonym of a previously described Australian species, possibly *E. salmonophloia*, Mueller. *E. Muelleriana*, A. W. Howitt, in *Trans. Roy. Soc. Victoria*, ii. pt. 1, p. 89 (1891) is a native of Gippsland in Victoria, and is possibly identical with *E. dextropinea*, R. T. Baker, in *Proc. Linn. Soc. N.S. Wales*, 1898, p. 417, t. 11.

end; fruit turbinate, $\frac{1}{3}$ in. long, about $\frac{5}{12}$ in. in diameter, reticulate-tuberculate on the surface, wide at the orifice with a convex rim; capsule slightly sunk, but with the three to four valves protruding when open.

This species¹ has been considered to be the lowland form of *E. vernicosa*; but it differs from that species in the shape and larger size of the leaves, which are not so thick or quite so shining as in that species, which has smaller fruit.

E. Muelleri is confined to Tasmania, where it was discovered by Mr. T. B. Moore in 1886, on the dividing range between the Huon and Derwent watersheds. Here on high bleak land, at 2000 feet elevation, there is a forest extending in a narrow strip for three miles along the southern side of the range, with trees averaging 100 ft. in height. Moore found trees 200 ft. in height in less exposed situations and at much lower elevations. Rodway,² who calls this tree mountain red gum, says that it is common on the mountains of south-western Tasmania at 2000 ft. elevation. Mueller states that this species is of great importance, as it is the only one of large size with good timber, which bears considerable frost. Both Mr. T. B. Moore and A. O. Green³ agree that the timber is valuable, being heavy, hard and strong; but the tree is not found in quantity near any shipping port.

This species is very rare in cultivation; and when found is generally labelled with an incorrect name. There are two trees at Abbotsbury, one about 40 ft. high, which were bearing fruit and flower buds in February 1911. These stand in an exposed position, and are considered to be very hardy. There is a young tree about 20 ft. high at Logan, Stranraer.

(A. H.)

There are two fine trees in a plantation near Derreen, Co. Kerry, one of which (Plate 364) the Marquess of Lansdowne showed me in August 1910. It was growing on wet peaty⁴ soil amongst poplars and *Thuya plicata*, which crowd it on both sides, and measured 63 ft. in height by 4 ft. 3 in. in girth at four feet above the ground. The other tree is about 100 yards distant, and measured, in 1911, 64 ft. by 5 ft. They are said to have been planted about 1880; and, as indicating their rapid growth, Lord Lansdowne says that close by there is a *Cupressus macrocarpa* of the same height, girthing 6 ft. 10 in., and a *Tsuga Albertiana*, also equal in height and 5 ft. 1 in. in girth. These two conifers were planted in 1878. A small specimen of *E. Muelleri* at Mount Usher is about 15 ft. high and very thriving. Seedlings of this valuable species, from seed kindly sent by Mr. Rodway, are now being raised at Holkham, Culford, Avondale, and other places.

(H. J. E.)

¹ There is no specimen of *E. Muelleri* in the Kew Herbarium, and my description is drawn up from fruiting specimens of the tree at Derreen, which were identified with this species by Maiden.

² In J. C. Penny, *Tasmanian Forestry*, 17, 19, 21 (Hobart, 1905).

³ In *Proc. Roy. Soc. Tasm.* 1902, p. 44.

⁴ Lord Lansdowne says the soil might be described as almost pure peat.

EUCALYPTUS URNIGERA, URN-BEARING GUM

Eucalyptus urnigera, J. D. Hooker, in *Lond. Journ. Bot.* vi. 477 bis (1847), and *Fl. Tasm.* i. 134, t. 26 (1860); Bentham and Mueller, *Fl. Austral.* iii. 227 (1866); Maiden, in *Rep. Aust. Assoc. Advance. Sci., Hobart*, 1902, p. 375; Rodway, *Tasmanian Flora*, 58 (1903).
Eucalyptus cornigera, Earl Annesley, *List of Plants hardy at Castlewellaan*, 88 (1903).

A tree, occasionally attaining 50 ft. in height in Tasmania. Bark peeling off, smooth, green blotched with reddish brown. Young branchlets terete, glabrous, green often tinged with red, dotted with oil-glands not raised above the surface. Leaves (Plate 365, Fig. 11) on adult trees, alternate, lanceolate or ovate-lanceolate, averaging 3 to $3\frac{1}{2}$ in. long and 1 to $1\frac{1}{2}$ in. broad, often falcate, equal or unequal at the short cuneate or rounded base, gradually tapering to the apex, which ends in a fine long straight point; margin whitish, revolute, with remote irregular shallow crenations; thick in texture, with numerous translucent unequal oil-dots; equally dull green on both surfaces; lateral veins numerous, arising from the midrib at an angle of 40° ; petiole twisted, $\frac{1}{2}$ to $\frac{3}{4}$ in. long.

Leaves on young trees and on suckers, opposite, sessile, orbicular or broadly ovate, $1\frac{1}{2}$ to 2 in. in diameter, deeply cordate at the base, emarginate at the apex, from which arises a short point; conspicuously crenulate in margin; green on both surfaces; lateral nerves 7 to 8 pairs, arising from the midrib at an angle of 70° . Branchlets reddish, covered with bright red raised oil-glands.

Flowers in axillary umbels of three; peduncle $\frac{3}{4}$ in. long, slender, slightly thickened at the distal end; pedicels $\frac{2}{5}$ to $\frac{1}{2}$ in. long; flower-buds, $\frac{1}{2}$ in. long; calyx-tube narrowly urn-shaped, swollen at the base, contracted in the middle, and expanded above; operculum wider than the calyx-tube, cap-shaped, with a projecting umbo in the centre; stamens all perfect, inflexed in the bud; anthers with distinct parallel cells. Fruit, on pedicels which are nearly $\frac{2}{5}$ in. long, urn-shaped, swollen below, narrowed in the upper third, with a projecting narrow rim; surface with raised oil-glands; valves deeply sunk. The fruit varies in size, long narrow and short broad forms occurring, varying from $\frac{1}{2}$ to $\frac{3}{4}$ in. long, and $\frac{3}{10}$ to $\frac{4}{10}$ across the distal end.

1. Var. *elongata*, Rodway, ex Maiden, in *Rep. Aust. Assoc. Advance. Sci., Hobart*, 1902, p. 376.

A taller tree than the type, attaining 200 ft. in height, with smooth ashy-white bark, and very long linear-lanceolate leaves (up to 6 to 9 in. in length). Flowers; operculum conical, umbonate, half the length of the calyx-tube. Fruit much shorter than in the type, pyriform-globose, slightly constricted. This occurs at 1000 to 2000 feet elevation in Tasmania, and, though I have seen no specimens, seems to me to be a distinct species, or possibly a hybrid of *E. urnigera* with *E. viminalis*. We have found nothing like this form in cultivation in England.

E. urnigera is confined to Tasmania, where it is common in the mountains,

especially in the south. Rodway,¹ who calls it urn-bearing gum, informs us that it has not been found at lower altitudes than 1000 feet, and extends up to 3000 feet. At 2000 feet it is very similar to *E. Muelleri* in general appearance, both of bark and habit; but below this altitude, it is said that the bark becomes ashy-white, and the leaves very long and narrow, constituting var. *elongata*. So far as we can ascertain this species has no economic value in Tasmania, the timber being considered, according to Rodway, brittle and worthless.

It was discovered² by R. Brown at the beginning of the nineteenth century; but was described by Hooker from specimens gathered by Gunn in 1842 on the summit of Mount Wellington and near Lake Echo. The exact date of its introduction is uncertain; but Hooker states that it was in cultivation in England in 1860.

This is one of the hardiest species, but is by no means a handsome tree, often being spare of branches. It is also devoid entirely of the glaucous bloom on the branchlets and leaves, which give a pleasing effect to *E. coccifera* and *E. Gunnii*. The late Earl Annesley considered it to be as hardy as the laurel; but it has suffered at several places from frost, especially when in a young stage.

The finest trees in England are two growing at Coombe Royal, Kingsbridge, Devon, the larger³ of which was 72 ft. by 9 ft., and the other 60 ft. by 6½ ft. in 1904.

At Menabilly, the finest Eucalyptus is a tree of this species, with a clean straight stem, which Mr. W. H. Bennett reported to be 80 ft. by 3 ft. 9 in. at three feet from the ground in 1909. It⁴ was raised from seed about twenty years ago, and is hardier at Menabilly than *E. coccifera* or *E. cordata*. Younger trees here, planted in 1901, were about 30 ft. high in 1911.

At Sidbury Manor, Sidmouth, there is a tree, of which Sir Charles Cave sent us a branch in 1910. Miss Woolward measured it in 1904, as 43 ft. high, with three stems springing from near the base, the main one being 3 ft. 8 in. in girth. It was then fifteen years old, and growing in a sheltered situation at 250 ft. above sea-level.

At Abbotsbury, this is considered to be one of the hardiest species. Young plants have passed through three severe winters without injury, and are now growing freely. There are several specimens, the largest of which is 50 ft. by 5 ft.⁵ At Leonardslee, Sussex, specimens of *E. urnigera*, though 20 ft. high, were killed in a severe winter. At Ponfield, Herts, a small tree, which was 15 ft. high in 1906, died in 1910. We have seen no specimens near London or in the eastern counties. At Cefnamwich, Nevin, N. Wales, a tree raised from seed in the spring of 1894, was 45 ft. high and 2 ft. 6 in. in girth in December 1910.

In Scotland, the finest specimens are at Stonefield, Loch Fyne, one of which measured in December 1910, 81 ft. high by 5 ft. in girth at four feet from the ground.

¹ In J. C. Penny, *Tasmanian Forestry*, 17, 19, 21 (1905).

² A specimen in the Kew Herbarium is labelled: "R. Brown, *Iter Australiense*, 1802-5, No. 4775."

³ From this tree, which was called *E. montana*, a specimen was sent to Kew, in 1874, when it was reported to be 50 ft. high. This tree is probably the oldest in England, and may date back earlier than 1860.

⁴ Mr. Rashleigh in a letter to Kew, reported it to be 60 ft. by 2½ ft. in 1903. It was 85 ft. by 4 ft. in January 1911.

⁵ *E. urnigera* has been grown at Abbotsbury under several names, as *E. hemastoma*, *E. rudis* × *E. rostrata*, and *E. Stuartiana*.

The forester, Mr. R. Stewart, says that it has never been injured by frost since it was planted out. It¹ had long been known erroneously both as *E. Gunnii* and *E. coccifera*.

This is one of the hardy species at Kinloch Hourn, where there are several good specimens. There are also many trees² on the hill-sides up to 600 ft. above sea-level, which were raised from Tasmanian seed in 1895, and were planted out in 1896 to 1898. They were about 24 to 28 ft. high in 1907. In Arran, a specimen³ planted in 1885 was killed in the winter of 1894-1895; but it was growing in a wood amidst higher trees, and never prospered. None of the Eucalyptus do well when shaded by other trees; and Mr. Bateman lays great stress on this fact, as borne out by his experiments in planting *E. Gunnii* at Brightlingsea. We have received a specimen from Whitefarland, Pirnmill, Arran, where there are several trees, the oldest of which, planted in 1895, is now 23 ft. by 3 ft. 4 in. at a foot from the ground. This species also thrives well at Inverewe, where a tree, twelve years old, was 35 ft. by 1 ft. 8 in. in 1912. It also succeeds at Logan, near Stranraer. A tree⁴ at Roseneath Manse, planted in 1883, was 12 ft. high in 1895, and had never been injured by frost; but it subsequently died in a mild winter without any apparent cause. At Dalkeith, it is reported⁵ to have borne without injury the severe frost of 7th January 1894, when the temperature fell to 4° Fahr.

In Ireland, this species proved very hardy at Castlewellan, where a tree⁶ attained 65 ft. in height; but it was blown down some years ago. There are two or three younger trees now living raised from its seed; but Eucalyptus trees are no longer planted at Castlewellan, as they are always blown down when they grow to a large size. We have not seen any specimens of *E. urnigera* elsewhere in Ireland except at Mount Usher, where there are small trees, raised from seed sown in 1904. These are very thriving, and bore fruit in 1911. (A. H.)

¹ This tree is erroneously called *E. Gunnii* by Dr. Landsborough, in *Trans. Bot. Soc. Edin.* xx. 517 (1896), and xxiii. 144 (1905). It was planted in 1881, had attained 38 ft. high in 1896, and measured 71 ft. by 4 ft. 4 in. in 1905.

² Erroneously called *E. acervula* by Dr. Landsborough, in *Trans. Bot. Soc. Edin.* xiii. 145 (1905).

³ Dr. Landsborough, in *Trans. Bot. Soc. Edin.* xx. 519 (1896), and xxiii. 146 (1905).

⁴ *Journ. Roy. Hort. Soc.* xviii. 76 (1895).

⁵ A tree formerly cultivated at Castlewellan as *E. cornigera* was undoubtedly *E. urnigera*; and specimens of it were so named by Naudin. It appears that the trees of this species at Castlewellan differed in habit. One with numerous spreading branches was called *E. cornigera*; others with few branches and ungainly in habit were named *E. urnigera*.



COMMON SPRUCE IN MASSACHUSETTS

PLATE 340.



COMMON SPRUCE AT STUDLEY

PLATE 341.

69-12139



PLATE 342.

SPRUCE AVENUE AT OAKLEY PARK



COMMON SPRUCE AT GWYDYR CASTLE



SPRUCE AT KILWORTH, IRELAND



WESTERN HIMALAYAN SPRUCE AT MELBURY

PLATE 345.



BLACK SPRUCE AT COLESBORNE

PLATE 346.



SIKKIM SPRUCE AT CASTLEWELLAN

PLATE 347.



COMMON JUNIPER AT COLESBORNE

PLATE 348.



JUNIPERUS RECURVA AT CASTLEWELLAN

PLATE 349.



CATALPA AT HAM MANOR

PLATE 350.



ROBINIA AT FROGMORE

PLATE 351.



ROBINIA AT THE MOTE, MAIDSTONE

PLATE 352.



TRUNK OF ROBINIA IN AMERICA



EVERGREEN MAGNOLIA IN NORTH CAROLINA

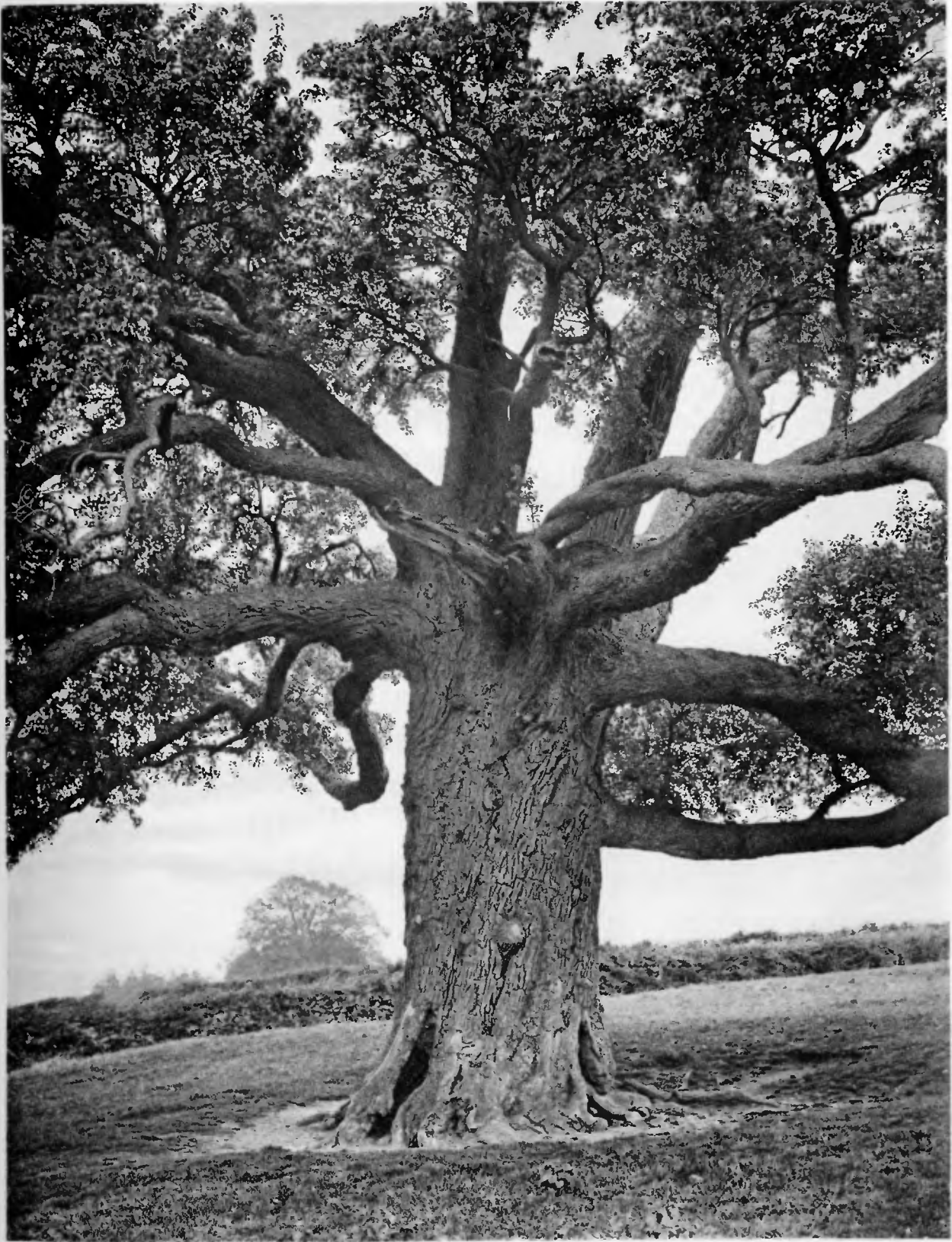


WILD CHERRY IN SAVERNAKE FOREST



CHERRY AT GEORGE'S GREEN, SLOUGH

PLATE 355.



PEAR AT LASSINGTON, GLOUCESTER

PLATE 356.



PEAR AT STOCKTON, WORCESTER

PLATE 357.



MAGNOLIA AT WEST DEAN PARK



BLUE GUM AT TORQUAY

PLATE 359.



BLUE GUM AT PENMERE

PLATE 360.



EUCALYPTUS COCCIFERA AT POWDERHAM

PLATE 361.



EUCALYPTUS GUNNII AT BRIGHTLINGSEA

PLATE 362.



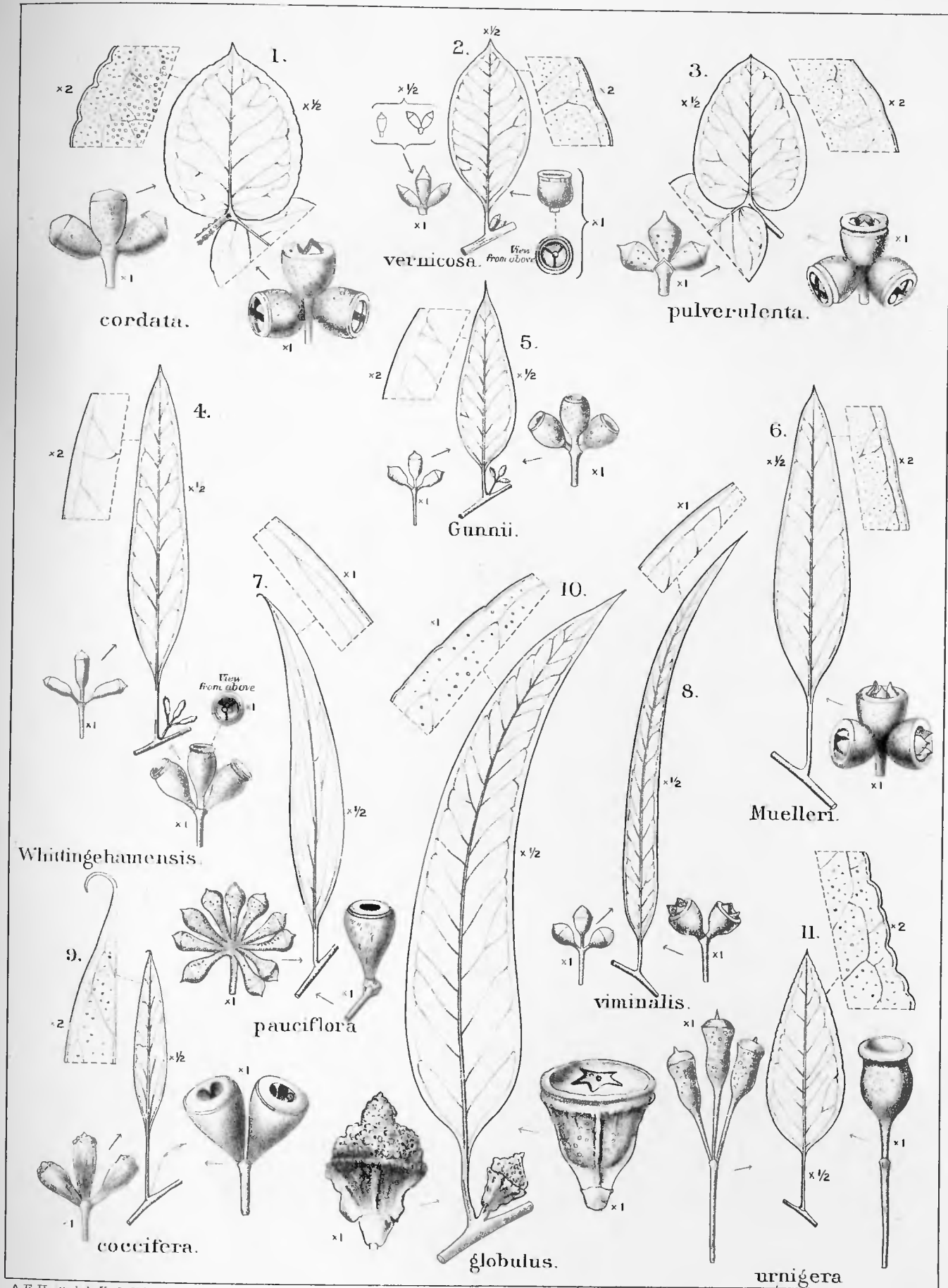
EUCALYPTUS WHITTINGEHAMENSIS AT WHITTINGEHAME

PLATE 363.



EUCALYPTUS MUELLERI AT DERREEN

PLATE 364.



A.E. Ibbitt, del. H. B. H. H. H.

WALNUT AT CAM-YR-ALYN PARK

THE magnificent Walnut tree here represented was unknown to us when Vol. II. was published in 1907. We are indebted to Mr. F. R. S. Balfour for its discovery, and to Mr. G. Cromar for the following particulars:—The tree stands in Cam-yr-Alyn Park, Denbighshire, the property of Wilson Sweetenham, Esq., and in 1910, when the photograph was taken by Mr. W. P. Wilkes, was about 70 ft. high, and $32\frac{1}{2}$ ft. in girth. It has five main branches, which measure as follows: 9 ft. 4 in., 10 ft. 3 in., $12\frac{1}{2}$ ft., 9 ft., and $11\frac{1}{2}$ ft. respectively, and cover an area of 88 ft. by 80 ft. The tree is healthy, and grows on a light loam and gravelly soil, at an elevation of about 100 feet above sea-level. The water in this district is full of lime, and there is a stream about 15 yards from the tree.



WALNUT AT CAM-YR-ALYN PARK

PLATE 366.

ORIENTAL PLANE AT WESTON PARK

THE Plane tree here figured was referred to on page 622 in the third volume of our work, as having measured, in 1875, 80 ft. by 18½ ft. Until I saw it in 1909 I had not realised that though not quite so large as the tree at Ely, figured on Plate 174, it is in some respects a finer and better-shaped tree. Though it was seriously damaged in March 1894 by a gale, it is now in perfect health, and measured, in August 1909, about 80 ft. by 20 ft. in girth, and 120 paces round the branches. I am informed by the Earl of Bradford that he has no record as to the date when it was planted. The leaves of this tree are unusually large, and though not so deeply cut as usual in the Oriental Plane, were quite free from the fungus *Glæosporium* (cf. p. 618).



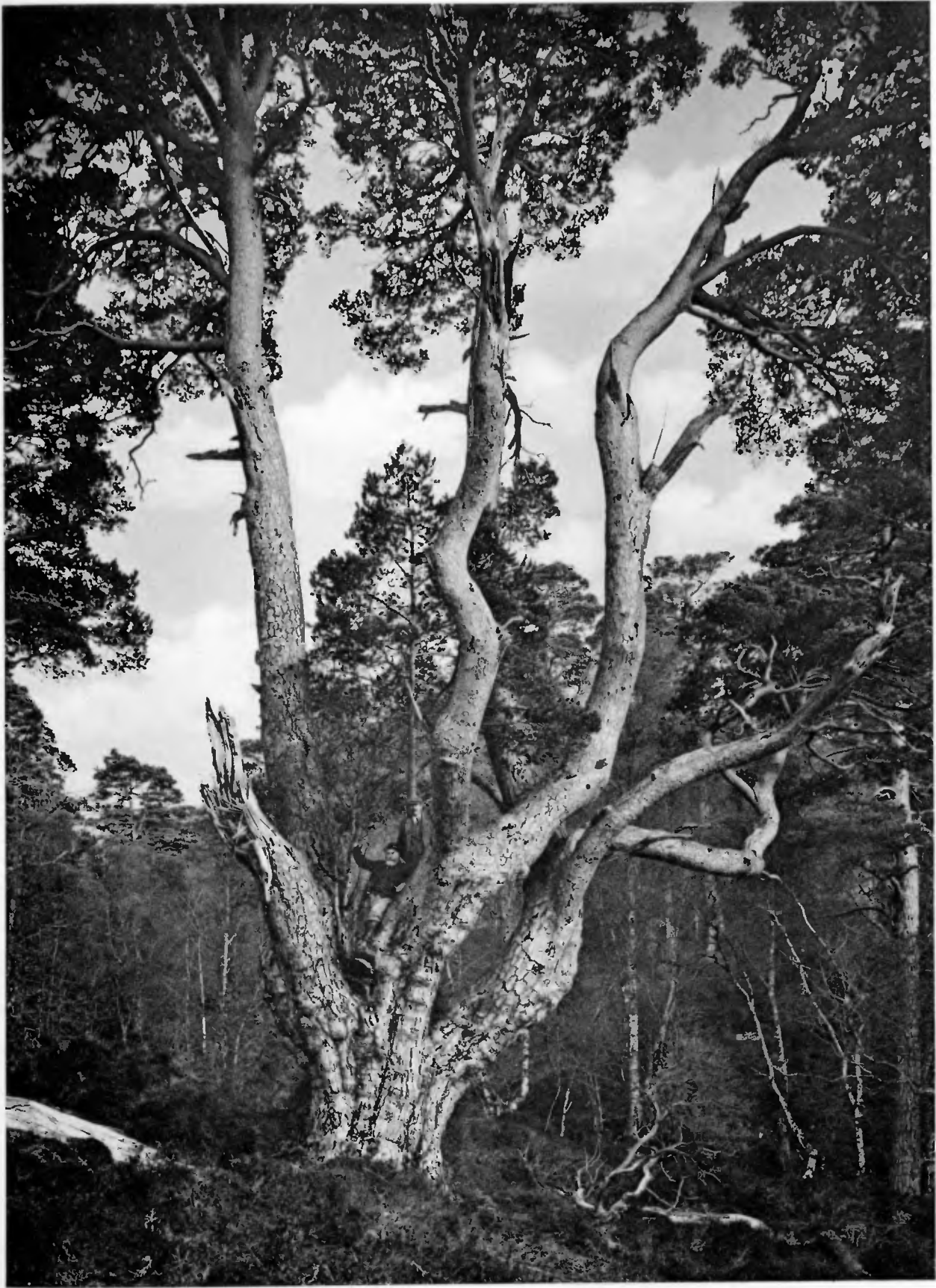
ORIENTAL PLANE AT WESTON PARK.

SCOTS PINE IN GLEN MAILLIE

THE remarkable tree which is here figured, though the size of the plate is insufficient to do it justice, is a larger one than any of those mentioned in Vol. III. of this work. I am not sure whether it is the same tree of which Capt. Ellice had sent me a sketch, and which is mentioned on p. 588. Though much injured by the breaking of two of the large limbs, it was still healthy when I saw it in 1910. The trunk in the smallest place near the ground measured 18 ft. 1 in., and at five feet from the ground, below the fork, 22 ft. in girth. Its height is about 75 ft. An unusual feature in this tree is a young pine about 25 ft. high and 2 ft. 9 in. in girth, which has grown from a seed dropped in the fork of the old tree; and which has now become as completely united with the sound wood of the trunk as if it was a true branch. A good-sized birch and a small rowan are also growing as epiphytes on the trunk.

The primæval forest, in which this tree is probably the largest, is in my judgment the finest in Scotland, and extends from a little above sea-level up to 700 or 800 feet. The largest trees in it are probably over 300 years old, and grow on dry ridges among patches of peat covered with long heather and intersected by small watercourses. A few hollies, rowans, and birches are scattered among the pines; but few seedlings of the latter are visible owing to the presence of deer. There are many fine timber trees, as well as trees attractive to the naturalist. Among them is one 74 ft. high and 13 ft. in girth, which has three tall clean stems of equal size, dividing at about 10 feet from the ground and remaining close together for a considerable height.

In Lochiel's house at Achnacarry there is a beautiful water-colour, painted in 1847 by I. Giles, of a pine called "The Fir of Gusach," which formerly grew on the shore of Loch Arkaig, but has long ago disappeared. It was remarkably similar in form and size to the tree now figured.



SCOTS PINE IN GLEN MAILLIE

LARCH AT POLTALLOCH

THE plate shows a remarkable instance of witches' broom, growing on a larch, which I first heard of from Col. Malcolm of Poltalloch, Argyllshire, to whom I am much indebted for the photograph. This tree grows in a wood called Bar-na-sluid, about two miles from Poltalloch, at perhaps 200 ft. above sea-level, and is believed to be 60 or 70 years old. When I saw it in September 1911, it appeared to be quite healthy, and was about 48 ft. by 5 ft. The dense mass of twigs forming the witches' broom was about 15 ft. wide and 10 ft. deep. A stunted spruce grew close to the base of the tree, which was cut away in order that the photograph might be taken.



LARCH AT POLTALLOCH.

PLATE 369.

LABURNUM ALPINUM

THE finest specimen, that I have seen or heard of, grows at Countesswells near Aberdeen, the seat of Sydney J. Gammell, Esq., to whom I am indebted for the photograph taken by him on 30th June 1912, when the flowers were a little past their prime. The age of this tree is uncertain, but probably coeval with the oldest part of the house, built about 1700. Though several large limbs have fallen outwards, and the main trunk, which is split into three portions at the base, has been cut off at about ten feet from the ground; yet the vitality of the tree is so great, and the old wood so resistant to decay, that the tree is covered with young branches; and in some seasons the racemes of flower are so thickly set that the leaves can hardly be seen. The height of the tree is about 30 ft.; the girth of the largest part of the trunk is 7 ft., and of the split trunk at the ground 10 ft. The spread of the branches covers an area 153 ft. round. The fertile granite soil of the district, where I saw many laburnums of large size, seems specially favourable to this species. A tree, self-sown, at the foot of a cherry at Balcraig farm, near Aboyne, was over 30 ft. high and almost without branches for 20 ft. Mr. H. B. Watt tells us of a fine tree in the grounds of Dr. R. Farquharson at Finzean, Aberdeenshire, which measured on 27th June 1912, when it was in full flower, about 25 ft. in height and 5 ft. 10 in. in girth at three feet from the ground. Here the altitude is 550 feet; but Mr. Watt sent us specimens in flower of both species from Braemar at 1100 to 1200 feet. The alpine laburnum seems to grow and flower in shade better than the common laburnum.



ALPINE LABURNUM AT COUNTESSWELLS, ABERDEEN



SPRUCE PLANTATION AT RHINDBUCKIE HILL, DURRIS

PLATE 371.



The Trees
of
Great Britain
& Ireland

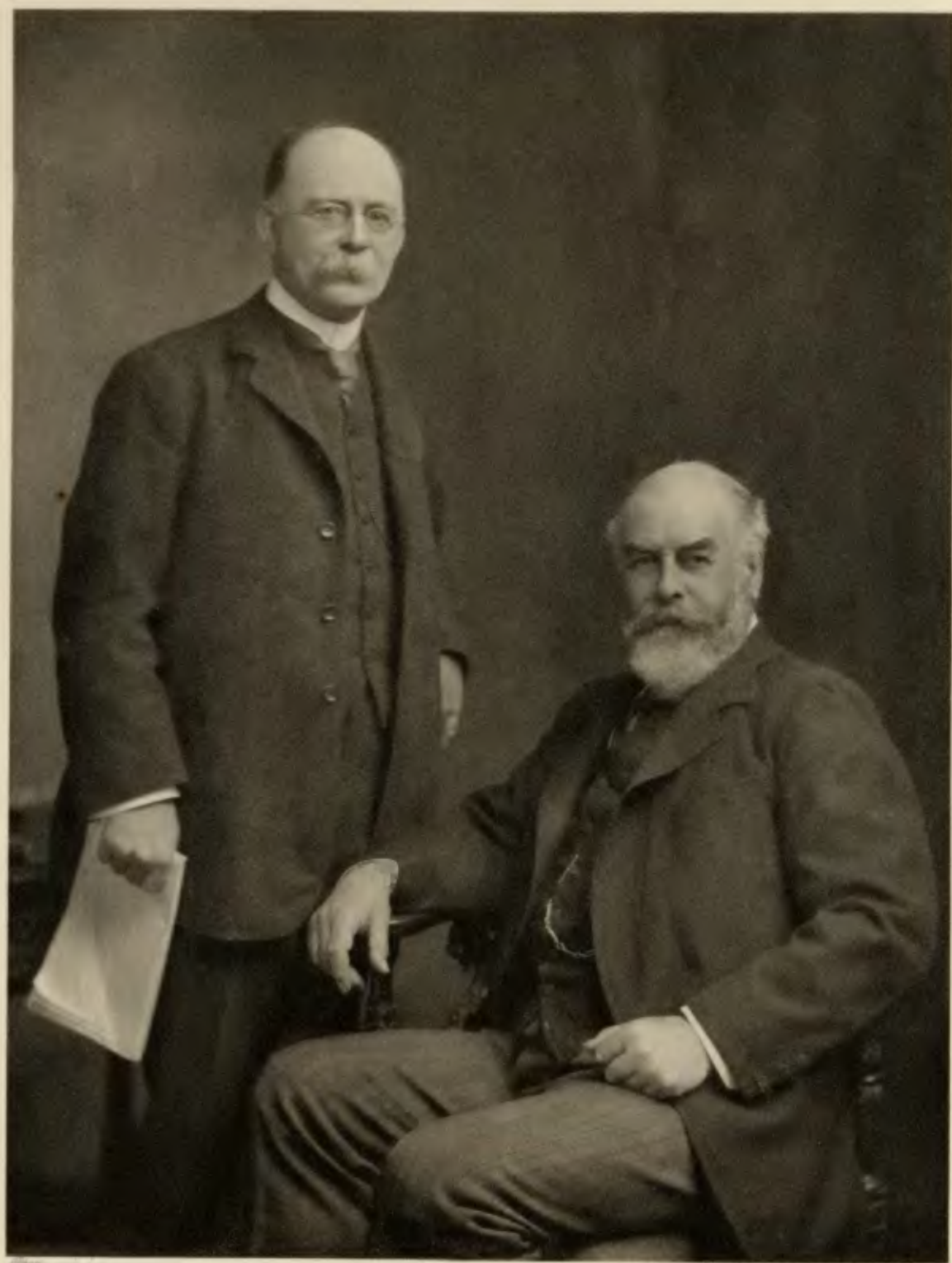
BY
Henry John Elwes, F.R.S.
AND
Augustine Henry, M.A.

Edinburgh: Privately Printed

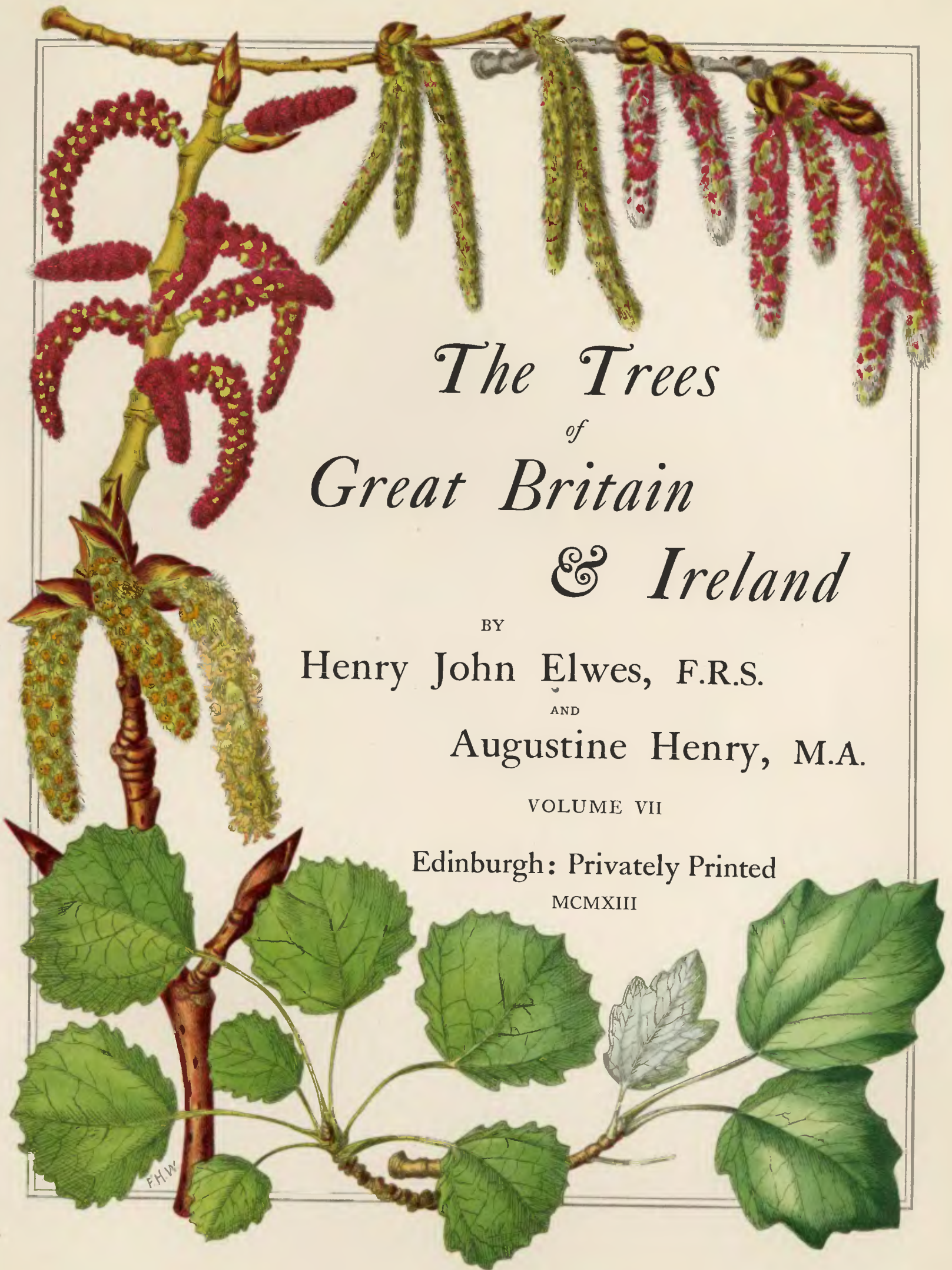
F.H.W.

THE TREES OF GREAT BRITAIN AND IRELAND





Wm. & M. L. G. & Co. N. Y.



The Trees
of
Great Britain
& Ireland

BY
Henry John Elwes, F.R.S.
AND
Augustine Henry, M.A.

VOLUME VII

Edinburgh: Privately Printed

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F.H.W.

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TILIA

Tilia, Linnæus, *Hort. Cliff.* 204 (1735), *Sp. Pl.* i. 514 (1753), and *Gen. Pl.* 267 (1767); Bentham et Hooker, *Gen. Pl.* i. 236, 986 (1862-7); V. Engler, *Monog. Gatt. Tilia*, pp. 1-159 (1909).

DECIDUOUS trees, belonging to the order Tiliaceæ, with tough fibrous inner bark. Leaves simple, long-stalked, alternate, arranged on the branchlets in two rows; unequal¹ and cordate or truncate at the base; acute or acuminate at the apex; serrate or toothed; venation pseudo-palmate, the midrib giving off secondary nerves pinnately on both sides, the lower two pairs of which arise together at the base, and give off tertiary nerves on the outer side only. Stipules ligulate, membranous, caducous.

Flowers white, fragrant, regular, perfect, in cymes; peduncle connate with the axis of a membranous elongated persistent bract, from the middle of which it apparently arises; inflorescence and bract springing from the axil of a leaf, alongside a bud, which develops into a branch in the following year.² Sepals five, distinct; petals five, imbricate in bud. Stamines either absent or present as petaloid scales, one opposite each petal, and united with the base of the stamens. Stamens numerous, free, or in five clusters united together at the base. Filaments unbranched, or forked at the apex, with each branch bearing an extrorse half-anther. Ovary sessile, five-celled; style erect, dilated at the apex into five spreading stigmatic lobes; ovules two in each cell. Fruit nut-like, dry, indehiscent, one-celled, and one- to two-seeded by abortion. Seeds obovate, with fleshy albumen. Cotyledons reniform or cordate, palmately five-lobed, raised above ground on germination.

In winter the twigs are zig-zag and bear lateral buds, disposed alternately in two ranks; each bud with two to three scales visible externally, ovoid, obliquely displaced to one side of the semicircular leaf-scar, which is set on a prominent pulvinus. Stipule-scars small, linear or oblong, one on each side of the leaf-scar. Terminal bud absent; a circular scar at the apex of the twig, opposite the uppermost leaf-scar, indicating where the tip of the branchlet fell off in early summer. Base of the branchlet girt with a ring of scars, due to the fall of the bud-scales in the previous spring.

About twenty species of *Tilia* can be distinguished. These are widely distributed in the temperate regions of the northern hemisphere, extending southward in North America as far as the highlands of Mexico; but in the old world, while common in Europe and in northern and eastern Asia, no species is known in

¹ Cf. Van Tieghem, in *Ann. Sci. Nat. (Bot.)* iii. 378 (1906), on the peculiar asymmetry in the leaves and stipules of the lime.

² The occurrence of an inflorescence and a normal bud in one and the same axil is unusual; and is explained by the fact that the former is the result of the very early development of a flower-bud under the first scale of the normal bud, the other scales of the latter remaining dormant until the following season.

northern Africa or in the Himalayas. A large number of hybrid forms have arisen, some of which are common in cultivation. The following key, based on the characters of the branchlets and leaves, will serve to distinguish the species and hybrids which are cultivated in this country.

I. LEAVES GREEN BENEATH, WITH AXIL-TUFTS OF PUBESCENCE, BUT WITHOUT ANY STELLATE TOMENTUM.

(a) *Axil-tufts*¹ present at the base of the leaf and elsewhere.

* *Branchlets glabrous, or nearly so. Leaves glabrous, except for axil-tufts beneath.*

1. *Tilia mongolica*, Maximowicz. North China and Mongolia. See p. 1679.

Branchlets quite glabrous, reddish. Leaves $2\frac{1}{2}$ in. wide, often trilobed, glaucous beneath with non-prominent tertiary veins, coarsely toothed.

2. *Tilia cordata*, Miller. Europe, Caucasus. See p. 1656.

Branchlets slightly pubescent at first, speedily becoming glabrous. Leaves 2 to $2\frac{1}{2}$ in. wide, bluish green beneath with non-prominent tertiary veins, finely serrate.

3. *Tilia vulgaris*, Hayne. A hybrid, occasionally wild in Europe. See p. 1664.

Branchlets quite glabrous. Leaves 3 in. wide, dull green above, pale green beneath and with prominent tertiary veins, finely serrate with short points to the teeth.

4. *Tilia euchlora*, Koch. A hybrid, occasionally wild in the Caucasus. See p. 1674.

Branchlets usually quite glabrous. Leaves $2\frac{1}{2}$ to 3 in. wide, dark shining green above, pale green beneath and with prominent tertiary veins, finely serrate with long points to the teeth.

** *Branchlets densely pubescent with long hairs.*

5. *Tilia platyphyllos*, Scopoli. Europe. See p. 1661.

Leaves 3 to 4 in. wide, upper surface with short scattered pubescence, lower surface covered with long hairs.

(b) *Axil-tufts absent at the base of the leaf, present elsewhere.*

6. *Tilia americana*, Linnæus. North America. See p. 1685.

Branchlets glabrous. Leaves 5 to 6 in. long and $3\frac{1}{2}$ to $4\frac{1}{2}$ in. wide, broadly ovate, cordate at the base, glabrous beneath and with numerous prominent parallel tertiary veins; margin with long-pointed coarse serrations.

7. *Tilia paucicostata*, Maximowicz. Western China. See p. 1680.

Branchlets glabrous. Leaves $2\frac{1}{2}$ in. long and 2 in. wide; ovate, usually truncate at the base, glabrous beneath with few prominent irregular tertiary veins; margin with long-pointed fine serrations.

II. LEAVES GREEN OR GREYISH BENEATH, WITH SCATTERED STELLATE TOMENTUM.

(a) *Under surface of the leaves without axil-tufts, but with long hairs on the midrib.*

8. *Tilia Moltkei*, Schneider. See p. 1686.

A hybrid, with large leaves similar to those of *T. americana* in shape and serrations. Buds and branchlets glabrous.

¹ These are tufts of hairs at the junctions of the midrib and lateral nerves on the under surface of the leaf, which are now often termed *domatia*; they are the abodes of mites, and serve a useful purpose in the economy of the tree. They were fully studied and described by Lundström, in *Nov. Act. Reg. Soc. Sci. Upsala*, xiii. pt. 2, pp. 3-10 (1887). Cf. Lord Avebury, *Brit. Flowering Plants*, 123 (1905).

9. *Tilia spectabilis*, Dippel. See p. 1686.

A hybrid similar to *T. Moltkei*, but with smaller leaves, which have long hairs on the principal nerves, as well as on the midrib. Buds pubescent in their upper half. Branchlets with traces of stellate pubescence.

(b) *Under surface of the leaves with axil-tufts.*

10. *Tilia Michauxii*, Nuttall. North America. See p. 1689.

Leaves usually large,¹ 5 to 7 in. in length and 4 to 6 in. wide; ovate-cordate, very oblique at the base, with long-pointed large triangular serrations. Buds and branchlets glabrous.

III. LEAVES WHITE OR GREY BENEATH, AND COVERED WITH A DENSE STELLATE TOMENTUM.

(a) *Branchlets glabrous.*

* *Axil-tufts present.*

- 10A. *Tilia Michauxii*, Nuttall. In some forms of this species the leaves are densely greyish tomentose beneath. See above, No. 10.

* *Axil-tufts absent.*

11. *Tilia heterophylla*, Ventenat. North America. See p. 1688.

Leaves ovate-cordate, very oblique at the base, 4 to 5 in. long, 3 to 4 in. wide, covered beneath with a silvery white tomentum; serrations coarse and short-pointed.

12. *Tilia Oliveri*, Szyszyłowicz. China. See p. 1681.

Leaves orbicular-ovate, 3 to 4 in. long, $2\frac{1}{2}$ to 3 in. wide, silvery white beneath; serrations minute, crenate.

(b) *Branchlets pubescent.*

* *Axil-tufts present.*

13. *Tilia Maximowicziana*, Shirasawa. Japan. See p. 1683.

Leaves orbicular-ovate, averaging 5 in. long and broad, covered beneath with a greyish tomentum; axil-tufts and tomentum on midrib and nerves brownish.

** *Axil-tufts absent.*

14. *Tilia tomentosa*, Moench. South-eastern Europe, Asia Minor. See p. 1675.

Leaves orbicular-ovate, 3 to 5 in. across, greyish or snowy white beneath, with stout or slender short petioles; serrations fine, regular, ending in short points. Buds, branchlets, and petioles grey tomentose.

15. *Tilia petiolaris*, Hooker. See p. 1677.

Possibly a sport of *T. tomentosa*, from which it differs in the pendulous habit of the tree, the long slender petioles, and the peculiar fruit.

16. *Tilia mandshurica*, Ruprecht and Maximowicz. Manchuria, North China, Korea. See p. 1682.

Leaves orbicular-ovate, 4 to 5 in. across, white beneath; margin often one- to two-lobed, with coarse serrations, ending in long awn-like points. Branchlets, buds, and stout petioles brown tomentose.

¹ In native specimens the leaves are smaller, averaging 4 to 5 in. long and 3 to 4 in. wide.

17. *Tilia Miqueliana*, Maximowicz. Cultivated in Japan. See p. 1684.

Leaves remarkably variable in shape, deltoid or ovate, usually much longer than broad, 3 to 4 in. long and 2 to 2½ in. wide, grey beneath; serrations irregular, ending in short points. (A. H.)

TILIA CORDATA, SMALL-LEAVED LIME

Tilia cordata, Miller,¹ *Gard. Did.* No. 1 (1768); Moench, *Verz. Ausl. Weissenst.* 135 (1785); Schneider, *Laubholzkunde*, ii. 372 (1909); V. Engler, *Monog. Gatt. Tilia*, 74 (1909).

Tilia europaea, Linnaeus, *Sp. Pl.* 514 (1753) (in part); Loudon, *Arb. et Frut. Brit.* i. 364 (1838).

Tilia ulmifolia, Scopoli, *Fl. Carn.* i. 374 (1772); Sargent, in *Garden and Forest*, ii. 256, f. 111 (1889).

Tilia parvifolia, Ehrhart, *Beitr. Naturk.* v. 159 (1790); Willkomm, *Forstliche Flora*, 729 (1887); Mathieu, *Flore Forestière*, 29 (1897).

Tilia microphylla, Ventenat, in *Mem. Acad. Sc. Paris*, iv. 5 (1803).

Tilia sylvestris, Desfontaines, *Table Éc. Bot. Mus. Paris*, 152 (1804).

A tree, attaining 100 ft. in height and 20 ft. in girth. Bark smooth and grey on young trees; ultimately on old trunks divided by narrow longitudinal fissures into scaly ridges. Young branchlets green, slightly pubescent at first, speedily becoming glabrous, the pubescence, however, being often retained on short shoots; older branchlets dark brown. Leaves² (Plate 407, Fig. 8), membranous, 2 to 2½ in. wide, usually broader than long, smooth and not wrinkled, cuspidate at the apex, cordate at the base; margin non-ciliate, regularly serrate, the teeth ending in short cartilaginous points; upper surface dark green, shining, glabrous except for occasional long hairs on the nerves; lower surface bluish or glaucous green, glabrous except for the conspicuous dense orange-brown axil-tufts at the base, and at the junctions of the midrib, primary, and secondary nerves; tertiary veins scarcely prominent on the under surface, and more irregular, and less straight and parallel than in *T. vulgaris* and *T. platyphyllos*; petiole about half as long as the blade, slender, glabrous, or with a few scattered hairs.

Cymes directed upwards, five- to seven-flowered; bract long-stalked, glabrous; pedicels glabrous or with a few scattered hairs; sepals pubescent; petals glabrous; stamens about thirty, longer than the petals; staminodes absent; ovary tomentose, style glabrous. Fruit globose, faintly ridged, apiculate at the apex, covered with long scattered tomentum; shell thin and fragile.

In winter the buds are more globose than those of *T. vulgaris* or *T. platyphyllos*, and appear to be composed of two external scales, though the

¹ E. G. Baker, in *Journ. Bot.* xxxvi. 318 (1898), states that Miller's specimen in the British Museum is *T. platyphyllos*; but there is no evidence that this is a type specimen. It is plain from Miller's statement that *T. cordata* "grows naturally in the woods in many parts of England," and from his identification of it with *Tilia foemina, folio minore*, C. Bauhin, *Pinax*, 426 (1671), that he meant the small-leaved lime.

² The leaves on coppice shoots in the first year are remarkably large. Mr. Riddelsdell sent us specimens from Glamorganshire, with leaves 5 to 7 in. long and nearly as broad, coarsely toothed, deeply and narrowly cordate at the base, ending at the apex in a long acuminate point, and on short petioles scarcely an inch in length. As the coppice shoots lengthen year by year, the leaves gradually assume their normal form, small in size, broader than long, and with long petioles. Lees, in *Bot. Worcestershire*, 16 (1867), argues from the variable appearance of the leaves of coppice shoots of *T. parvifolia*, that the common lime is only a variety of the latter. The coppice shoots of most broad-leaved trees have peculiar leaves, different from those in the adult state, and more alike in allied species, so that their discrimination is difficult.

pubescent tip of a third scale may be discerned at the apex of the bud; the first and second scales are shining, glabrous, ciliate.

This species is readily distinguished by the bluish tint of the under surface of the leaves, which are very different in their tertiary venation from the other common limes. The erect and not pendulous cymes of flowers are also a peculiar feature.

VARIETIES

This species, as limited here to the European and Caucasian small-leaved lime, displays little variation in the wild state, the varieties¹ established by Schneider on the shape and size of the leaf and the amount of the pubescence on the fruit, being probably due to soil conditions, and not worth enumerating. A few peculiar sports have been noticed, none of which appear to be known in England:—

1. Var. *vitifolia*, Schneider, *op. cit.* Leaves three-lobed. Wild in Hungary.

2. Var. *aureo-variegata*, Schneider,² *op. cit.* Leaves variegated with yellow.

3. Var. *cucullata*, Henry (*var. nova*). Similar to the variety so named of *T. platyphyllos*. De Vries, *Species and Varieties*, 355, 669 (1906) and *Mutation Theory*, 470, fig. 106 (1910), draws attention to a tree with peltate and pitcher-like leaves, which is growing at Lage Vuursche, near Amsterdam.

DISTRIBUTION

The small-leaved lime is a native of the greater part of Europe and of the Caucasus, the closely allied forms³ in Siberia, Manchuria, and Japan being now regarded as distinct species. In Europe, it extends from northern Spain to the Ural range, attaining its maximum development in Russia, where it occasionally forms pure woods, but more usually, as is always the case elsewhere, growing as isolated trees or in small groups with other deciduous trees. It occurs as far north as the province of Volgoda, where it disappears after becoming a small shrub at lat. 62°. In the Ural, it reaches as far north as lat. 58° 50'. The finest lime woods

¹ Var. *Blockiana*, Schneider (*T. Blockiana*, Borbas), and var. *ovalifolia*, Spach, with leaves larger and less cordate than usual, are possibly of hybrid origin.

² *Tilia ulmifolia*, Scopoli, var. *foliis variegatis*, Petzold and Kirchner, *Arb. Musc.* 156 (1864), is another name for this variety.

³ The Asiatic forms are distinguished as follows from the European *T. cordata*:—

A. *Tilia sibirica*, Bayer, in *Verh. Z. Bot. Ges. Wien*. xii. 23 (1862).

Tilia cordata, var. *sibirica*, Maximowicz, in *Bull. Ac. St. Petersb.* xxvi. 432 (1860). Indigenous in western Siberia. Not yet introduced. Differs mainly in the leaves, truncate or cuneate at the base, with sharper serrations, and long hairs on the nerves.

B. *Tilia amurensis*, Ruprecht, *Fl. Cauc.* 253 (1869).

Tilia Maximowiczii, Baker, in *Journ. Bot.* xxxvi. 319 (1898).

Tilia cordata, var. *mandshurica*, Maximowicz, in *Mé. Biol.* x. 584 (1880). Indigenous in Manchuria and Korea. Not yet introduced. Differs in the larger leaves, with fewer coarser serrations, which are tipped with long points.

C. *Tilia japonica*, Simonkai, in *Math. Term. Koesl.* xxii. 326 (1888).

Tilia cordata, var. *japonica*, Miquel, in *Ann. Mus. Lugd. Bat.* iii. 18 (1867); Sargent, in *Garden and Forest*, vi. 111 (1893), and *Forest Flora Japan*, 20 (1894); Shirasawa, *Icon. Ess. Forest. Japon.* i. text 115, t. 72, figs. 1-10 (1900). Indigenous in Japan, where it is a small tree, rarely higher than 60 ft. It was introduced into the Arnold Arboretum, U.S.A., in 1886, where it is hardy, producing flowers and fruit every year; but is said to be scarcely distinct from the European species. It appears to differ mainly in the flowers, which are 20 to 40 in each cyme, and possess staminodes. Specimens collected by Elwes at Asahigawa in Yezo show no difference in leaves and branchlets.

in Russia are in the region extending southwards from Kostroma to the edge of the steppe; and here both this species and *T. platyphyllos* grow together. In Norway it is found as a wild tree as far north as lat. $62^{\circ} 9'$ on the west coast, and in Sweden up to $63^{\circ} 10'$ in Angermanland; but according to Schübeler, it thrives when planted as far north as $67^{\circ} 56'$ in Norway, $65^{\circ} 50'$ in Sweden, and 63° in Finland.

It appears to be not a native tree in Belgium, Holland, Denmark, and north-western Germany; and is nowhere very common in central Europe at present, though it is supposed to have been more widely spread in ancient times, as the word linden is very prevalent in German and Slavonic names of places. It is rather a tree of the plains than of the mountains; but it ascends in Bohemia and Bavaria to 2000 ft., and in Switzerland and the Tyrol to 4000 ft. Bolle informed Sargent that very old and enormous trees¹ of this species, one being nearly 23 ft. in girth, exist at Paelitzaerder on the Paarestein lake near Eberswalde.

In France, it is met with in most of the forests of the plains and low hills, except in the departments bordering on the Mediterranean. It is occasionally treated as coppice, being used for firewood and making charcoal. Bast, which was formerly a product of some importance, is now only produced in the forest of Chantilly, nearly all the bast used being now imported from Russia. Mathieu mentions a tree, planted at Gerardmer in the Vosges, which measured 95 ft. in height and 19 ft. in girth, and was supposed to be at least 250 years old.

The small-leaved lime extends southwards to about lat. 41° , occurring in northern Spain, Italy, and the Balkan States; but is unknown in Greece and Sicily. Huffel² says that both it and *T. platyphyllos* are common in the forests of the hills of Dobrudja, Roumania, where they are the dominant trees.

The small-leaved lime is a native of England, ranging from Cumberland southward. It occurs in woods in rather inaccessible positions, where it is a rare tree, and more commonly in coppice, situations in which the indigenous vegetation has often been preserved. Ray³ considered this species to be a true native; and in his time it was frequent and wild in woods and coppices in Essex, Sussex, Lincolnshire, and especially in Bedfordshire, "where there were thousands of lime trees." He adds that it was less common in the Forest of Dean, and rare in Cranborne Chase in Dorset. Many of the local floras give instances of its occurrence, as J. G. Baker⁴ for Yorkshire, who states that it occurs "at Slip Gill near Rievaulx, where aboriginal woods composed principally of oak and hazel cover the steeply-sloping rocky banks of one of the loneliest and pleasantest glens in the eastern calcareous range." Ley⁵ records it for different parts of Herefordshire. Murray⁶ says it is abundant in the Leigh woods near Bristol. It is said⁷ to be wild in several localities in Glamorgan-shire. Bromfield⁸ mentions wild trees in one locality in the Isle of Wight, and in aboriginal woods on the chalk at Bordean Hill, near Petersfield, Hants.

Bromfield supposes that Lyndhurst, in the New Forest, owes its name to the

¹ Bean, in *Kew Bull.* 1908, p. 397, mentions a tree in the Grosse Garten, Dresden, branching close to the ground, where the trunk was about 8 ft. through.

³ *Syn. Meth.* 316 (1696) and *Philos. Letters*, 250 (1718).

⁶ *Flora Herefordshire*, 54 (1889).

⁷ Riddelsdell, in *Journ. Bot. Suppl.* 18 (1907).

² *Les Forêts de la Roumanie* (1890).

⁴ *Flora N. Yorks.* 274 (1906).

⁵ *Flora Somerset*, 64 (1896).

⁸ *Fl. Vect.* 83 (1856).

prevalence of this species there in ancient times. Limehouse, in London, according to Stowe, was originally called Limehurst, meaning a grove of linden trees in Saxon times.

(A. H.)

Some doubt exists among botanists as to whether the small-leaved lime is truly native of England or not. It is not mentioned by Clement Reid as having been found in the fossil state in Britain; and by some it is supposed to have been introduced at an early epoch, perhaps by the Romans. But in some parts of the West Midlands it is found in woods remote from buildings, where one can hardly believe it was planted, so that it might fairly be considered a native but for one important fact. Notwithstanding many inquiries even in the districts where it now seems most at home, I have found no one who has seen a self-sown small-leaved lime. It seems hardly possible that a native tree should have lost its power of reproduction by seed, in a climate where it succeeds so well even as far north as Ross-shire; and in the north of France self-sown seedling limes are not uncommon, as I have myself observed in the Forêt de Retz. The tree has a remarkable power of persistence after repeated cutting, and of extending from stools to a considerable distance; so that in two old coppiced woods on my own property, it is now impossible to say where the stools originated. I have seen limes in remote rocky woods on the Wye valley near Moccas Court, whose stools had the appearance of very great age; and in the deep rocky gorge of Castle Eden Dene, on the coast of Durham, there are limes growing on such steep rocks that they could scarcely have been planted. But though rabbits will eat almost anything before they touch lime, I have searched in vain for seedlings in all these places. On the Carboniferous limestone rocks at Pen Moel near Chepstow, the residence of W. R. Price, Esq., I saw the tree growing in situations where it must have grown naturally from seed; and though Mr. Price has never found ripe fruit he has not the least doubt that it is indigenous here and elsewhere on the cliffs of the lower Wye valley.

E. Lees, in *Botany of Worcestershire*, 16 (1867) gives an excellent account of the occurrence of the lime in that county, where it is, in his opinion, "an undoubted native." He states that Shrawley wood, west of the Severn, which is about 500 acres in extent, is remarkable for a great part of it consisting of an undergrowth of lime, which is regularly cut as coppice-wood, and, therefore, is never in a flowering state.¹ On visiting this place, I agreed with Sir H. Vernon, of Hanbury Hall, near Droitwich, the owner of the wood, that the stools are in rows as though they had been planted; moreover there is not, so far as he knows, any lime in the adjoining woods. He says that this underwood used to be cut every seventeen years, and sent to the Potteries for making crates, but that this demand having ceased, it is now difficult to get rid of. It is now allowed to grow into poles, which are sometimes sold for copper-smelting in the Black Country, at about six or seven pounds per acre for twenty to twenty-five years' growth. In Sir H. Vernon's opinion, it would now pay better to grub the lime and plant larch in its place.

Lees² goes on to state that "Ockeridge wood, near Holt, though in a lesser

¹ Cf. p. 1656, note 2.

² Cf. also Lees' remarks in *Forest and Chase of Malvern*, abstracted in *Gard. Chron.* 1870, p. 1536.

degree, nourishes the same tree, as well as various coppices on the banks of the Severn between Ombersley and Hawford, where *T. grandifolia* exists in a naturalised state." He mentions "a very old and remarkable pollard tree of *T. parvifolia* at Hawford, on the ridge not far removed from the Severn. The base is more than 40 ft. round and six large boles arise from this in a semicircular manner. In fact, commencing with the border of Wyre forest and proceeding southward, the lime appears in numerous woods, coppices, and old hedgerows, to the very end of the Malvern range near Bromsberrow. The base of the round hills near Alberley, Ockeridge wood, the western base of the Berrow Hill near Martley, the banks of Leigh brook, Rosebury Rock on the Teme, the Old Storridge Hill, the country about Great Malvern, and ancient woods in the parishes of Castle Morton and the Berrow, may be particularly mentioned. Many of the old lime trees get pollarded, and then, in the course of years, put on a very grotesque appearance."

REMARKABLE TREES

The small-leaved lime apparently never attains so great a height in England as the common lime, but is occasionally of great girth and is certainly long-lived. A tree (Plate 372), remarkable for its spreading habit, at Sprowston Hall, Norwich, was figured by Grigor in *Eastern Arboretum*, 200 (1841), where it is stated that it measured 24 ft. 7 in. "near the ground" and was believed to have been planted on 30th January 1649. It still survives in a shattered condition.

There is a remarkably fine tree of this species at The Hall, Thirsk, the seat of Reginald Bell, Esq., who has kindly sent us photographs. In 1904 the trunk in its narrowest part was 20 ft. in girth, and the spread of the branches was about 250 ft. in circumference.

One of the finest small-leaved limes is growing on a flat by the River Teme, at Oakly Park, Ludlow, which, in 1908, as nearly as I could measure it, was about 110 ft. by 14½ ft.

A fine tree, of weeping habit, at Hursley Park, Hants, the seat of Sir G. A. Cooper, Bart., measures about 80 ft. by 15½ ft. Close to it stands the hollow trunk of a much larger tree of the same species, which was blown down some years ago, and measures 19½ ft. in girth. The spread of its branches is said to have exceeded 100 ft.

At Arley Castle, Bewdley, a good specimen measured, in 1903, 85 ft. by 9 ft. 9 in. At Woburn Abbey, the largest tree of this species measures 76 ft. by 7 ft. 4 in., but appears to be still young, as the bark is comparatively smooth.

In Lincolnshire, the tree is not uncommon in parks and hedgerows. In Burghley Park there are several old trees, one of which measured, in 1908, 80 ft. by 11 ft. 4 in. At Casewick House, another was 82 ft. by 9 ft. 6 in. in the same year. At Syston Park there is a fine specimen, which measured 97 ft. by 11 ft. in 1906.

(H. J. E.)

TILIA PLATYPHYLLOS, LARGE-LEAVED LIME

Tilia platyphyllos, Scopoli, *Fl. Carn.* i. 373 (1772); Sargent, in *Garden and Forest*, ii. 256, f. 109 (1889); Schneider, *Laubholzkunde*, ii. 376 (1909).

Tilia grandifolia, Ehrhart, *Beit.* v. 158 (1790); Willkomm, *Forstliche Flora*, 733 (1887); Mathieu, *Flore Forestière*, 33 (1897).

Tilia pauciflora, Hayne, *Arzn.* iii. 48 (1813).

Tilia corallina, Smith, in Rees, *Cycl.* xxxv. No. 2 (1819).

Tilia mollis, Spach, in *Ann. Sc. Nat.* ii. 336 (1834).

Tilia europæa, Linnæus, *Sp. Pl.* 514 (1753) (in part); Loudon, *Arb. et Frut. Brit.* i. 364 (1838).

A tree, attaining 130 ft. in height and upwards of 20 ft. in girth. Bark at first smooth and grey, ultimately on old stems with narrow shallow longitudinal fissures and ridges separating on the surface into small quadrangular scales. Young branchlets moderately covered with long white hairs; older branchlets glabrescent. Leaves (Plate 407, fig. 6) 3 to 4 in. in width and length, slightly uneven or wrinkled, ciliate in margin, regularly serrate, the serrations ending in short cartilaginous points; upper surface dull green, covered with short pubescence; lower surface lighter green, covered with long whitish pubescence, densest on the midrib, nerves, and veinlets, and forming dense axil-tufts at the base of the blade and at the junctions of the primary nerves with the midrib and with the secondary nerves; tertiary veinlets parallel and prominent on the under surface; petiole stout, shorter than the blade, whitish pubescent.

Flowers in pendulous, usually three-flowered cymes; about ½ in. in diameter, yellowish-white; sepals slightly pubescent externally, downy within; petals oblanceolate, longer than the sepals; stamens about thirty, longer than the petals; staminodes absent; ovary globose, tomentose; style glabrous. Fruit globose, pyriform, or ovoid, usually¹ with three to five prominent ribs, tomentose, apiculate at the apex; shell woody and hard.

In winter this species may be recognised by the twigs being slightly pubescent near the buds, which are minutely pubescent at the tip and show externally three glabrous ciliated scales.

VARIETIES

This species in the wild state varies considerably in the amount of pubescence on the leaves, branchlets, and petioles; and has been subdivided into five subspecies by Schneider, who acknowledges, however, the great difficulty of limiting them clearly. The most pubescent forms occur in northern Germany, northern France, and Scandinavia; while nearly glabrous forms are found in southern France, Austria, and the Balkan States. V. Engler disagrees with Schneider's classification; and considers that the limes occurring in southern France, the Pyrenees, Italy, etc., should be united with *T. caucasica*; but this view is hardly tenable. The bract is stalked in most cases, but is occasionally sessile; and abnormal forms occur

¹ A tree at Kew of undoubted *T. platyphyllos*, bore fruit in 1907, on which no trace of ribs was perceptible.

(var. *multibracteata*) in which two bracts are borne on one peduncle. The fruit is remarkably variable, both in shape and in the prominence of the ribs.

The southern more glabrous forms are rarely cultivated in England, the only specimen which I have seen being a tree at Kew about 25 ft. high, which is named var. *obliqua*.¹ The branchlets are nearly glabrous; leaves very oblique and truncate at the base, glabrous above, with scattered pubescence below. It bears flowers similar to those of the type.

A large number of sports have arisen both under cultivation and in the wild state, the most noteworthy of which are:—

1. Var. *pyramidalis*, Simonkai, in *Math. Term. Koezl.* 334 (1888). Pyramidal in habit; leaves usually more or less cordate at the base. According to Schneider this is occasionally wild in south-eastern Europe.

2. Var. *tortuosa*, Bean, in *Kew Hand-list Trees*, 71 (1902). A peculiar sport, with all the twigs and branches twisted and curved. This² originated in the Royal Horticultural Society's garden at Chiswick in 1888 as a single specimen out of a bed of 500 large red limes. Grafts were sent to Kew from Chiswick in 1890, and three trees about 18 ft. high survive, in the Lime collection.

3. Var. *aurea*, Loudon (var. *aurantia*). Twigs golden yellow.

4. Var. *corallina*, Solander, in Aiton, *Hort. Kew.* ii. 229 (1789). Twigs bright red. Both these varieties are conspicuous in winter, and have been known for more than a century. According to Koch they were probably introduced from England to the Continent. The latter is the red-twigged lime of some English nurseries.

5. Var. *laciniata*, Loudon (var. *asplenifolia*, var. *filicifolia*). Leaves smaller than in the type, deeply and irregularly cut and twisted. This never attains a large size,³ and is only suitable for planting as a curiosity in gardens. It commonly throws out branches on which the foliage is normal.

6. Var. *vitifolia*, Simonkai, *op. cit.* Leaves lobulate or weakly three-lobed.

7. Forms with variegated leaves are known, as var. *albo-marginata*, Van Houtte.

8. Var. *cucullata*, Schneider (*T. cucullata*, Jacquin,⁴ *Frag. Bot.* 19, t. 11, f. 3 (1800)). A form with small leaves, of which the edges of the two sides are joined together at the base, making the leaf pitcher-shaped. It is said to occur wild in southern Bohemia, where, according to Willkomm, there are some old trees, with all the leaves showing this peculiarity, at the monastery of Goldenkron, near Krumau.

DISTRIBUTION

This species is widely distributed throughout central and southern Europe, extending as far eastward as the Ural Mountains. Its northern limit as a wild tree is not known with certainty, and Willkomm considers it not to be indigenous in

¹ Probably identical with *T. obliqua*, Host, in Schmidt, *Oestr. Baumz.* iv. t. 224 (1822), and Host, *Fl. Austr.* ii. 62 (1831). The Kew tree agrees with a dried specimen collected in Host's garden in 1832.

² Cf. *Gard. Chron.* iv. 708 (1888).

³ A. B. Jackson saw a tree at Blenheim, 40 ft. by 3½ ft., in 1908.

⁴ Jacquin figures leaves from trees in a cemetery at Sedlitz, near Kuttendorf in Bohemia. Leneck, in *Mill. Nat. Ver. Univ. Wien*, 1893, pp. 19-29, figs. 1-11, gives an account of these abnormal leaves; and records a large-leaved lime growing at Leitmeritz in northern Bohemia, of which 20 to 30 per cent of the leaves were pitcher- or cowl-shaped. Cf. Just, *Bot. Jahresh.* xxii. pt. 2, p. 219 (1894).

northern Germany, Denmark, and the Baltic provinces of Russia. Bolle, however, states that it grows sparingly in these countries, and mentions small groups of wild trees growing in the islands on the west coast of Sweden, near Strömstad. It is most common in southern Russia, where in the provinces of Ukraine and Volhynia it often forms pure woods, though it is also seen in mixture with the small-leaved lime and *Quercus pedunculata*. It is also frequent in the southern states and Rhenish provinces of Germany, and ascends in the Bavarian Alps to 3300 ft. It is also widely spread in Austria, Hungary, and the Balkan States; and occurs in Italy and Spain, reaching its most westerly point in Asturias and New Castile. In France it is found scattered in the forests of the plain, except in the Mediterranean region, where, however, it has been observed as a rare tree in the Ravin des Arcs, 15 miles north of Montpellier.¹ More common in the hills and mountains, it attains its highest elevation, 4600 ft., in the Pyrénées-Orientales. It is replaced in Greece by the closely allied species *T. corinthiaca*, Bosc, and in the Caucasus, north Persia, and Armenia by *T. caucasica*, Ruprecht. Neither of these is in cultivation.

This species is a doubtful native of England, and was considered by Watson to be only a denizen. Bromfield² says that the broad-leaved lime, though partly naturalised in hedgerows, is nowhere indigenous in this country. Ley,³ in 1889, however, considered it to be truly wild in rocky woods in the lower valley of the Wye, where, on the Great Doward and at Symonds Yat, it grows on bare limestone rock in company with the small-leaved lime. The occurrence here of *Pyrus latifolia* as an indigenous tree supports Ley's opinion. Baker⁴ also considers it to be a native of Yorkshire, where it grows on the limestone scars of the lower part of Swaledale in a rocky wood, where no trees have ever been planted. Linton⁵ also records it as growing wild on limestone cliffs in Derbyshire. (A. H.)

REMARKABLE TREES

One of the oldest large-leaved limes in England is the famous tree⁶ planted by Queen Elizabeth during her visit to Burghley Park, Stamford. This is now only about 60 ft. high, having lost many limbs in recent years, but it is 20 ft. in girth, and still bears foliage freely.

The tallest trees of this species which I have seen are those on the hill in the park at Longleat, where there are many from 120 to 130 ft. high, and some probably

¹ Elwes found a lime wild in the Forêt de Sainte Baume, near Aubagne (Var), which was identified by M. Mader of Nice with *T. platyphyllos*. It is recorded for this station by Albert and Jahandiez, *Plant. Vasc. du Var*, 84 (1908). Enormous trees of this species are said to have existed in France, one at Château Chaillé near Melle (Poitou) having measured 50 ft. in girth in 1804, when it was 538 years old. T. Hartig alludes to another at Saint Bonnet which was 55 ft. in girth. Cf. Kanngieser, in *Flora*, xcix. 428 (1909). Willkomm, *Forstliche Flora*, 736, note (1887), mentions also large limes in Germany, one at Staffelstein in Bavaria being 57 ft. in girth at three feet from the ground. We have not been able to confirm these records.

² *Flora Vexl.* 83 (1856).

³ *Flora Herefordshire*, 54 (1889). The late Rev. Augustin Ley, who kindly sent me specimens for examination, informed me in a letter, that "it occurs sparingly in aboriginal woodland, through Herefordshire, where there are nine stations in which the tree is native. It extends northwards into Shropshire, westwards into Radnor and Brecon, and southwards along the Wye valley into west Gloucester and Monmouth. In many of its stations it occupies crannies of limestone cliff, where it is physically impossible that it should be planted."

⁴ *Flora North Yorkshire*, 274 (1906).

⁵ *Flora Derbyshire*, 91 (1903).

⁶ Figured in *Gard. Chron.* xvi. 400, fig. 78 (1881).

taller, all running up to a great height with clean straight stems. These are reputed to have been planted in 1690. At Revesby Abbey there is a fine old tree, about 100 ft. by 13 ft. 3 in., with the branches descending to the ground. The avenue at Poltimore, which is very fine, is composed of limes¹ of the species.

Mr. Renwick reports a large-leaved lime² at Ancrum, near Roxburgh, which in 1909 measured 26 ft. in girth at 6 ft. from the ground. (H. J. E.)

TILIA VULGARIS, COMMON LIME

Tilia vulgaris, Hayne, *Arzn.* iii. 47 (1813); Sargent, in *Garden and Forest*, ii. 256, fig. 110 (1889).

Tilia intermedia, De Candolle, *Prod.* i. 513 (1824); Mathieu, *Flore Forestière*, 32 (1897).

Tilia europæa, Linnæus, *Sp. Pl.* 514 (1753) (in part); Loudon, *Arb. et Frut. Brit.* i. 364 (1838).

Tilia cordata × *platyphyllos*, Schneider, *Laubholzkunde*, ii. 374 (1909); V. Engler, *Monog. Gatt. Tilia*, 144 (1909).

A tree, attaining 130 ft. in height and 15 ft. in girth. Bark similar to that of *T. platyphyllos*. Young branchlets green, glabrous, becoming dark-brown with age. Leaves (Plate 407, fig. 4) larger than those of *T. cordata*, averaging 4 in. in length and 3 in. in width, slightly wrinkled or uneven, cuspidate or acuminate at the apex, truncate or cordate at the base; margin slightly ciliate and regularly serrate, the teeth ending in short points; upper surface dark green, glabrous; lower surface pale green, with brown axil-tufts at the base and the junctions of the midrib, primary and secondary nerves, and a few scattered long hairs on the nerves, elsewhere usually glabrous; tertiary nerves on the lower surface prominent, mostly straight and parallel; petiole green, glabrous, about half the length of the blade.

Cymes pendulous, five- to ten-flowered, glabrous; bract slightly pubescent, sessile or stalked; sepals, petals, stamens, ovary, and style as in *T. platyphyllos*. Fruit ovoid or globose, apiculate at the apex, not ribbed when mature, covered with a dense tomentum; shell thick and tough.

The buds are similar to those of *T. platyphyllos*, showing three external scales, which are glabrous, shining, and ciliate; but the glabrous branchlets will readily distinguish the common lime in winter, those of *T. platyphyllos* always being more or less pubescent.

This species, though the most common lime in cultivation, both in Britain and on the Continent, is extremely rare in the wild state. Mathieu says that it is occasionally seen in woods³ in France; and Simonkai records reputed wild specimens from Upsala in Sweden and from Finland. Bolle informed Sargent that he had only once seen an indigenous specimen, a tree growing in the Tyrol.

¹ Cf. p. 1667, note 1, for other avenues of this species, and p. 1669.

² Cf. Christison, in *Trans. Bot. Soc. Edin.* xix. 494 (1893), who states that it was 20 ft. in girth at five feet up, the narrowest point, in 1877.

³ In the Cambridge herbarium there is a specimen gathered by Vincent in 1847 in the wood of Champigneulle, near Nancy; and another gathered in Switzerland by J. Stuart Mill, labelled "Mountain side, near Altdorf, Canton Uri, completely wild and native."

It is now universally admitted to be a hybrid between *T. cordata* and *T. platyphyllos*. The distinctive marks of these species and the hybrid are:—

T. platyphyllos. Branchlets and leaves very pubescent with long hairs. Buds with three external scales. Cymes pendulous, usually three-flowered. Fruit with prominent ribs; shell woody and hard.

T. cordata. Branchlets glabrous or nearly so. Leaves small, glabrous except for axil-tufts, bluish beneath with irregular and not prominent tertiary venation. Buds with two external scales. Cymes erect, five- to seven-flowered. Fruit faintly ridged; shell thin and fragile.

T. vulgaris. Branchlets quite glabrous. Leaves larger than those of *T. cordata*; under surface pale green, glabrous except for axil-tufts and a few hairs on the nerves, with parallel straight and prominent tertiary venation (as in *T. platyphyllos*). Buds with three external scales. Cymes pendulous, five- to ten-flowered. Fruit faintly ribbed; shell woody and hard.

There are at least two distinct forms of the common lime in cultivation in England and elsewhere which require further study, one with leaves light green beneath, longer than broad, the form described above and considered by botanists to be typical *T. vulgaris*, Hayne; and the following:—

1. *T. pallida*,¹ Wierzbicki, in Reichenbach, *Icon. Fl. Germ.* vi. 58, t. 315 (1844).

Leaves smaller, often not much larger than those of *T. cordata*, as broad as or broader than long, yellowish or bluish green beneath. It is readily distinguishable from *T. cordata* by its prominent tertiary venation, and has flowers and fruits like those of typical *T. vulgaris*. According to V. Engler, it is occasionally found in the wild state in Hungary.

Rarer hybrids also occur:—

2. *T. flavescens* and *T. floribunda*, A. Braun, in Doell, *Rhein Fl.* 672 (1843).

These peculiar trees, possibly hybrids of the same parentage as *T. vulgaris*, were noticed growing in an avenue at Karlsruhe in 1836. The leaves closely resemble those of *T. cordata*, but are larger and with paler axil-tufts. The cymes, with numerous flowers, in which staminodes² are developed, resemble in these respects those of *T. japonica*, the small-leaved lime of Japan. According to Koch,³ the seed was sown, and produced pure *T. cordata* seedlings; but two trees at Kew, labelled *T. flavescens*, presumably seedlings, have larger leaves than those of the common small-leaved lime, and are peculiar in their yellow branchlets and petioles. These, though young trees,⁴ bear flowers, few in the cyme, without staminodes, in partly erect and partly pendulous cymes. One obtained from Späth in 1900 is about 20 ft. high; the other, from Simon-Louis in 1902, is about 15 ft.

¹ Identified by Schneider, with *T. subparvifolia*, Borbas, in *Oest. Bot. Zeit.* xxxvii. 297 (1887). *T. vulgaris*, var. *pallida*, Sargent, *Bull. Pop. Inform.* No. 30 (1912), and in *Gard. Chron.* lii. 88 (1912), is the typical form of *T. vulgaris*, and not the tree described by Wierzbicki.

² On account of the staminodes, these trees are often supposed to be hybrids of *T. cordata* with *T. americana*, but they show no resemblance to the latter species in the shape, size, or serrations of the leaves.

³ *Dendrologie*, i. 481 (1869).

⁴ Sargent, *Bull. Pop. Inform.* No. 30, 1912, and in *Gard. Chron.* lii. 87 (1912), says that plants only a few feet high flower profusely.

3. *T. Beaumontia*,¹ which is sold in Späth's and Simon-Louis's nurseries, appears to be a form of the common lime, with pendulous branches.

The common lime is not indigenous in Britain, where it is never found except in plantations, avenues, and hedgerows, and rarely² produces natural seedlings. It comes into flower³ about ten days later than *T. platyphyllos*, and a fortnight earlier than *T. cordata*.

In the common lime and allied species, the upper surface of the leaves is frequently found in summer to be sprinkled over with a viscid saccharine fluid, which is popularly known as honey dew. There has been great diversity of opinion as to whether this honey dew is always an exudation from the leaves, or is in some cases voided by aphides on the leaves. Sorauer,⁴ the latest investigator of this subject, believes that the saccharine excretion originates without the assistance of aphides, and is the result of excessive transpiration, brought about usually by intense sunlight, a common occasion being when a cold night is followed by a hot morning sun. After the honey dew dries and thickens, it becomes the seat of growth of certain fungi, species of *Fumago*, which give the leaves a blackened appearance. Paths and garden seats situated under lime trees frequently show a disagreeable coating of this viscid exudation, which has fallen from the leaves.

The date of its introduction into England is uncertain, but this tree appears⁵ to have been first planted on a large scale by Le Notre,⁶ in the reign of Charles II., who used it for avenues, as was then the custom in France. The lime trees mentioned by Turner in 1562 as attaining a large size, and the old trees reported by Barrington⁷ to be growing in 1769 in Moor Park in Hertfordshire and on the river Neath in Glamorganshire, were probably *T. cordata*, and of indigenous origin.

(A. H.)

CULTIVATION

The lime seems to ripen its seed more often than is generally supposed in warm summers in the south of England, and I have raised seedlings⁸ from seeds gathered as far north as near Newark in 1904. In the same year Mr. A. C. Forbes sent me some of the common lime from Longleat, saying that very little, if any, of the seed of

¹ Cf. Schneider, *Laubholzkunde*, ii. 374 (1909), who considers it to be a hybrid between *T. euchlora* and *T. platyphyllos*.

² Mr. Anderson has found a few seedlings from trees planted on the edge of Lord Bathurst's deer park, just opposite the Royal Agricultural College at Cirencester.—H. J. E.

³ Cf. Dr. Moss, in *Bot. Exchg. Club Rep.* 1910, p. 550.

⁴ *Pflanzenkrankh.* i. 412-414 (1909). The literature about honey dew on the lime is extensive. Boussingault's article in *Comptes Rendus*, lxxiv. 87 (1872), and Rivière's and Roze's articles in *Bull. Soc. Bot. France*, xiv. 12, 15 (1867), are abstracted in *Gard. Chron.* 1872, pp. 509, 609. See also various letters in *Gard. Chron.* 1873, pp. 920, 952, 1308, 1340, 1372, 1404, 1501, 1602. Buckton, *British Aphides*, i. 39-47 (1876), may also be consulted.

⁵ Cf. Loudon, *Arb. et Frut. Brit.* i. 23, 24 (1838), who states, quoting Hasted, *Kent*, 562 (1769), that Sir John Speilman, in the reign of Elizabeth, brought over two lime trees from Germany, which were planted at Portbridge, near Dartford. These trees were cut down some time previous to 1769, and there is no means of determining what species of lime they belonged to.

⁶ According to Chalmers, *Biog. Dict.* xxiii. 251 (1815), Andrew Le Notre, who was born in 1613 and died in 1700, laid out St. James's and Greenwich Parks in the reign of Charles II.

⁷ In *Phil. Trans.* lix. 35 (1769).

⁸ In the west court of the University Library, Cambridge, which is laid out in grass, secluded, and surrounded by high buildings, there were in 1912 several natural seedlings, arising from seed brought by winds or birds. These included *Betula pubescens* and *B. verrucosa*, elder, *Salix Caprea*, *Crataegus monogyna*, sycamore, and a solitary seedling, three or four years old, which was apparently *T. vulgaris*. It differed slightly in having slight pubescence on the branchlets and under surface of the leaves, thus showing a reversion to *T. platyphyllos*.—A. H.

the small-leaved lime was fertile, possibly because it flowers later than the other. A small proportion of this seed germinated in the first spring, but most of it lay dormant till the following year, and this has been my experience with many sowings of seed from abroad of the various European forms, as well as of the American lime. After germination they grow slowly for the first two years, and the young wood is liable to be killed back in winter. For this reason layering is the method adopted by nurserymen, though the varieties are usually grafted. I cannot say that my experience is as yet long enough to justify me in preferring seedlings.¹

With regard to soil, the lime is not particular, but requires a good deep loam to bring it to perfection. It transplants very well, and may, if properly prepared by cutting round the roots two years previously, be safely moved when 20 to 30 ft. high.

Owing to the depreciated value of the timber, the lime cannot now be recommended except as an ornamental tree, the principal objection to it for this purpose being the early period at which its leaves wither and fall in autumn.

LIME AVENUES

The common lime is one of the most valuable avenue trees that we have; the fashion for planting them is, however, not very ancient, having apparently been introduced by Le Notre and other French landscape gardeners in the latter half of the seventeenth century, from which period most of our best avenues date.

Of these one of the finest is the avenue at Burghley Park, Stamford, the seat of the Marquess of Exeter. This is about 3000 yards long, with four rows of trees planted 6 yards apart in the row, 10 yards between the two outer rows and 20 yards between the inner ones. The trees are 100 ft. to 110 ft. in height on an average, and all appear to have been pollarded when young, though they have the upright habit which distinguishes most of the older lime avenues. I was informed by Mr. C. Richardson, of Stamford, that about fifty-five years ago—when lime wood was much more valuable than it now is, and made 5s. to 6s. per foot, single trees being sometimes sold at £40 to £50—an offer was made by a syndicate of London timber merchants to buy the whole of this avenue for £100,000. This story appears hardly credible, and I could obtain no verification; but, if made, the offer was refused, and there is no chance of such a price being paid for lime trees now.

Another beautiful avenue of fine tall limes is at Stratton Park, Hants, the seat of the Earl of Northbrook, whose late father informed me that it probably dates from about 1715. This avenue shows a common defect, which consists in the mass of spray that springs from some point usually near the root, though sometimes at 10 to 20 ft. up the trees, or even higher. I have searched in vain the works of Evelyn, Duhamel, Miller, Boutcher, and Loudon, for any reference to these abnormal growths,

¹ *T. platyphyllos* is usually imported from France as seedlings; and these appear to thrive in some cases better than plants of the common lime, which have been raised from layers. A young avenue of *T. platyphyllos* at Terling, Essex, with trees about 30 ft. high, is very thriving. The lime avenue at the back of Trinity College, Cambridge, which was celebrated by Tennyson, consists of two parts. That on the west side of the Cam now consists of 38 common limes, one half of which are very burry and much decayed, gaps showing where a few have died. These trees, which now average 6 ft. 9 in. in girth, were planted in 1671, at a cost of £10:6s., plus carriage from London amounting to £1:4s. On the east side of the Cam there are 20 trees, all but one of which are *T. platyphyllos*. These, which now average 6 ft. in girth, were planted in 1717, and look much healthier than the others. Cf. Willis and Clarke, *Archit. Hist. Univ. Camb.* ii. 641, 646 (1886).—A. H.

which, so far as I can learn, seldom appear on wild trees, or on any species but *T. vulgaris*. It is scarcely due to soil, since in some of the finest old lime avenues, as those at Cassiobury Park, Waldershare Park, and Newhouse Park, these growths appear in some trees only. They extend to a considerable height up some of the trees, which are much stunted, as it seems, from this cause. This may arise from the affected trees having been propagated by layers from inferior shoots, or having been planted later to fill gaps, and thus having to contend with trees already established.

It is, however, a point which deserves careful attention on the part of nursery-men; as, though these growths may be pruned off annually, they constantly reappear at the same spot, and not only take a great deal of trouble and time to remove, but eventually disfigure the trees; and limes which produce them rarely attain the same height or beauty as those which are free from them. The trees now sold by nursery-men, which are always propagated from layers, seem to be more subject to these growths than the limes planted two centuries ago; and I believe that limes raised from seed are rarely if ever affected.

The longest avenue of limes which I have seen is comparatively modern, and as I am informed by Mr. A. H. Elliott, agent for the Clumber estate, was planted by Henry, fourth Duke of Newcastle, about the year 1840. It is 1 mile and 1590 yards long, and consists of 1315 trees planted in a double row on each side of the drive at Clumber. The trees are 31 ft. apart each way, and the total width is 143 ft. The trees are fairly uniform in habit, but have spreading bushy tops, and when I saw them in 1906 did not exceed about 60 ft. in height by about 4½ ft. in girth. The soil is rather sandy, and the trees when planted were only 5 ft. high, and were not pruned sufficiently after planting to develop a good trunk, so that this avenue is never likely to rival those at Burghley, Ashridge, or Cassiobury. Mr. Elliott tells me that the trees have suffered considerably from the attacks of the following geometrid moths: *Cheimatobia brumata*, *C. boreata*, *Hybernia aurantiaria*, *H. defoliaria*, *H. progemmaria*, *Anisopteryx æscularia*; but this damage has been checked, if not entirely prevented, by putting grease bands on the trees, which arrest the female moths when they try to ascend the stems in the winter months, and by killing the pupæ in the soil in July with gas-lime. Besides this avenue there are at Clumber two much older ones, over 150 years old, running north and south on either side of the elm avenue leading to West Drayton. One of these is 385 yards long and 30 yards wide, the other 330 yards long and 55 ft. wide. The trees are planted 24 ft. apart. They were pollarded in 1888 in order to save their lives.

At Newhouse Park, near Mamhead, Devonshire, Sir Robert Newman showed me a fine avenue which seems to have been planted about 200 years ago in anticipation of a mansion which was never built. It is only 20 ft. wide and the trees 10 ft. apart; but favoured by a fine soil and climate, the trees, which seem to have been pollarded at 10 ft., have shot up to an immense height, averaging at least 120 ft., and several exceeding 130 ft. Two which I measured were 115 ft. by 5 ft. 9 in., and 135 ft. by 7 ft. 6 in. I have little doubt that they were seedlings. In a chestnut avenue at the same place the trees were much shorter and thicker, about 70 ft. to 80 ft. by 15 ft. to 18 ft. in girth.

At Cassiobury Park, Herts, there is a lime avenue supposed to have been planted by Le Notre, but some of the trees, which are very inferior to the rest in height and symmetry, are smothered in dense masses of small spray at 20 ft. to 30 ft. from the ground, and seem to have been planted later, possibly to replace dead trees in the original avenue. This avenue is 24 yards wide and the trees 8 yards apart. The best of the trees are 120 ft. to 130 ft. high, and one measures 13½ ft. in girth. There is a fine avenue, about half a mile long, at Denham Court, near Uxbridge.

At Braxted Park, Essex, the property of C. H. Du Cane, Esq., there is a lime avenue composed of three rows of trees on each side, which shows extraordinary variation in the growth of the trees, giving it a very irregular appearance. The tallest at the bottom of the hill are about 120 ft. high, and covered to an extent I have never seen elsewhere, with mistletoe growing in large bushes nearly up to their tops. At the top of the hill near the entrance gate, many of the trees are poor and stunted, with masses of spray at their root and higher up, and with gouty swellings on their branches which may be due to the mistletoe.

At Betchford Park, Surrey, there is a remarkable avenue of very old trees, some of which, when seen by Henry in 1906, were 130 ft. in height and 12 ft. to 13½ ft. in girth. This avenue was described as a very fine one by Dr. Aikin¹ in 1798.

At Doneraile Court, in Ireland, there is a fine avenue, one tree measuring 98 ft. by 10 ft. in 1907; most of the trees were covered with masses of spray.

An excellent article by Alfred Rehder of the Arnold Arboretum, on the lime as an avenue tree, in *Möller's Deutsche Gärtner Zeitung*, 1904, p. 188, should be consulted by those who think of planting. After giving the distinctive characters of the species, and describing their peculiarities of growth, he says that the choice must depend on the character of the soil and climate, and considers that the large-leaved lime, *T. platyphyllos*, is the best where the ground is deep and moist and where rapid growth and heavy shade are required. For drier soil he prefers *T. cordata*, which does not, however, make such a large or fine tree. *T. vulgaris* is in most of its characters intermediate, and this is the lime which is most generally used in England, though according to Rehder most, if not all, of the limes celebrated for their size and age in Germany are *T. platyphyllos*. He thinks that *T. euchlora*, Koch, is the best for town planting, because its smooth leaves do not hold the dust so much as those of other species, and because its leaves do not fall so early. He prefers *T. petiolaris*, the pendulous silver lime, for park avenues, and for single specimens where its branches can show their full beauty. Rehder does not give any observations as to the relative advantage of trees propagated from seed, from layers, or from grafts; but he rightly says that it is important that all the trees should be propagated from the same variety.

REMARKABLE TREES

Among the most remarkable limes that I have seen is a walk at Ashridge Park. These trees are individually much larger than those at Burghley or Stratton, and

¹ In *Monthly Magazine* for 1798, quoted in *Gard. Chron.* 1841, p. 4.

though planted only 4 to 5 yards apart, average 120 ft. high and about 10 ft. in girth. They have the amount of variation in their leaves that one would expect to find in seedlings, and though 250 years old¹ only one out of forty is decayed. The bark of these trees is more like that of an elm than the usual bark of a lime, but this is perhaps owing to some peculiarity in the soil. A great lime at the end of the pinetum at Ashridge is of a totally different character, having very drooping branches and an immense spread. It has a trunk about 30 ft. high, and does not exceed 80 ft. to 90 ft. in total height, but the branches cover a circumference of 110 paces.

In Windsor Park, near Cranbourne Tower, there are some extremely tall and graceful limes growing with beech in a circle which were planted² in 1697. The best of these that I measured was 130 ft. by 14 ft. in girth, a beech close by it being 125 ft. by 10 ft.

A remarkable case of the tendency of the lime to layer which occurs at Rothamsted, is figured in the *Gardeners' Chronicle*, June 5, 1875. Here a row of fine old limes have dropped their branches on each side to the ground, and these have grown up in a thick mass, forming a shady corridor on each side of the trunks. There is another good example at Enville Hall, Stourbridge, where hundreds of young stems have arisen from layers, the whole mass measuring 140 paces round in 1904.

A curious instance of natural inarching of the lime is described and figured in *Gard. Chron.* xi. 277 (1879).

The branches of the lime sometimes spread laterally to a great distance. One of the best instances I have seen was shown me by Mr. Tudway at the Coombe, near Wells in Somersetshire. The tree is a large-leaved lime growing in a sheltered dell, about 100 ft. by 14 ft., and has three immense horizontal limbs 8 to 9 ft. in girth, one of which extends for 64 ft. from the trunk. In Stoneleigh Park, Warwickshire, there are some fine limes remarkable for their wide-spreading branches. In the Thames valley there are many fine lime trees, one at Osterley Park being about 120 ft. in height; while at Crowsley Park, near Henley, there are several in a clump, one of which was 118 ft. by 12½ ft. in 1908.

E. Lees, in his account³ of the *Forest and Chase of Malvern*, speaking of the common lime, says:—"Some very fine trees now stand in a field about half a mile south of Bromsberrow Church, and by the side of the road leading from Ledbury towards Gloucester. Two of these, growing near each other, have become conjoined, both by the amalgamation of their arms, and by a lateral junction at the root.⁴ The largest of these trees is 27 ft. in circumference at three feet from the ground, and is 36 ft. round the base; the other is 11 ft. 3 in. in girth at a yard from the ground, and 19 ft. in circumference at the base. The whole mass, if measured as one tree (and the interval between the boles where the connecting root joins them is only 19 in.) is full 48 ft. in circumference. In a field on the Priory Farm, Little Malvern, are several large

¹ In a book called *Chiltern and Vale Farming*, p. 153, published in 1745, it is stated by the anonymous author, who lived close to Ashridge, that they were planted in 1660, and in 1745 or thereabouts were near 3 ft. in diameter at the bottom.

² W. Menzies, *History of Windsor Great Park*, 44 (1864).

³ Abstracted in *Gard. Chron.* 1870, p. 1536, figs. 264, 265, 266.

⁴ I visited these trees in 1905, and found the largest now standing to be about 80 ft. high and 20 ft. 9 in. in girth. The fruit was fully formed on 18th July.

trees of *Tilia platyphyllos*, but these do not belong exactly to forest trees, having certainly been planted either by one of the Priors of Little Malvern or some of his lay successors to the Priory lands."

A very large lime formerly grew in Hagley Park, Worcestershire, the seat of Lord Cobham, which, according to Lees,¹ in 1874 measured 27 ft. in girth at 3 ft. from the ground, but this I am told was blown down about twenty-five years ago. At Arley Castle there is a fine tree, about 120 ft. high by 12 ft. 8 in. in girth.

The most curious instance of artificial layering I have seen anywhere is at Knole Park, where a lime described by Loudon as having covered nearly a quarter of an acre in 1820 still grows. The central stem no doubt originally dropped its branches on the ground in a circle of about 8 yards in diameter. These have grown up into trees 80 ft. to 90 ft. high, some of which are thicker than their parent. These again have layered themselves in a second concentric circle 20 yards in diameter, the trees in which are 20 ft. to 40 ft. high, and these are now rooting their outer branches in a third circle more irregular than the others, and 8 yards distant from it, so that the total diameter of the group is 36 yards. All the stems are more or less covered with spray, and the central one seems to have long ceased to grow.

Strutt paid less attention to the lime than it deserves. He figures only two, one of which, at Cobham, is in the same plate with a sycamore; the other at Moor Park, near Rickmansworth, Herts. This stood at the end of a line of large limes, and was a very wide-spreading tree, with a trunk 17½ ft. at three ft. from the ground, and branches 120 yards in circumference. I am informed by Mr. Haynes, gardener at Moor Park, that this tree was blown down in 1860; but it is still alive, and some of the branches have taken root in the ground and have sent up stems about forty-five feet high. Within fifty yards of it another tree in the same row is now 21 ft. in girth.

A similar case of a lime having been blown down and the branches taking root occurs at Stratton Strawless. This tree, as Mr. Birkbeck tells me, was mentioned by Sir T. Browne in the reign of Charles I. It was blown down in 1895 and lay till 1900, when the roots were covered with a mound of sand. When I saw it in 1909, many branches were throwing up vigorous shoots, and the tree looked as if it might live for centuries. Its trunk was about 12 ft. in girth. A very fine tall red-twigged lime by the water at Gatton Park, in 1904, was 131 ft. by 12½ ft. A large spreading tree, at Osberton Grange, Notts, is about 80 ft. high by 19 ft. in girth.

At Dallam Tower, Westmoreland, there is an old lime in an exposed situation in the park which measures no less than 22 ft. 3 in. in girth, though not over 65 ft. in height; and, as showing the influence of situation on trees, I may say that, in a sheltered hollow close to the house at the same place, I measured a lime 128 ft. high, double the height of the first, but only 7 ft. 8 in. in girth.

There is a row of very large and apparently old limes at Hawsted, near Bury St. Edmunds, in the same field, and probably planted at the same time as the Oriental planes which we have described.² The largest is about 105 ft. by 20 ft. Another, whose trunk is covered with large burrs, is 16 ft. in girth. The leaves on the shoots from the base of these trees vary considerably in size and shape.

¹ *Gard. Chron.* i. 49 (1874).

² Cf. Vol. III. pp. 621, 622.

In the west garden at Hatfield House, Herts, there is a remarkable pergola of the common lime, about 280 yards long, and 10 ft. wide. The trees, which are pruned every year, stand 12 ft. apart in the row on each side, and are $7\frac{1}{2}$ ft. high.

In some parts of England, especially in Essex and Herts, the lime is infested by mistletoe, which often kills the branches and causes irregular excrescences, which sometimes have an elongated gourd-like shape. A remarkable specimen of this, taken from a tree in front of Spains Hall, the seat of A. W. Ruggles-Brise, Esq., in Essex, is now in the Forestry Museum at Cambridge. It was stated in the *Gardeners' Chronicle*,¹ in answer to an inquiry by me, that such swellings are abundant on the limes at Hampton Court and at Dropmore, where Mr. Page states that a large tree was cut down on account of it being in a dying condition.

In Scotland² the lime is at many places almost as fine as in England. An immense tree growing at Kinloch, Meigle, is, as I am told by Sir John Kinloch, about 90 ft. by 21 ft., and spreads over an area of a hundred yards in circumference. A wide-spreading lime at Gordon Castle, which is known as the Duchess' tree, measures about 89 ft. high and 17 ft. 4 in. in girth; its layered branches form a dense mass of shoots and have not been trained into trees like the lime at Knole. Their total circumference is not less than 126 paces, so that it covers as large an area of ground as the Newbattle beech.³ This tree is mentioned in *Old and Remarkable Trees* as having been, in 1867, 70 ft. by $16\frac{1}{2}$ ft. at 3 ft., the circumference of the branches being 310 ft. There is a wide-spreading common lime at Pitfirrane, near Dunfermline, of which the gardener, Mr. Percy Brown, has sent us a photograph. It was, in 1912, 74 ft. high, and 13 ft. 3 in. in girth, the circumference around the branches being 298 ft. At Leny there are some fine limes, one of which I found to be 105 ft. by 12 ft. 3 in., which, at such a high elevation above the sea, is remarkable. At Ancrum, near Roxburgh, Mr. Renwick saw a common lime 17 ft. 3 in. in girth in 1909.

At Roseneath, near the great silver firs (see p. 729), is an old avenue of large-leaved limes, covered with such a mass of small spray that it was impossible to see the bark near the ground, and one of these, measured over the spray with the tape as tight as I could make it, was no less than 24 ft. There are some fine lime trees of great size in the park at Taymouth Castle.

In Ireland we have seen no limes of remarkable size, and the tree never seems to have been so generally planted as in England. There is an avenue of fair-sized trees at Muckross Abbey; and Loudon mentions a tree in the park at Charleville forest, Co. Meath, which was reported at that time to be 110 ft. high and $5\frac{1}{2}$ ft. in diameter at 1 ft. from the ground. At Rossanagh a remarkable tree was growing in 1908 which, as I was informed by Mr. W. T. Tighe, was blown down about 1825. His grandfather had it pulled up into a leaning position, and placed a large boulder over the roots to keep it firm. It now leans at an angle of about 40° , and has grown into a flat trunk 6 ft. wide on the side but only 14 ft. 10 in. in girth. It is about 100 ft. in height and twice as large in girth as any other of the trees in the same line, which appear to have been planted at the same time.

¹ *Gard. Chron.* xli. 240, 257 (1907).

² Cf. Christison, in *Trans. Bot. Soc. Edin.* xix. 494 (1893).

³ Vol. I. p. 23, Plates 8, 9.

TIMBER

The wood of the lime is pale yellow or white, light, soft, and close-grained, and is not liable to become worm-eaten. It was formerly valued by pianoforte-makers for sounding-boards; and cutting boards used by shoemakers, glovers, and harness-makers, were made of it. I am informed by Mr. Anderson that twenty-five years ago he was sometimes able to sell the best part of large trees at as much as 5s. or 6s. per foot; and at Longleat a large lime tree blown down in the park realised 4s. 6d. per foot; but its use has now been superseded by foreign imports from America and elsewhere, and from one to two shillings per foot is its usual value. Owing to its softness, consistency, and non-liability to split, it was preferred for wood-carving; and all the finest carvings by Grinling Gibbons are said to be done in lime wood.¹

In northern Europe, especially in Russia, the inner bark of the small-leaved and large-leaved limes is largely used for making the bast mats which are used as dunnage in grain cargoes, and also imported for covering garden frames. The shoes worn by the Russian peasants are made from plaited lime bark, and Loudon says that ropes were made from it in his time in Devonshire and Cornwall; but this, like so many other rural industries, has now, I believe, quite died out.

I am indebted to Mr. J. Rose, of Messrs. Broadwood & Sons, for the following:—"Fine lime-tree was at one time very eagerly sought after in this country for the manufacture of pianoforte keys. When large and freely grown it is a beautifully straight and silky-grained wood, easily worked, not given to warping, very light in weight, and yet very tough. These qualities made it an admirable material for the purpose. But it became more and more difficult to obtain lime-tree of fine quality, and it was replaced by the importation of American basswood, a wood of similar character, easier to obtain in good sizes, free from knots, and straight in the grain, which is imported in the form of boards, or of glued-up and planed keyboards ready for the ivories. It has also been replaced, in part, for key-making by continental-grown pine, which has distinct advantages for the purpose."

A marked feature in the timber trade in recent years has been the importation of sawn timber, which has greatly affected the sale of home-grown timber. The manufacturer is now supplied with foreign timber ready sawn, seasoned to some extent, and often carefully graded; whereas home-grown timber has to be collected in comparatively small parcels, and its selection and handling require a great amount of knowledge and experience possessed by a very few persons. (H. J. E.)

¹ Evelyn (*Silva*, Hunter's ed. i. 205 (1801)), says: "Because of its colour and easy working, and that it is not subject to split, architects make with it models for their designed buildings; and the carvers in wood use it not only for small figures, but for large statues and entire histories in bass and high relieve; witness beside several more the festoons, fruitages, and other sculptures of admirable invention and performance, to be seen about the choir of St. Paul's and other churches, royal palaces, and noble houses in city and country; all of them the works and invention of our Lysippus, Mr. Gibbons, comparable, and for ought appears equal to anything of the antients. Having had the honour (for so I account it) to be the first who recommended this great artist to his Majesty Charles II., I mention it on this occasion with much satisfaction."

TILIA EUCHLORA

Tilia euchlora, Koch, in *Wochenschr. Gärtn. u. Pflanzenk.* ix. 284 (1866), and *Dendrologie*, i. 473 (1869); Schneider, *Laubholzkunde*, ii. 374 (1909); V. Engler, *Monog. Gatt. Tilia*, 149 (1909).
Tilia multiflora, Simonkai, in *Math. Term. Közl.* xxii. 328 (1888) (not Ledebour).
Tilia rubra, var. *euchlora*, Dippel, *Laubholzkunde*, iii. 63 (1893).
Tilia dasystyla, Jack, in *Garden and Forest*, i. 332 (1888); Nicholson, in *Kew Hand-list Trees*, 45 (1894) (not Steven).¹

A tree, attaining 50 ft. in height and 6 ft. in girth, but possibly larger in its native country. Bark grey and scaly. Young branchlets green, glabrous, the short shoots, however, being slightly pubescent. Leaves (Plate 407, Fig. 10) intermediate in size between those of *T. cordata* and *T. vulgaris*, averaging 2½ in. in width and length, orbicular-ovate, coriaceous, cuspidate at the apex, oblique and cordate at the base; upper surface dark shining green, glabrous; lower surface paler, almost glaucous, glabrous, except for brownish axil-tufts at the base and at the junctions of the midrib, primary and secondary nerves; margin regularly serrate, the teeth ending in long slender points; petiole glabrous, slender, more than half the length of the blade. Buds, with three external green glabrous ciliate scales.

Cymes glabrous, pendulous, exceeding the leaves in length, three- to seven-flowered; bract glabrous, tapering at both ends, shortly stalked; flowers similar to those of *T. platyphyllos*, but the ovary is tomentose with long hairs, which are continued on the base of the style, the upper ¾ of which is glabrous. Fruit ovoid, indistinctly five-ribbed, covered with dense short brownish grey tomentum, the base of the style persistent at the apex; shell thick and woody.

This species is remarkably distinct in appearance, owing to the dark green and remarkably glossy upper surface of the leaves. It comes into flower about the end of July at Kew, later in the season than most of the limes, and the flowers have a peculiar colour, owing to the distinctly yellow tinge of the petals and filaments.

It has been much confused with *T. dasystyla*,² Steven, a native of the Crimea, which has leaves quite different in colour and shape, and, as its name indicates, a densely tomentose long style.

Tilia euchlora is represented in the Kew herbarium by a wild specimen from Karabagh in Russian Armenia; but it is supposed by Schneider and V. Engler to be a hybrid; and, if this is the case, its parents are possibly *T. caucasica*,³ Ruprecht, the common large-leaved lime in the Caucasus, and *T. cordata*. It is always propagated in nurseries by budding on the common lime; and seedlings of it appear to be unknown.

¹ Loudon, *Arb. et Frut. Brit.* i. 366 (1838), refers to Steven's species from the Crimea, and not to the tree called by us *T. euchlora*, Koch.

² *T. dasystyla* is represented in the Kew herbarium by Steven's type specimen and two other specimens, all from the Crimea.

³ The Caucasian lime can scarcely be identified with *T. rubra*, De Candolle, in *Cat. Plant. Hort. Monsp.* 150 (1813), which is described as having leaves pubescent beneath as in *T. platyphyllos*, and evidently refers to the southern form of the latter species in Europe.

This species is perhaps the handsomest of all the limes, on account of its shining foliage, which is very late in falling in autumn, and seems to be free from insect and fungoid attacks and from honey dew. It is apparently quite as hardy as the common lime, and young trees at Kew are remarkably thriving and healthy. It was unknown in Loudon's time, and seems to have been introduced a short time before 1866, when it was first accurately distinguished by Koch. It is rather rare in cultivation in England, though it is planted in Berlin and other German cities,¹ and thrives² in the Arnold Arboretum in Massachusetts. (A. H.)

TILIA TOMENTOSA, WHITE LIME

Tilia tomentosa, Moench, *Verz. Ausl. Bäume Weissenst.* 136 (1785); V. Engler, *Monog. Gatt. Tilia*, 116 (1909); Schneider, *Laubholzkunde*, ii. 386 (1909).
Tilia alba, Aiton,³ *Hort. Kew.* ii. 230 (1789), and iii. 300 (1811); Waldstein and Kitaibel, *Icon. Pl. Hung.* i. 2, t. 3 (1802); Loudon, *Arb. et Frut. Brit.* i. 372 (1838).
Tilia pallida, Salisbury, *Prod.* 367 (1796).
Tilia rotundifolia, Ventenat, *Mém. Inst. Paris*, iv. 12, t. 4 (1803).
Tilia argentea, Desfontaines, in De Candolle, *Cat. Pl. Hort. Monsp.* 150 (1813).
Tilia petiolaris, De Candolle, *Prod.* i. 514 (1824) (not J. D. Hooker).

A tree, attaining 100 ft. in height and 15 ft. in girth, usually with markedly ascending branches. Young branchlets covered with white stellate tomentum, more or less retained in the second year. Leaves (Plate 407, Fig. 3), about 3 to 5 in. across, nearly orbicular, cuspidate at the apex, cordate or truncate at the base; margin often lobulate, serrate or biserrate, the serrations ending in short blunt cartilaginous points; upper surface green, with scattered stellate pubescence; lower surface covered with a dense whitish tomentum, without axil-tufts; petiole stout or slender, less than half the length of the blade, stellate-pubescent. Buds, with three external grey tomentose scales.

Flowers, in seven- to ten-flowered pendulous tomentose cymes, which are shorter than the leaves; bract tomentose, sub-sessile; sepals tomentose, clothed with long hairs at the base within; petals glabrous, longer than the sepals; staminodes slender, spatulate, shorter than the petals; stamens, shorter than the staminodes, numerous, with the halves of each anther on a distinct short stalk; ovary ovoid, tomentose; style glabrous. Fruit ovoid, elongated, apiculate, slightly five-angled, grey tomentose, smooth or only indistinctly warty; shell woody.

This species shows in the wild state considerable variation in the shape of the

¹ Mr. Bean, in *Kew Bull.* 1908, p. 390, says that this species, which is so promising a tree for street planting, is abundant in the Boskoop nurseries, near Gouda, in Holland.

² *Garden and Forest*, i. 332 (1888).

³ In Aiton, *Hort. Kew.* ii. 230 (1789), it is erroneously stated that the common white lime is a native of North America, an error which was rectified in the second edition of this work, iii. 300 (1811), where Hungary is correctly given. Some writers have supposed that *T. heterophylla* was the species referred to; but the type specimen in the British Museum, inscribed *Tilia alba* in Solander's handwriting, though bearing neither flowers nor fruit, is without doubt a branch of the common European lime, identical with var. *argentea*.

leaves—some specimens, distinguished by V. Engler, as var. *typica*, having suborbicular leaves, usually cordate at the base; whilst others, var. *petiolaris*,¹ V. Engler, have leaves usually broader than long, and more or less truncate or subcordate at the base. These are connected by numerous intermediate forms, and can scarcely be maintained as distinct varieties.

All the wild specimens which I have seen, are characterised by leaves, thin in texture, usually pale green above, greyish and not snowy-white beneath, and with slender petioles. Trees similar to the wild form are occasionally seen in cultivation; but the tree which is more commonly cultivated under the name *T. argentea*, and which possibly was the one described by Moench as *T. tomentosa*, and in that case technically the typical form of the species, differs considerably in having larger leaves, thick in texture, more or less orbicular, uneven on the surface, dark shining green above, snowy white beneath, margin often lobulate, petioles short and stout. It is convenient to distinguish this cultivated form, the origin of which is unknown to me, as var. *argentea*. It has always ascending branches, and is possibly a sport.

This species is a native of south-eastern Europe, and Asia Minor; but does not extend as far eastward as the Caucasus. Its northern limit is southern Hungary, where it is found in some parts of Banat, Slavonia, and Croatia. It is widely distributed throughout the Balkan peninsula, extending southwards as far as Laconia in Greece; and spreads eastward through Roumania and Moldavia to Bessarabia, Podolia, and the Crimea. In Asia Minor, it is limited to Bithynia and the island of Chios. It is usually a component of mixed deciduous woods, growing in valleys and mountain slopes at a low elevation, but occasionally forms pure woods of small extent.

(A. H.)

CULTIVATION

The white lime was introduced into England in 1767, and has been planted as an ornamental tree at many places; but I know no avenues of it in England.

This species should be multiplied either by seed, which here only ripens in hot seasons such as 1911, or by layering, as when grafted, as is often done, on the common lime, the scions grow thicker than the stock and produce an unsightly swelling at the point of junction. As an ornamental tree, and for use in towns, it is much superior to the common lime, on account of the freedom of the leaves from honey dew.

The only place where I have seen the silver lime growing wild in Europe is in the forests of Bosnia, near Maglai in the valley of the Bosna, at about 1000 ft. elevation. Here it was scattered in forests of oak, and other deciduous trees, and was so conspicuous when the silvery white undersides of the leaves were upturned by the wind, that at a distance of a mile or so I at first supposed it to be a tree covered with white flowers.² Probably some such experience must have induced a former owner of Highclere to plant it largely in that beautiful park, where, as Loudon

¹ To be carefully distinguished from *T. petiolaris*, Hooker (see p. 1677).

² In sunny weather, the leaves on the sunny side, especially at the ends of the branchlets, are reversed, turning their white sides to the light. This is a provision against excessive transpiration of water; and has been observed in the other silver limes and in *Quercus conferta*. See Kerner's remarks in his *Nat. Hist. Plants*, Eng. Trans. i. 338 (1898).—A. H.

remarks, its presence could be detected at some miles distance through the apparently dense forest by the white tops appearing at intervals among other trees.

The finest tree of this species that we have seen grows at Albury Park, Sussex, in front of the Duke of Northumberland's house, and measures 100 ft., or perhaps a little more, in height, by 13½ ft. in girth (Plate 373). The ascending branches seem characteristic of this species, in cultivation at least, but this tree has an unusually regular and perfect head. I was informed by the late Mr. Leach that at Albury the flowers of this tree are poisonous to bees,¹ whose dead or stupefied bodies are found lying on the grass below it in August, and this observation is confirmed by Mr. Comber at The Hendre and by other observers.

At Henham Hall, Suffolk, a tree measured 76 ft. by 8 ft. 10 in. in 1909. It is grafted on the common lime, and is of the typical upright habit. At Hewell Grange a large tree, with the bark decaying on one side, was 92 ft. by 9 ft. 8 in. in 1909. At Dropmore there are two trees in the avenue to the Taplow gate, the larger of which is about 70 ft. by 11 ft. 3 in. At Harpsden Rectory, Oxon., Henry saw two trees, the larger of which was 80 ft. by 6 ft. 8 in. in 1907. At Arley Castle, a round-headed tree of upright habit measured² 62 ft. by 6 ft. 9 in. in 1903. At Beauport, Sussex, there is a tall but slender tree in a rather crowded situation, which has been grafted at about 10 ft. from the ground. Dr. Masters reported³ a tree of fine proportions and symmetry at Strathfieldsaye, 70 ft. by 6 ft. 2 in., in 1899. Mr. Bean⁴ saw a tree 80 ft. high in the Royal Gardens at Sans Souci, Berlin. (H. J. E.)

TILIA PETIOLARIS, WEEPING WHITE LIME

Tilia petiolaris, J. D. Hooker, *Bot. Mag.* t. 6737 (1884) (not De Candolle); Boissier, *Fl. Orientalis*, *Suppl.* 136 (1888).

Tilia alba, Koch, *Dendrologie*, i. 478 (excl. syn.) (1869) (not Aiton).

Tilia tomentosa, Moench, var. *petiolaris*, Kirchner, in Petzold and Kirchner, *Arb. Musc.* 162 (1864); V. Engler, in *Mitt. Deut. Dend. Ges.*, 1907, pp. 218-221.

Tilia tomentosa, Moench, var. *sphaerobalana*, Borbas, in *Bot. Centralb.* xxxvii. 168 (1889); V. Engler, *Monog. Gatt. Tilia*, 121 (1909).

A tree, attaining 80 ft. in height, differing from the wild form of *T. tomentosa*, as follows: Branches and branchlets pendulous; leaves with long slender petioles, exceeding half the length of the blade; fruit globose, depressed at the summit, from which arises a short stout style, very warty on the greyish surface, and divided by five vertical furrows into as many lobes; seeds⁵ often imperfect.

The leaves (Plate 407, Fig. 2) average about 3 in. across, and are obliquely orbicular, cordate or truncate at the base, cuspidate at the apex, flat on the surface and not wrinkled; margin finely and regularly serrate, the teeth ending in short points; under surface covered with a dense white tomentum; upper surface dark

¹ The flowers of the large tree of *T. petiolaris* at Kew are equally poisonous to bees. Cf. p. 1679, note 1.

² R. Woodward, *Hortus Arleyensis*, 25 (1907).

³ In *Gard. Chron.* xxvi. 162 (1899).

⁴ *Kew Bull.* 1908, p. 395.

⁵ Engler, out of fifty fruits which he examined, found only three with good seed, 1 to 2 in each fruit.

green, with scattered stellate pubescence. The branchlets, buds, and flowers are identical with those of *T. tomentosa*.

This tree appears to be a sport of *T. tomentosa* of unknown origin. Schneider considers it to be a native of southern Hungary and the Balkan States; and no doubt, specimens of silver limes with longer petioles than usual occur in that region, but no one, so far as I am aware, has ever seen a tree in the wild state with the pendulous habit and the peculiar fruits of *T. petiolaris*, Hooker. V. Engler admits that it is only known in cultivation.

The history of this tree is obscure; but it seems to have been first accurately distinguished by Kirchner, who, in 1864, described it as *T. tomentosa*, var. *petiolaris*, and erroneously identified it with *T. petiolaris*, De Candolle.¹ Hooker, in *Bot. Mag.* t. 6737 (1884), following Kirchner, adopted De Candolle's name; but, though this was incorrect, it is convenient to retain the name as *T. petiolaris*, Hooker. This peculiar tree was not known in Loudon's time; but must have been introduced from the Continent soon afterwards, as the fine specimen in the Cambridge Botanic Garden was probably planted² in 1842. Before 1864 it was known in cultivation as *T. americana pendula*³; and Koch in 1869 considered it to be of American origin.

1. *Tilia orbicularis*, Carrière,⁴ which originated in Simon-Louis' nursery at Plantières, is evidently a seedling of *T. petiolaris*, from which it differs mainly in being less pubescent. The leaves, which are dark glossy green above and dull grey beneath, also differ from those of *T. petiolaris* in the shorter petioles, which are, however, slender as in that species. The serrations are also slightly sharper and occasionally more irregular. Flowers as in *T. petiolaris*, but with the bract larger and nearly glabrescent, and the sepals and pedicels covered with a less dense and greyish tomentum. Fruit strictly globose, not depressed at the summit, and showing no furrows, but having the same warty surface as that of *T. petiolaris*.

This tree, which is not nearly so pendulous in habit as *T. petiolaris*, is reputed, on account of the dark glossy green of the upper surface of the leaves, to be a hybrid between *T. petiolaris* and *T. euchlora*; but, in the present state of our knowledge of hybrids, it is judicious to say nothing about its parentage until experimental sowings have been made on a large scale of the seed of *T. petiolaris*.⁵

Two small trees of *T. orbicularis*, obtained from Plantières in 1900, are thriving at Kew, one of which has already produced flowers and fruit. They retain their foliage late in the season. (A. H.)

¹ *T. petiolaris*, De Candolle, was founded in 1826 on a branch without flowers or fruit, now preserved in the Geneva Herbarium, which was taken from a tree cultivated in the Imperial Botanic Garden at Odessa; but Lange, in *Flora*, i. 233 (1827), who had seen this tree, states that it was identical in every respect with the ordinary form of *T. argentea* cultivated at Paris; and a drawing at Kew of De Candolle's specimen confirms Lange's opinion. The name *T. petiolaris*, De Candolle, thus disappears, being a mere synonym of *T. tomentosa*.

² The oldest herbarium specimen, which I have seen, is one in fruit from a tree growing in a street at Nancy, collected by Billot in 1861. According to Bunbury, *Arb. Notes*, 67 (1889), the fine tree at Barton was planted by his father; but no exact date can be now ascertained.

³ Cf. Rehder, in *Mitt. Deut. Dend. Ges.* 1904, p. 209.

⁴ Ex Beissner, in *Mitt. Deut. Dend. Ges.*, 1898, pp. 86 and 88. It appears, however, to have been first accurately described by Jouin in *La Semaine Horticole*, 1899, p. 335.

⁵ A branch from a seedling of *T. petiolaris*, raised in the Arnold Arboretum and sent to me by Prof. Sargent in 1910, bears foliage identical with that of the parent. Sargent, *Bull. Pop. Inform.* No. 30 (1912), and in *Gard. Chron.* lii. 88 (1912), states, however, that plants raised in the Arnold Arboretum from the seeds of a tree of *T. petiolaris*, which was growing near *T. americana*, the two flowering at the same time, are identical with trees of *T. spectabilis*. See p. 1686.

Tilia petiolaris is a beautiful weeping tree, which has not been nearly so generally planted as it deserves to be. There are good examples in the Botanic Gardens at Kew, Cambridge, and Glasnevin. At Stowe, near Buckingham, there is a handsome tree, 74 ft. by 6 ft. 8 in. There are two fine trees, girthing 7 ft. 4 in. and 5 ft. 7 in., and about 80 ft. high, growing on the bank of the Thames near Cliveden on the Wharfe Estate, belonging to Lord Boston. A very similar one on the lawn at Barton, Suffolk, was measured by Henry as 83 ft. by 8 ft. 2 in. in 1908. Another at Chiswick House, which has the trunk decayed on one side, measured 77 ft. by 10½ ft. in 1903. At Bicton a handsome tree, near the house, grafted at seven feet from the ground, measured 80 ft. by 5½ ft. in 1906. At Hatherop Castle there is a beautiful specimen of moderate size on the lawn (Plate 374), which has layered naturally; and many plants have been propagated from it also by artificial layers. At Gunnersbury House there is a good tree, which in 1912 measured 56 feet high by 6 ft. in girth at 4 ft. from the ground. At Aldenham there is a tree on the lawn which ripened fruit in 1911 from which I raised seedlings. I noticed many dead bees¹ under it on August 20.

In Scotland it appears to be perfectly hardy at Durriss; and Henry found, in 1905, a tree at Bargaly, 41 ft. by 4 ft. 8 in.

Mr. Bean² saw a fine specimen at Herrenhausen, in Hanover, which was 9 ft. 2 in. in girth in 1908. (H. J. E.)

TILIA MONGOLICA

Tilia mongolica, Maximowicz, in *Mé. Biol.* x. 585 (1880), and *Enum. Pl. Mongol.* 118, t. 11 (1889); L. Henry, in *Rev. Hort.* 1902, p. 476, figs. 214, 215, 217; Rehder, in Sargent, *Trees and Shrubs*, i. 121, t. 61 (1903).

A small tree, scarcely exceeding 30 ft. in height, and flowering when only a few feet high. Young branchlets glabrous, reddish, becoming grey in the second year. Leaves (Plate 407, Fig. 7) about 2½ in. wide, acuminate at the apex, with one or two sharp-pointed lateral lobes; base truncate or cordate; coarsely serrate, with a few large triangular teeth, tipped with long callous points; upper surface dark green, shining, glabrous; lower surface glaucous, with pubescent tufts in the axils at the base and at the junctions of the primary and secondary nerves, elsewhere glabrous; petiole glabrous.

Flowers, six to twelve in a cyme; bract stalked; sepals erect, villous within, glabrous without; petals erect, longer than the sepals; staminodes five, obtuse; stamens, as long as the sepals, thirty-five to forty, in five bundles; style glabrous. Fruit ovoid, mucronulate, without ribs or only slightly ribbed, thick-walled, shortly tomentose.

This species is very distinct in appearance, the small coarsely serrate leaves resembling those of a birch, and opening with a reddish tint in spring.

¹ In 1908, the bodies of innumerable bees, poisoned by the flowers of a tree of *T. petiolaris* at Tortworth, had so much manured the ground under its outer branches, that a very green ring of turf was visible in the autumn following, and was noticed by the Earl of Ducie to be even more conspicuous in 1909.

² *Kew Bull.* 1908, p. 392.

This tree occurs in northern China, at Jehol, and on the Po-hua mountain, west of Peking; and has also been found in the Moni Ula range, north of Ordos, in Mongolia. It was introduced into cultivation by Dr. Bretschneider,¹ who sent seeds from Peking to the Museum at Paris in 1880, and to the Arnold Arboretum in 1882. The specimen in the Jardin des Plantes at Paris is about 20 ft. high. A small tree at Kew flowered, when only 5 ft. high, at the end of July 1907. This species has lately been introduced into the Coombe Wood Nursery by Mr. Purdom, who has been collecting for Messrs. Veitch in northern China. (A. H.)

TILIA PAUCICOSTATA

Tilia paucicostata, Maximowicz, in *Act. Hort. Petrop.* xi. 82 (1890); Schneider, *Laubholzkunde*, ii. 371 (1909); V. Engler, *Monog. Gatt. Tilia*, 87 (1909).

Tilia Miqueliana, var. *chinensis*, Diels, in Engler, *Bot. Jahrb.* xxxvi., *Beibl.* No. 82, p. 75 (1905) (not Szyszylowicz).

A small tree. Young branchlets glabrous, green. Leaves about $2\frac{1}{2}$ in. long and 2 in. wide, ovate, usually truncate and rarely cordate at the base, ending at the apex in a long non-serrate acuminate cusp; green and glabrous on both surfaces, except for minute axil-tufts of pubescence beneath, which are, however, absent at the base of the blade; tertiary veins on the lower surface few, irregular, not parallel, but anastomosing, more or less prominent; margin with regular fine serrations ending in long points; petiole about an inch long, green, glabrous.

Cymes erect, each with seven to fifteen flowers; bracts glabrous, stalked; staminodes present; style pilose at the base. Fruit globose, tomentose, faintly five-ribbed.

This species differs from *T. cordata* and its allies, in the prominent tertiary venation and the green and not glaucous under surface of the leaf, which is usually truncate at the base. It is a native of the provinces of Kansu, Shansi, and Szechwan, in western China, where it was collected by Potanin, Giraldi, and Wilson. The latter sent a living plant² in 1901 to Coombe Wood, which I consider to be probably of this species. From it many grafts have been taken, and it now produces coppice shoots with large leaves, which show at the base of the blade and on the adjoining end of the petiole a trace of scattered stellate pubescence. This is probably a juvenile character, disappearing on adult plants; and a young tree at Kew, one of the grafts, about 8 ft. high, bears leaves similar to those of the adult wild tree, though slightly larger, and in these the stellate pubescence has almost disappeared. (A. H.)

¹ *Hist. Europ. Bot. Disc. China*, ii. 1050 (1898). The seedlings mentioned here as being alive at Kew in 1893 cannot be traced.

² This is probably the plant referred to *T. Miqueliana*, var. *chinensis*, in *Hortus Veitchii*, 381 (1906).

TILIA OLIVERI

Tilia Oliveri, Szyszylowicz, in Hooker, *Icon. Plant.* ad t. 1927 (1890); Schneider, *Laubholzkunde*, ii. 387 (1909); V. Engler, *Monog. Gatt. Tilia*, 114 (1909).

Tilia pendula, V. Engler, ex Schneider, *Laubholzkunde*, ii. 387 (1909), and *Monog. Gatt. Tilia*, 113 (1909).

Tilia mandshurica, Szyszylowicz, in Hooker, *Icon. Plant.* ad t. 1927 (1890) (not Ruprecht and Maximowicz).

A tree, attaining in western China about 50 ft. in height. Young branchlets glabrous. Leaves variable in size, usually longer than broad, averaging 3 to 4 in. in length and $2\frac{1}{2}$ to $3\frac{1}{2}$ in. in breadth, orbicular-ovate, cordate at the base, cuspidate at the apex; margin regularly serrate, with shallow sinuses between the crenate teeth, which are very short and end in cartilaginous points; upper surface dark green, glabrous; lower surface covered with a dense white thin tomentum, without axil-tufts; petiole glabrous, one-half to three-fourths the length of the blade.

Cymes usually much longer than the leaves, each with about twenty flowers, which are similar to those of *T. tomentosa*, but are smaller in size and on short thickened pedicels. Fruit globose, grey tomentose and tuberculate on the surface, thick-shelled, apiculate, $\frac{1}{8}$ in. in diameter.

This species, which promises to be a beautiful ornamental tree, is readily distinguished from the other limes with a pure white under surface to the leaves, by the glabrous branchlets and petioles, and the crenately serrate orbicular leaves.

This species is a native of central China, where it was discovered by me in 1888, in the mountains north of the Yangtze, in the Fang and Wushan districts of Hupeh. *T. Oliveri* was founded by Szyszylowicz on a branch (Henry, No. 7089) from a small shrubby tree, growing in a sunny exposure on high cliffs, and bearing in consequence small leaves, averaging 2 in. in length. Another specimen (Henry, No. 7452 B), gathered by me at no great distance, but in a shaded valley, bore leaves averaging $3\frac{1}{2}$ in. in length, and was identified by Szyszylowicz with *T. mandshurica*, which is a native of northern China. This specimen has been made the type of a new species, *T. pendula*, V. Engler. A third specimen, collected since by Wilson (No. 2274), with leaves intermediate in size, is considered by Schneider to be *T. pendula*, but by Engler to be *T. Oliveri*. A careful examination of the whole material shows that all the specimens belong to one species.

T. Oliveri was introduced by Wilson, who sent seed from central China in 1900. It is now growing vigorously at Coombe Wood, and a small specimen is thriving at Kew. (A. H.)

TILIA MANDSHURICA

Tilia mandshurica, Ruprecht et Maximowicz, in *Bull. Acad. St. Pétersb.* xv. 124 (1856); Maximowicz, *Prim. Fl. Amur.* 62 (1859), and in *Mél. Biol.* x. 586 (1880); Baker and Moore, in *Journ. Linn. Soc. (Bot.)* xvii. 380 (1879); Franchet, *Pl. David.* i. 60 (1884); Forbes and Hemsley, in *Journ. Linn. Soc. (Bot.)* xxiii. 94 (1886); Komarov, in *Act. Hort. Petrop.* xxv. 28 (1907).

Tilia pekinensis, Ruprecht, in *Bull. Acad. St. Pétersb.* xv. 125 (1856), and in Maximowicz, *Prim. Fl. Amur.* 469 (1859); Bayer, in *Verh. Zool. Bot. Ges. Wien*, xii. 49 (1862).

A tree, attaining in Manchuria about 60 ft. in height and 10 ft. in girth. Young branchlets and buds covered with brownish tomentum. Leaves, 4 to 5 in. in breadth and length, orbicular-ovate, usually cordate at the base, cuspidate at the apex; margin, often with one or two lobes, coarsely serrate, the teeth ending in long awn-like points; upper surface with a scattered stellate pubescence, which forms dense tufts at the base of the blade; lower surface densely covered with whitish stellate tomentum, but without axil-tufts; petiole half the length of the blade, stout, brown tomentose.

Flowers similar to those of *T. tomentosa*, but with bracts, pedicels, and sepals more densely covered with a brownish tomentum. Fruit globose, tomentose, and slightly warty, either without ribs or with five indistinct ribs towards the base.

This species is closely allied to *T. tomentosa*; but has larger leaves, with long-pointed serrations and different fruit. Young trees have usually lobed leaves, as is often the case in other species; and *T. pekinensis*,¹ founded on this character, cannot be retained even as a distinct variety.

Tilia mandshurica is widely spread throughout the whole of Manchuria, and also occurs in Korea, where it was found on the Diamond Mountains by Père Faurie. It is not uncommon in the mountains west and north of Peking. It occurs scattered or in groups throughout the broad-leaved forest of these regions. It is known to the Chinese, like all the other species of lime, as the *tuan* tree; and the bark is used for making ropes and sandals.

It was probably introduced by Maximowicz into the St. Petersburg botanic garden; but is extremely rare in cultivation, the only specimen which I have seen being a small tree at Kew, which was procured from Booth of Hamburg in 1871. As it comes into leaf very early in the spring, it is often cut by frost, and is not in a thriving condition.

(A. H.)

¹ Var. *pekinensis*, Engler, ex Schneider, *Laubholzkunde*, ii. 384 (1909).

TILIA MAXIMOWICZIANA

Tilia Maximowicziana, Shirasawa, in *Bull. Coll. Agric. Univ. Tokyo*, iv. 158, t. xviii (1900), and *Icon. Ess. Forest. Japon.* ii. t. 50 (1908); Schneider, *Laubholzkunde*, ii. 385 (1909).

Tilia Miqueliana, Sargent, in *Garden and Forest*, vi. 111, fig. 19 (1893), and *Forest Flora of Japan*, 19, t. 8 (1894) (not Maximowicz).

Tilia Miyabei, Jack,¹ in *Mitt. Deut. Dend. Ges.*, 1909, p. 285.

A tree, attaining in Japan 100 ft. in height and 10 ft. in girth. Young branchlets densely covered with a greyish brown tomentum. Leaves usually large,² about 5 in. in breadth and length, cordate at the base, cuspidate at the apex; margin ciliate, coarsely and regularly serrate, the serrations ending in blunt cartilaginous points; upper surface dark green, with scattered stellate tomentum on the surface between the nerves, and dense tomentum on the nerves, especially at the base of the blade; under surface greyish, densely covered with stellate tomentum, and with conspicuous brownish axil-tufts at the junctions of the nerves; petiole stout, less than half the length of the blade, covered with greyish brown tomentum. Buds covered with greyish or rusty brown tomentum.

Flowers, ten to eighteen in each pendulous tomentose cyme; bract shortly stalked, strongly veined and tomentose on both surfaces, the tomentum brown and very dense on the midrib; sepals lanceolate, acuminate, pubescent on both surfaces; petals keeled, glabrous; staminodes five, keeled, toothed at the apex, as long as but narrower than the petals; stamens sixty-five to seventy-five, united in five bundles, shorter than the petals, each half of the anther on a short stalk; ovary pubescent, ovoid; style glabrous. Fruit globose, about $\frac{1}{3}$ in. in diameter, with a thick woody grey pubescent five-ribbed shell.

This species is a native of Japan, ranging from central Hondo (lat. 36°) northwards to Hokkaido. In Hondo, according to Shirasawa,³ who has observed it in the provinces of Kotsuke, Rikuchu, and Mutsu, it grows at altitudes of 800 to 1600 ft., in deep valleys, in mixed woods with *Alnus tinctoria*, *Populus Sieboldii*, and *Quercus grosseserrata*. It appears to be more common in Hokkaido, where it was seen by Elwes at Sapporo and Asahigawa, in virgin forest at 500 to 750 ft. above sea-level, where it attains about 100 ft. in height and forms a wide-spreading tree, with a stem 10 ft. in girth.⁴ Shirasawa states that its wood is of little use except for firewood; but the bark, after steeping, is plaited by the Ainos into coarse cloth and mats.

There is a small tree of this species at Grayswood, Haslemere, which the late Mr. Chambers procured from the Yokohama Nursery Co. in 1894. It has not suffered from frost, but is rather slow in growth. Elwes has raised plants at Colesborne from

¹ Jack proposes this name on account of the earlier use of *T. Maximowiczii*, Baker, in *Journ. Bot.* xxxvi. 319 (1898), an untenable name for another species. Cf. p. 1657, note 3, B.

² Those on coppice shoots, gathered by Elwes in Hokkaido, are 8 to 10 in. long.

³ Specimens collected by Shirasawa in different localities are now in the Kew Herbarium.

⁴ Sargent says it attains 100 ft. in height in Hokkaido, where it frequently grows in company with *T. japonica*, which is much smaller in size. Cf. p. 1657, note 3, C.

seed sent by Shirasawa in the spring of 1905. These are 3 to 5 ft. in height, and differ from adult trees in having only traces of stellate pubescence on the leaves and branchlets.

(A. H.)

TILIA MIQUELIANA

Tilia Miqueliana,¹ Maximowicz, in *Bull. Acad. Imp. Sc. St. Petersb.* xxvi. 434 (1877), and *Mél. Biol.* x. 587 (1880); Shirasawa, *Icon. Ess. Forest. Japon.* i. text 116, t. 72, figs. 11-24 (1900), and in *Bull. Coll. Agric. Univ. Tokyo*, iv. 160 (1900); Schneider, *Laubholzkunde*, ii. 385 (1909); V. Engler, *Monog. Gatt. Tilia*, 111 (1909).

Tilia mandshurica, Miquel, *Procl.* 206 (1867) (not Ruprecht and Maximowicz); Franchet et Savatier, *Enum. Pl. Jap.* i. 67 (1875).

Tilia Kinashii, Lévillé and Vaniot, in *Bull. Soc. Bot. France*, li. 422 (1904).

Tilia Franchetiana, Schneider, in Fedde, *Repert.* vii. 201 (1909), and *Laubholzkunde*, ii. 386 (1909).

A tree, attaining in Japan about 40 ft. in height. Bark on young trees grey, smooth; on old trunks fissured longitudinally. Young branchlets with a minute grey stellate pubescence, very variable in amount. Leaves (Plate 407, Fig. 9) extremely variable in shape, but usually much longer than broad, averaging 3 to 4 in. in length and 2 to 2½ in. broad, ovate or deltoid; cordate at the base; acute, slightly acuminate or rounded, but rarely cuspidate at the apex; often lobulate and coarsely, irregularly, and sharply serrate, the teeth ending in incurved short callous points; upper surface shining green, with scattered slight pubescence, mostly on the nerves and at the base of the midrib; lower surface covered with a grey stellate tomentum, without axil-tufts; petiole short, less than half the length of the blade, with minute stellate pubescence. Buds grey tomentose.

Flowers, ten to twenty-two in a cyme; bract, peduncle, pedicels, and bracteoles tomentose; sepals ovate, acute, tomentose on both surfaces, shorter than the narrow obovate petals; stamens sixty to seventy-five, united in five clusters; staminodes more slender and shorter than the petals; ovary and base of the style covered with pale hairs. Fruit nearly globose, five-ribbed at the base, grey tomentose and warty.

This species is unknown in the wild state, and only occurs in Japan as a planted tree, most often seen in the courts of Buddhist temples, where it is regarded as sacred. It is reported by tradition to have been introduced from China by a Buddhist priest about the year 1190 A.D.; but it has not yet been found anywhere in that country.² Its extreme variability points to a hybrid origin. The species was founded by Maximowicz on two specimens, which he regarded as two forms: one with ovate-orbicular oblique leaves, long slender cymes, and broad bracts about 4 in. in length; the other with remarkably deltoid nearly symmetrical leaves, short cymes, and narrow bracts about 2½ in. long. It is impossible, however, following the opinions of Schneider and V. Engler, to retain those two forms as two distinct

¹ The tree described and figured under this name by Sargent, in *Garden and Forest*, vi. 111, fig. 19 (1893), and *Forest Flora Japan*, 19, t. 8 (1894), is *T. Maximowicziana*.

² *Tilia Miqueliana*, var. *chinensis*, Szyszlowicz, in Hooker, *Icon. Plant.* ad t. 1927 (1890), collected by me in Hupeh in central China, is referred by V. Engler, *Monog. Gatt. Tilia*, 130 (1909), to *T. chinensis*, Maximowicz, in *Act. Hort. Petrop.* xi. 83 (1890), a plant collected in Kansu. The Kansu and Hupeh plants do not seem to be quite identical; but neither can be considered the same as the Japanese *T. Miqueliana*. They have not been introduced into cultivation.

varieties or species; for the trees cultivated in Europe show great variation, no two specimens being alike, and both deltoid and ovate leaves are occasionally present on the same branch. Recent specimens from Japan, collected by Shirasawa, cannot be exactly matched with either of Maximowicz's specimens.

This species has lately been introduced into England, and the only specimens which we have seen are young trees at Kew, Aldenham, Casewick, and Glasnevin. The tree at Kew, obtained from Hesse's nursery in 1900, is now about 12 ft. high and appears to be thriving. It is also cultivated by Simon-Louis at Plantières, Metz.

(A. H.)

TILIA AMERICANA, AMERICAN LIME, BASS-WOOD

Tilia americana, Linnæus, *Sp. Pl.* 514 (1753); Loudon, *Arb. et Frut. Brit.* i. 373 (1838); Sargent, *Silva N. Amer.* i. 52, tt. 24, 25 (1891), and *Trees N. Amer.* 671 (1905).

Tilia caroliniana, Miller, *Dict.* ed. 8, No. 4 (1768).

Tilia latifolia, Salisbury, *Prod.* 367 (1796).

Tilia nigra, Borkhausen, *Handb. Forstbot.* ii. 1219 (1800).

Tilia glabra, Ventenat, *Mém. Acad. Sc. Paris*, iv. 9 (1802).

Tilia canadensis, Michaux, *Fl. Bor. Am.* i. 306 (1803).

Tilia stenopetala, Rafinesque, *Fl. Ludovic.* 92 (1817).

A tree, occasionally attaining in America 130 ft. in height and 12 ft. in girth. Bark deeply fissured, with ridges broken on the surface into small thin scales. Young branchlets green, glabrous. Leaves (Plate 407, Fig. 1) broadly oval, averaging 5 in. to 6 in. long and 3½ in. to 4½ in. broad, turning yellow in autumn, cordate or truncate at the base, cuspidate at the apex; margin ciliate, with coarse triangular serrations, ending in long callous points; upper surface dull dark green, glabrous; lower surface¹ light green, glabrous, except for minute pubescent tufts in the axils at the junctions of the midrib, primary, and secondary nerves, but absent at the base of the blade; petiole glabrous, 1½ in. to 2 in. long.

Cymes pendulous, many-flowered; bract stalked, broad and rounded at the apex, glabrous except for slight stellate pubescence on the midrib beneath; peduncle glabrous; pedicels slightly pubescent; sepals ovate, acuminate, densely hairy within, slightly pubescent without, shorter than the lanceolate petals; staminodes present. Fruit globose or ovoid, without ribs, covered with thick rufous tomentum; shell thick.

The American lime is readily distinguished from the other species with glabrous branchlets and leaves, by the minuteness of the axil-tufts, which are, moreover, not present at the base of the leaf. In winter, the branchlets are shining, glabrous; buds with three external scales, glabrous except for tufted cilia at their tips.

The leaves are remarkable for their variation in size, an interesting account of which is given by Penhallow.² In Canada, some trees have tolerably uniform leaves, about 3½ in. in diameter. Other trees have in addition many leaves 4½ in. across. On vigorous shoots, especially on epicormic branches, the leaves are often 8 in.

¹ In *T. americana* the midrib and principal nerves are remarkably yellow, and this character is also seen in its reputed hybrids, *T. Molthei*, *T. spectabilis*, and *T. Michauxii*.

² *Canadian Record of Science*, ix. 291 (1905).

wide. This lime coppices freely, and on shoots so produced the foliage is always enormous, reaching a maximum of 10 in. in diameter. This variation is due in part to the amount of nutrition available, which is greatest on coppice shoots, owing to their extensive root system; but the size of the leaves is also much influenced by shade. Trees with large leaves are often known in gardens as *var. mississippiensis*, but this name is erroneous, as there is no reason to suppose that such trees are limited to the Mississippi basin.

Tilia americana, since its introduction into Europe, has given rise to hybrids¹ with other species, especially with *T. tomentosa*, which is probably the other parent in the following:—

1. *Tilia Moltkei*, Schneider, *Laubholzkunde*, ii. 381 (1909).

A tree with leaves similar in shape and serrations to those of *T. americana*, but larger, 6 in. to 7 in. long and 5 in. to 6 in. wide, and differing in the lower surface, which is pale or greyish green, more or less covered with scattered stellate pubescence, without axil-tufts, but with occasional long hairs on the midrib. Buds, petioles, and branchlets glabrous, and identical with those of *T. americana*.

This tree, which is remarkable for its vigorous growth and handsome foliage, originated² in Späth's nursery at Berlin, and is named after the famous general, who planted a young tree in front of Herr Späth's house in 1888. Specimens are growing at Kew and Aldenham.

2. *Tilia spectabilis*, Dippel, *Laubholzkunde*, iii. 73 (1893).

A tree resembling *T. Moltkei* in the shape, colour, and serration of the leaves, but differing as follows:—Young branchlets apparently glabrous, but showing traces of stellate pubescence. Buds pubescent in their upper half. Leaves (Plate 407, Fig. 11), variable in size, 4 in. to 6 in. long and 3 in. to 5 in. wide; under surface with scattered stellate pubescence, very variable in amount,³ and with long hairs on the principal nerves as well as on the midrib, but without axil-tufts; petiole glabrous or with a few scattered hairs. The flowers are intermediate in character between those of *T. americana* and *T. tomentosa*, and open at Kew three weeks earlier than those of the latter species. The stellate pubescence on the bract, peduncle and pedicels is like that of *T. tomentosa*, but less in amount. The shape of the bract and the size of the flowers are similar to *T. americana*.

This tree has probably been long in cultivation, but I have not been able to trace its origin.⁴ It is often planted in botanic gardens, as at Kew, where there are several specimens, one nearly 40 ft. in height.⁵ At Cambridge a tree, about 35 ft. by 3½ ft. in 1907, has long been labelled *T. heterophylla*; and reputed trees of the latter species usually turn out to be either *T. spectabilis* or *T. Michauxii*.

¹ In America it probably forms hybrids with *T. heterophylla*. See *T. Michauxii*, p. 1689.

² It is mentioned as a new plant, *Tilia americana Moltkei*, in Späth's *Catalogue*, No. 57, p. 71 (1883).

³ In cases where the stellate pubescence on the under surface of the leaves becomes dense and greyish, trees of *T. spectabilis* are often confused with *T. tomentosa* and *T. Michauxii*. They are readily distinguishable from the latter by the absence of axil-tufts, and from the former by the glabrous branchlets. The long hairs on the midrib and nerves seem to be peculiar to *T. spectabilis* and *T. Moltkei*.

⁴ Dippel found it in 1893 in Froebel's nursery under the name *T. alba spectabilis*, and in the Zoeschen arboretum as *T. Blechiana*; but it must have originated much earlier. Cf. *ante*, p. 1678, note 5.

⁵ This tree has been labelled *T. argentea*, and resembles *T. tomentosa* in habit.

3. *Tilia viridis*, Simonkai, in *Math. Term. Koezl.* xxii. 320 (1888).

In addition to the usual form of *T. spectabilis* described above, there appears to be another hybrid of the same parentage, which is represented at Kew by a tree about 25 ft. high, obtained under the name *T. spectabilis* from Späth in 1899. It is closer to *T. tomentosa*, as the buds, branchlets, and upper surface of the leaves are covered with a scattered stellate pubescence, which is denser on the under surface of the leaves than in ordinary *T. spectabilis*. This tree closely resembles, if it is not identical with, a specimen¹ taken from a tree cultivated at Baden in 1835, which was identified by A. Braun with *T. argentea*, var. *virescens*, Spach, in *Ann. Sci. Nat.* ii. 344 (1834). Spach's description was based on a tree in the Trianon, which was said to have been raised from seeds of *T. tomentosa*; and if this account is correct, this tree would appear to have been the first cross observed between *T. tomentosa* and *T. americana*.

DISTRIBUTION

Tilia americana is widely spread, occurring in Canada from the valley of the Assiniboine River and the southern shores of Lake Winnipeg eastward to northern New Brunswick, and extending in the United States southwards to Virginia and along the Appalachian mountains to Georgia and Alabama, and ranging westward to Dakota, Nebraska, Kansas, Indian Territory, and eastern Texas. It grows in rich often moist soil, and formerly occurred as pure forest.² It attains its largest size in the alluvial lands of the lower Ohio river, where Ridgway records a tree 135 ft. in height and 17½ ft. in girth.³

According to Loudon, the American lime was cultivated⁴ by Miller in 1752, but had not been extensively distributed. It is very rare at the present time in cultivation, and the tree at White Knights, mentioned by Loudon as 60 ft. in height, is no longer living. The only specimens which we have seen in England are small trees at Kew, Eastnor Castle, and Liphook. (A. H.)

TIMBER

The wood of the American limes is very similar in character to that of the European species, and according to Sargent is largely used in the United States under the name of whitewood for the manufacture of cheap furniture, carriage panels, and woodenware. He states that, though one of the woods most largely used for making pulp, the quick decomposition of the sap makes it unfit for white paper. It is imported to some extent into Europe under the name of basswood, and has

¹ This specimen is considered by Bayer, in *Verhand. Zool. Bot. Ges. Wien*, xii. 50 (1862), to be a hybrid between *T. tomentosa* and *T. americana*, which he calls *T. argentea-nigra*. V. Engler (*op. cit.* 152) considers it to be *T. cordata* × *T. tomentosa*, but it shows no trace of *T. cordata* parentage.

² In *U.S. Forest Service, Circular 63* (1907), which gives an account of this species, it is said to do well when planted in pure stands, and to be the most prolific of American trees in shoots from the stumps.

³ Sargent, *Bull. Pop. Inform.* No. 30 (1912), and in *Gard. Chron.* lii. 87 (1912), says that it shows its greatest beauty in the forests of New Brunswick, northern New England, and the valley of the St. Lawrence. The leaves of planted trees in eastern Massachusetts are, especially in dry summers, made brown by the red spider, which, however, is easily controlled by spraying.

⁴ In the *London Catalogue of Trees*, 1730, p. 81, the Carolina lime tree is mentioned as "*Tilia*, with leaf more longly mucronate. Seeds sent from Carolina by Catesby in 1726, hardy, and may be propagated as other limes."

partially displaced native limewood in the pianoforte trade on account of its cheapness. Owing to the facility with which large thin sheets can be turned off the log by rotating it against a knife-edge, it is coming into use for three-ply boards, a manufacture which, though only recently invented, is likely to grow rapidly for many purposes. (H. J. E.)

TILIA HETEROPHYLLA

Tilia heterophylla, Ventenat, in *Anal. Hist. Nat. Madrid*, ii. 68 (1800), and *Mém. Acad. Sc. Paris*, iv. 16, pl. 5 (1803); Sargent, *Silva N. Amer.* i. 57, t. 27 (1891), and *Trees N. Amer.* 674 (1905).

Tilia americana, Linnæus, var. *heterophylla*, Loudon, *Arb. et Frut. Brit.* i. 375 (1838).

A tree, attaining in America 60 ft. in height and 12 ft. in girth. Young branchlets glabrous. Leaves similar to those of *T. Michauxii* in size and shape, but differing in being covered beneath with a silvery white tomentum, without axil-tufts, and having finer serrations with shorter straighter points. The flowers appear to differ in the bract¹ pubescent on both surfaces, and the stellate-pubescent peduncle and pedicels. There appears to be no constant difference in the fruit.

Both this species and *T. Michauxii* are readily distinguished from the other white limes by the glabrous branchlets, and the different shape of the leaves, which are usually very oblique at the base, and always longer than broad. *T. pubescens*, Aiton, the white lime of the Gulf States, is not in cultivation, and probably would not live in our climate. It has pubescent branchlets.

T. heterophylla, according to Sargent, is found on rich wooded slopes or near the banks of streams; and ranges from Ithaca, New York, southwards along the Alleghany mountains to northern Alabama, and westward to middle Tennessee, Kentucky, southern Indiana, and Illinois. It is most abundant and of its largest size on the high mountains of North Carolina and Tennessee.

Typical *T. heterophylla* is described by most authors as having the leaves covered beneath with a silvery white tomentum; but Sargent informs me in a letter that Rehder found trees on the mountains of West Virginia, with leaves nearly glabrous beneath,² which he considered to be undoubtedly *T. heterophylla*. Such trees are probably hybrids with *T. americana*; and a further study of the American limes is necessary, as the relationship of *T. Michauxii* and the glabrous forms of West Virginia with *T. heterophylla* in its typical form, is very obscure.

T. heterophylla was introduced, according to Loudon, in 1811; but he had seen no specimens except small trees in the Chiswick Garden; and these may have been *T. Michauxii*, which he did not distinguish as a separate species. Most of the trees which occur in cultivation under this name are either *T. Michauxii* or *T. spectabilis*; and we have seen no living specimens in England which can be identified with *T. heterophylla*. (A. H.)

¹ The bract is said by Schneider to be stalked in *T. heterophylla*, and sessile in *T. Michauxii*; but native specimens show it to be variable in both species.

² *T. eburnea*, Ashe, in *Bot. Gaz.* xxxiii. 231 (1902), usually considered to be a peculiar variety of *T. heterophylla* in the Carolinas and Georgia, is said to lose its pubescence in autumn occasionally.

TILIA MICHAUXII

Tilia Michauxii, Nuttall, *N. Amer. Sylva*, i. 108 (1865); Sargent, *Trees N. Amer.* 673 (1905); Schneider, *Laubholzkunde*, ii. 387 (1909).

Tilia alba, Michaux, *Hist. Arb. Amer. Sept.* iii. 315, t. 2 (1813), and Nuttall, *N. Amer. Sylva*, iii. 84, t. 132 (1865). (Not Aiton, *Hort. Kew.*)

A tree, attaining in America 80 ft. in height and 9 ft. in girth. Young branchlets and buds glabrous. Leaves (Plate 407, Fig. 5) very variable in size, averaging 1/4 to 5 in. in length, and 3 to 4 in. in breadth, always much longer than broad, ovate, very oblique and cordate or truncate at the base, cuspidate at the apex; margin with large triangular serrations ending in long incurved points; upper surface dark green, glabrescent; lower surface covered with a scattered or dense greyish tomentum, very variable in amount, and with conspicuous axil-tufts at the junctions of the midrib, primary and secondary nerves; petiole stout, short, glabrescent.

Cymes, ten- to twenty-flowered; bract tomentose above, glabrous below; peduncle glabrous; pedicels slightly pubescent; sepals lanceolate, pubescent on both surfaces; petals lanceolate, acute, twice as long as the sepals; staminodes present. Fruit globose, marked with five furrows and minutely tuberculate on the grey slightly tomentose surface.

This species was first described and figured by Michaux, who, however, considered it to be the same as the European white lime. Nuttall² based his name *T. Michauxii* on Michaux's description and figure. It appears to have much the same distribution as *T. heterophylla*, but is imperfectly known,³ and in all probability is a hybrid of that species with *T. americana*, resembling the latter in the serrations, axil-tufts, and yellow midribs and nerves of the leaves. The characters of the flowers are intermediate between the two species mentioned. The extreme variability in the amount of the tomentum on the leaves points to a hybrid origin.

It is not very common in cultivation in England; but there are two fine trees at Beauport, which are both grafted; one of these measures 84 ft. by 9 ft. 1 in., and the other is nearly as large. There are also small trees at Kew and Tortworth. There is an ill-shaped tree at Castlemartyr in Ireland, which Elwes found in 1908 to be about 40 ft. by 3 1/2 ft.; some of its leaves were no less than 12 in. long and 9 in. wide. It is cultivated under the name *T. americana rubra* in the Heatherside nursery; and appears to be known in continental nurseries under various names, as *T. americana pubescens*, *T. gigantea*, *T. macrophylla*, *T. hybrida superba*, etc.

(A. H.)

¹ In cultivated trees in Europe the leaves are usually larger, averaging 7 in. long and 5 to 6 in. broad; but this may be a juvenile character.

² Nuttall says: "The *Tilia alba* of Michaux, not being the *T. alba* of Kitaibel and Aiton, it is necessary to change the name, and we propose to call it *T. Michauxii*."

³ I am unable to follow V. Engler's view, that all the trees in the wild state in America, supposed to be *T. Michauxii* by Sargent and others, are simply *T. heterophylla*. Engler restricts the hybrid *T. americana* × *T. heterophylla* to trees found in cultivation in Europe. Wild *T. Michauxii* in America, judging from a considerable number of specimens which I have seen, is readily distinguishable from the true *T. heterophylla*; and I see no reason for supposing that the trees referred by me to *T. Michauxii*, which are in cultivation in Europe, are not originally from America. A small tree at Kew, received from Baltimore, U.S.A., is undoubtedly *T. Michauxii*.

TRACHYCARPUS

Trachycarpus, H. Wendland, ex Gay, in *Bull. Soc. Bot. France*, viii. 429 (1861); Bentham et Hooker, *Gen. Pl.* iii. 929 (1883); Beccari, in Martelli, *Webbia*, i. 41-73 (1905).
Chamærops, Martius, *Hist. Nat. Palm.* iii. 247 (1836-1850) (in part).

TALL unarmed trees, belonging to the order Palmaceæ, with flabellate leaves, without a rachis, deeply divided into numerous plicate segments, which are narrow, entire in margin, and bifid at the apex.

Flowers monœcious; spadices numerous, paniced, sessile between the leaves, and embraced by sheathing coriaceous spathes; individual flowers small; sepals three, ovate; petals three, broadly ovate, valvate; stamens six, with free filaments and short dorsifixed anthers, rudimentary in female flowers; ovary of three carpels, connate at the base, represented in the male flowers by three small subulate processes; stigmas three, recurved; ovules basilar, erect. Fruits, one to three, globose or oblong, with a terminal style; containing one erect seed, which is grooved on the ventral side, and has a small hilum at the base.

Three species¹ of *Trachycarpus* are known, natives of the Himalayas, Assam, Burma, and China.

TRACHYCARPUS FORTUNEI, CHUSAN PALM

Trachycarpus Fortunei, H. Wendland, in *Bull. Soc. Bot. France*, viii. 429 (1861); Masters, in *Gard. Chron.* xxiv. 304, fig. 65 (1885).
Trachycarpus excelsa, H. Wendland, in *Bull. Soc. Bot. France*, viii. 429 (1861); Planchon, in *Flore des Serres*, xxii. 207, t. 2368 (1877); Beccari and J. D. Hooker, in J. D. Hooker, *Flora Brit. India*, vi. 436 (1892); Diels, in Engler, *Bot. Jahrb.* xxix. 233 (1900); Wright, in *Journ. Linn. Soc. (Bot.)* xxxvi. 168 (1903); Masters, in *Gard. Chron.* xxxv. 312, Supply. Illust. (1904); Beccari, in Martelli, *Webbia*, i. 41 (1905).
Chamærops excelsa, Martius, *Hist. Nat. Palm.* iii. 251, t. 125, figs. 2, 3 (1836-1850) (not Thunberg²); Miquel, *Anal. Bot. Ind.* ii. 21 (1851); Gay, in *Bull. Soc. Bot. France*, viii. 410 (1861); Houlet, in *Rev. Hort.* xl. 370, coloured plate (1868).
Chamærops Fortunei, W. J. Hooker, in *Bot. Mag.* t. 5221 (excl. figs. 6, 7) (1860).

A palm, attaining 30 to 50 ft. in height, with the trunk annulately scarred and clothed throughout with old leaf-sheaths. Leaves: lamina sub-orbicular or fan-

¹ The two species, not described by us, as they are scarcely hardy in cultivation, are: *T. Martiana*, Wendland, widely spread in the central and western Himalayas, Assam, and Burma; and *T. Takil*, Beccari, in *Webbia*, 52 (1905), which is a peculiar species occurring in Kumaon. The latter species is cultivated by Prof. Beccari in his garden at Florence. Bean, in *Kew Bull.* 1912, p. 291, quotes Beccari's description and gives a figure of this tree, which is readily distinguishable from *T. Fortunei* by its different habit and by the closer and neater fibre of the trunk.

² *Chamærops excelsa*, Thunberg, *Fl. Jap.* 130 (1784), is plainly from the description another palm, *Rhapis flabelliformis*, Aiton, *Hort. Kew.* iii. 473 (1789). Cf. Sims, *Bot. Mag.* t. 1371 (1811).

shaped, averaging 1½ ft. in length and breadth, deeply cut into numerous linear plicate segments, which are ½ to 1 in. broad, entire in margin, and bifid at the apex; petiole about 1½ ft. long, trigonous or nearly semicylindric in section, convex above, and flat beneath, with the two margins irregularly serrate or dentate towards the base; lower sheathing part furfuraceous, and separating into a network of brown fibres.

Staminate panicles¹ broad, thick, and obtuse, enveloped in a strong stout brownish spathe, at first erect, soon pendent, with arched ramifications; flowers small, numerous, close together, deep yellow-orange. Pistillate inflorescence smaller, less thick than the staminate one, clothed in an acuminate erect spathe, with distant spreading slender ramifications; flowers numerous, not close together, small, pale yellow or greenish. Drupe reniform, hollowed on one side.

This species is variable in habit, the leaves in some individuals being straight and stiff, whilst in others they droop at the tips; and the petioles show a varying amount of serration. There are no grounds, however, for supposing that there are two forms, corresponding to a supposed Chinese and Japanese origin. Plants which are sold as distinct, under the names *Chamærops excelsa* and *C. Fortunei*, are usually imported seedlings, which have been raised in the Riviera from the same batch of seed.

1. Var. *gracilis*, Carrière, in *Rev. Hort.* xlvii. 220 (1875). Petioles, longer and more slender than in the type, abruptly inflexed; laminae more deeply divided with narrower segments. The variety was described from a plant in the Jardin des Plantes at Paris, which was obtained from Thibaut and Keteleer's nursery in 1862.

2. Var. *surculosa*, Henry (*var. nova*). Leaves smaller and stiffer than in the type. Dwarf in habit, and freely reproducing itself by suckers like *Chamærops humilis* of the Mediterranean region. This peculiar variety, which was obtained a few years ago from Japan by Sir E. G. Loder, is possibly a distinct species. It thrives at Leonardslee, where it has produced flowers; but no fruit has yet been noticed.

T. Fortunei is a native of the central provinces of China, where it is certainly wild on the hills and lower slopes of the mountains in Szechwan, Hupeh, Kiangsu, and Chekiang. It is everywhere much cultivated, so that it is impossible to define its original distribution in the wild state. It is commonly planted around Shanghai, where it lives unprotected through the severest winters.² It is also cultivated on the island of Chusan, whence the name given to it of Chusan palm by Fortune,³ who saw it growing wild in great perfection near Yen Chow and on the Sung Lo mountain in Chekiang. It is known to the Chinese as *Tsung*, and is of great economic importance, owing to the large quantity of strong and useful fibre found on the stem at the bases of the leaf-stalks. This fibre, which is similar to the coir

¹ Inflorescences bearing both staminate and pistillate flowers have been noticed by Beccari. The germination of this species is described by Gatin, in *Ann. Sc. Nat. (Bot.)* iii. figs. 28, 29 (1906).

² It is unknown in North China, being killed when planted out at Chefoo and Tientsin. Cf. Gay, in *Bull. Soc. Bot. France*, viii. 412 (1861).

³ Cf. Fortune, *Wanderings in China*, 53, 54 (1847); *Tea Countries*, 58, 88, 117, 318 (1852); *Residence among the Chinese*, 5, 145, 189 (1857); and in *Gard. Chron.* 1850, p. 757, and 1860, p. 170.

obtained from the cocoa-nut, is used for making ropes and cables, which are very durable under water; in the manufacture of hats and rain-cloaks¹ (called *so-i*), which are used by the peasants in wet weather; and in making brushes and mattresses.

This palm is largely cultivated in southern and central Japan, where it is known as *Shuro*, but it does not seem to be a true native,² though it is naturalised in some places.³ It is recorded from Tamsui and Bankinsing in Formosa; but is probably only planted.⁴

This palm was first introduced by Siebold,⁵ who sent seeds from Nagasaki in Japan to Leyden in 1830. Of the plants which were raised, one was sent to Kew in 1837, where it was long an inmate of the Palm House; but it died some years ago. The Chinese plant was introduced by Fortune,⁶ who sent six living plants to Kew in 1849, two of which are still flourishing in the Temperate House, and are about 40 ft. and 50 ft. in height respectively; while two, which were planted out-of-doors, have remained stunted in growth and are only about 10 ft. high. Another of these plants, which was sent to Osborne in 1849, was planted out in front of the royal residence, and had attained⁷ 14½ ft. high in 1881. It is now about 21 ft. high and 2 ft. 4 in. in girth at a foot from the ground. (A. H.)

The Chusan palm is perfectly hardy⁸ in our climate, but grows slowly in the neighbourhood of London and to the northwards. It flourishes best in the south-west of England and in the south of Ireland, where it attains a height of 25 to 30 ft., and ripens seeds regularly. In the grounds of Tregothnan, I found in 1905 self-sown seedlings in the grass, and transferred some of them to my own garden at Colesborne, one of which has borne a temperature close to zero without injury. On the lawn at Williamstrip Park, Gloucestershire, an old specimen has flowered on several occasions. At Duncan House, Torquay, there is a group of about six trees, 14 to 25 ft. high in 1903, around which there are hundreds of young plants, which have come from their seed.⁹

Plate 375 shows a tree planted by the Rev. Hon. T. Boscawen at Lamorran in Cornwall, which was about 25 ft. high in 1905. At Riverhill, near Sevenoaks, the seat of J. T. Rogers, Esq., I saw one of the original seedlings introduced by Fortune, which was 27 ft. by 2 ft. 6 in. in 1911. At Powis Castle, I measured one in 1906, 25 ft. high, girthing 1 ft. 10 in. at the ground, but 3 ft. 4 in. at five feet up.

At Heckfield Place, near Winchfield, Hants, there are two good specimens¹⁰ of different sexes, which were planted in 1869. They measured in January 1912, 17½ feet and 15½ feet respectively.

¹ A rain-cloak and hat, brushes, cordage, and other articles made from this fibre, are displayed in the museum at Kew.

² Makino, in *Tokyo Bot. Mag.* xviii. 20 (1904), divides the species into two forms, var. *typica* and var. *Fortunei*; but in this he simply follows Wendland, and gives no distinguishing characters; moreover, he states of both these supposed forms, that they are planted and not native in Japan.

³ Cf. Franchet and Savatier, *Enum. Plant. Jap.* ii. 2 (1879).

⁴ Cf. Matsumura, *Index Plant. Jap.* ii. 168 (1905). Elwes saw it planted in many places in Formosa up to about 4000 ft. elevation; and the fibre is used for the same purposes as in China. ⁵ *Cat. Rais. Pl. Jap.* 1856, p. 7, note.

⁶ Fortune also obtained seed near Tsee-Kee, north-west of Ningpo, in 1853, from which plants were raised in England.

⁷ Cf. Smith, *Records of Kew Gardens*, 116 (1885).

⁸ Cf. *Gard. Chron.* 1860, pp. 170, 362, where it is stated that this palm suffered much but did not die in Northamptonshire in the severe winter of 1859-1860; while at Swansea, where the temperature fell to 10° Fahr., they were quite uninjured.

⁹ *Gard. Chron.* xxxiv. 329 (1903); one of these palms was figured in *Gard. Chron.* xxiv. 420, Supply Illust. (1898).

¹⁰ Cf. *Gard. Chron.* xv. 12, fig. 4 (1881), and xxiv. 216 (1885).

In Surrey, this palm can be grown very successfully in light dry sandy soil, provided the plants are placed in a sheltered position. In these conditions, they grow slowly, attaining about 10 ft. high in thirty years; but they flower regularly, and are very ornamental.¹ There is a fine specimen, 25 ft. high and 4 ft. in girth, at Joldwynds, near Dorking, the seat of Sir P. Bowman, Bart.

At Wisbech, Lord Peckover has a very old specimen, probably one of the original seedlings, which was 25 ft. high in 1912. A younger tree, planted about thirty-five years ago, is nearly 20 ft. high, and flowers more profusely than the older tree.

In Scotland² there is a good specimen at Ardchapel, Shandon, on Gare Loch in Dumbartonshire, which was planted in 1866 by the late Prof. Swan of St. Andrews. In 1905, it was 11 ft. high, with a girth of 3 ft. 8 in. at five feet from the ground. It has produced flowers regularly since 1881. There are small but thriving specimens in Arran, at Craigard, Lamlash; Whitefarland; and Cromla, Corrie.

In Ireland, it is slow in growth and of no great height in the open at Glasnevin. Two trees at Narrow Water, Co. Down, were 12 ft. high in 1903. It grows well at Mount Usher in Wicklow, where it ripens fruit; and is represented at Fota by several fine specimens, one of which is 25 ft. high.

The Chusan palm was introduced³ into France by seed sent from central China by M. de Montigny in 1851; and was first planted in Algeria in 1853. It exists in the climate of Paris, where it bore 16° Cent. below zero in 1870-1871; and it is hardier⁴ than *Chamærops humilis* at Montpellier, where the temperature occasionally falls to the same point. There are fine specimens⁵ in Brittany, notably one in the park of Porzantrez near Morlaix, which was planted in 1856, and had attained 27 ft. high in 1907. In Spain and Portugal there are fine specimens,⁶ one at Lisbon being 40 ft. high. (H. J. E.)

¹ Cf. *The Garden*, 15th November 1902, p. 341.

² Cf. Rev. Dr. Landsborough, in *Trans. Bot. Soc. Edin.* xx. 510 (1896), and xxiii. 140, 141 (1908).

³ Gay, in *Bull. Soc. Bot. France*, viii. 422 (1861).

⁴ Planchon, in *Flore des Serres*, t. 2368 (1877). There is a small plant of *Chamærops humilis* in the bamboo garden at Kew; but it would not survive without protection in winter. Landsborough, in *Trans. Bot. Soc. Edin.* xxiii. 141 (1908), mentions a thriving plant of this species at Cromla in Arran.

⁵ Pardé, in *Bull. Soc. Dend. France*, 1908, p. 20.

⁶ *Ibid.* 1910, p. 106.

ACANTHOPANAX

- Acanthopanax*, Miquel, in *Ann. Mus. Lugd. Bat.* i. 10 (1863); Bentham et Hooker, *Gen. Pl.* i. 938 (1863); Viguier, in *Ann. Sci. Nat. (Bot.)* iv. 33 (1906).
Kalopanax, Miquel, in *Ann. Mus. Lugd. Bat.* i. 16 (1863); Harms, in Engler and Prantl, *Pflanz-Fam.* iii. 8, p. 50 (1894).
Brassaiopsis, Seemann, in *Journ. Bot.* ii. 290 (1864) (not Decaisne and Planchon).
Panax, sub-genus *Acanthopanax*, Decaisne and Planchon, in *Rev. Hort.* 1854, p. 105.

DECIDUOUS trees or shrubs, belonging to the order Araliaceæ. Branchlets with or without spines. Stipules inconspicuous or absent. Leaves either compound and three- to five-digitate or simple and palmately lobed.

Flowers small, in paniced or solitary umbels, polygamous or perfect, on pedicels that are not articulated; calyx-tube coherent with the ovary, limb dentate; petals five, rarely four, valvate in the bud; stamens as numerous as the petals and inserted with them on the margin of the disc, filaments filiform, anthers ovate or oblong; ovary usually two-celled, rarely five-celled; styles, two or five, more or less connate at the base, with the apex recurved and stigmatose internally. Fruit baccate, laterally compressed or globose, with a fleshy exocarp; nutlets two to five, crustaceous or cartilaginous, each containing one seed.

About eighteen species are known, natives of Eastern Asia, extending from Amurland and Manchuria, through Japan, Formosa, and China to the Himalayas. The following species is the only one attaining timber size.

ACANTHOPANAX RICINIFOLIUM

- Acanthopanax ricinifolium*, Seemann, in *Journ. Bot.* vi. 140 (1868), and *Revis. Heder.* 86 (1868); Franchet and Savatier, *Enum. Pl. Jap.* i. 193 (1875); Hance, in *Journ. Bot.* 1885, p. 323; Hemsley, in *Journ. Linn. Soc. (Bot.)* xxiii. 340 (1888); Sargent, in *Garden and Forest*, vi. 234, fig. 36 (1893), and *Forest Flora Japan*, 45, fig. 16 (1894); Shirasawa, *Icon. Ess. Forest. Japon.* ii. t. 56, figs. 11-24 (1908); Beissner, in *Mitt. Deut. Dend. Ges.* 1909, p. 289; Schneider, *Laubholzkunde*, ii. 429 (1909).
Acanthopanax acerifolium, Schelle, in *Mitt. Deut. Dend. Ges.* 1908, p. 217, and 1909, p. 289.
Panax ricinifolium, Siebold and Zuccarini, *Fl. Jap. Fam. Nat.* i. 91 (1843), and in *Abh. Ac. Münch.* iv. 2, p. 199 (1845).
Kalopanax ricinifolium, Miquel, in *Ann. Mus. Lugd. Bat.* i. 16 (1863); Harms, in Engler, *Bot. Jahrb.* xxix. 488 (1900).
Kalopanax? *sp.*, Zabel, in *Mitt. Deut. Dend. Ges.* 1904, p. 63.
Brassaiopsis ricinifolia, Seemann, in *Journ. Bot.* ii. 291 (1864).

A tree, attaining in Yezo 80 to 90 ft. in height, and 10 ft. or more in girth. Bark very thick,¹ dark in colour, and deeply fissured. Branchlets stout, reddish brown, glabrous, armed with short stout spines, which are enlarged at the base and are often glaucous. Leaves sub-orbicular, but broader than long, averaging 6 to 10 in. in diameter, sub-cordate at the base, palmately five- or seven-nerved; on adult trees, divided to one-third of the length of the blade by acute sinuses into five ovate-triangular acuminate lobes, serrate in margin, with callous tips to the teeth; upper surface dark green, shining, glabrous; lower surface with slight whitish tomentum on the nerves, forming axil-tufts at their base, where they unite; petioles long and slender, more or less covered with scattered tomentum, especially near the base.

Flowers on long slender glabrous pedicels in many-flowered umbels, arranged in terminal compound panicles, which are sometimes 2 ft. in diameter; small, white in colour, appearing in August and September. Fruit black, globose.

1. Var. *Maximowiczii*, Schneider, *Laubholzkunde*, ii. 429 (1909).

Aralia Maximowiczii, Van Houtte, in *Flore des Serres*, xx. 39, t. 2067-2068 (1874).

This varietal name is applied for the sake of convenience to young trees in cultivation, which only show juvenile foliage. The leaves differ from those characteristic of adult trees, in being deeply lobed, with the sinuses extending more than two-thirds the length of the blade. It is impossible to say whether, as a result of being perhaps propagated by grafts from young seedlings, these trees will preserve the seedling foliage indefinitely, or will, when older, develop normal leaves. Seedlings occasionally show both kinds of foliage; and Siebold's original specimens also bear both shallow- and deeply-lobed leaves, with all intermediate stages.

This species is a native of China, Korea, Japan, Saghalien, and the Liu Kiu Islands. In China, it is widely spread in the central provinces, from Szechwan and Hupeh to Chekiang and Fokien, usually forming a tree 40 to 50 ft. high in the mixed forests on the mountains at no great elevation. It is known to the Chinese as *tz'e ch'iu*;² but its timber is little valued. (A. H.)

In Japan, where the tree is called *hari-giri*, it attains its largest size in the forests of Hokkaido, where, Sargent states, it is often 80 feet in height and 4 or 5 ft. in diameter, with a tall straight stem, covered with furrowed bark, and giving off great limbs, which spread horizontally. In central Hondo, it is smaller in size. Mayr³ who measured a tree in Hokkaido, which was 90 ft. high, states that this species is fast in growth and remarkable for its capacity of enduring shade in the forest. In Kiusiu I saw it in the forest, which covers the lower slopes of the volcano of Kiresima at 2000 to 3000 ft. altitude. Here it is not so fine a tree as in Hokkaido, the largest that I measured being about 60 ft. by 5 ft. 10 in.

A. ricinifolium was introduced into Europe by Van Houtte, who figured in 1874 a young plant, which had been raised from a single seed received from the

¹ The bark is well shown in a photograph of a tree growing in Japan, reproduced by Jack in *Mitt. Deut. Dend. Ges.* 1909, p. 285.

² Cf. Bretschneider, *Bot. Sinic.* ii. 344 (1892) and iii. 480 (1895).

³ *Fremdländ. Wald- u. Parkbäume*, 437 (1906).

1696 The Trees of Great Britain and Ireland

St. Petersburg botanic garden. A tree¹ in the forest garden at Münden, probably derived from Van Houtte's original specimen, was 21 ft. high in 1895.

This species is best raised from seed imported from Japan; but it can be propagated by cuttings of the half-ripened wood, which strike root if placed in gentle heat.¹ Mayr says that it bears transplanting badly, often dying to the ground, but afterwards producing an abundance of suckers from the collar of the root.

It ripens its young shoots well, and is perfectly hardy at Colesborne, where seedlings, that I raised in 1906, are now 4 to 6 feet high. The best specimen that I know in England is in the beautiful grounds of South Lodge, Horsham, the seat of F. D. Godman, Esq., which was, in 1905, 28 ft. high, fifteen years after planting. A solitary specimen at Kew has done badly, and appears to suffer from spring frost. At Westonbirt, there is a vigorous young tree, about 20 ft. high.²

At Grafrath, near Munich, this species has been planted in plots, and has thriven well for so far; but the trees are too young to give as yet any evidence as to their value in forestry.³ M. Hickel states that there is a fine specimen in Messrs. Barbier's nursery at Beuvronne.⁴

TIMBER

Mayr says that this species yields a light timber, which, though disagreeable in odour, is used in Japan for building generally, and for making shafts of spears. Sargent states that the wood is rather hard, straight-grained, and light brown, with a fine satiny surface. The timber has been largely imported into England during the last few years under the name *sen*, by which it is known in Hokkaido. It has been sold in some cases as Japanese ash, and mixed with the timber of *Fraxinus mandshurica*, which it somewhat resembles; but it is better fitted for making furniture than for the purposes for which ash is generally used. (H. J. E.)

¹ Rehder, in *Möller's Deut. Gart. Zeit.* 1st July 1897.

² In *Gard. Mag.* 1888, p. 526, mention is made of a plant then 12 ft. high in Messrs. Veitch's nursery at Coombe Wood. This was disposed of some years ago.

³ Weiss, in *Mitt. Deut. Dend. Ges.* 1912, p. 3, states that it has been tried in groups in the forest at Augsburg, where the trees are about 20 ft. high, but show no sign of being useful.

⁴ Cf. Hickel, in *Bull. Soc. Dend. France*, 1907, p. 153, and 1909, p. 230.

ACACIA

Acacia, Adanson, *Fam. des Plantes*, ii. 319 (1763); Willdenow, *Sb. Pl.* iv. 1049 (1805); Bentham et Hooker, *Gen. Pl.* i. 594 (1865).

TREES, shrubs, climbers, and rarely undershrubs, belonging to the division Mimoseæ of the order Leguminosæ. Branchlets with or without stipular or infra-stipular spines. Leaves alternate, either compound and equally bipinnate with minute leaflets, or reduced to simple phyllodes,¹ which are equivalent to dilated and flattened petioles, with their surfaces placed vertically.

Flowers, yellow or white; in globose heads, cylindrical spikes, or panicles, which are solitary or fascicled in the axils of the leaves; or paniced and ending the branchlets; perfect or polygamous, small, regular: sepals five, four, or three, rarely absent, free or united; petals as many as the sepals, free or united; stamens numerous, free or slightly connate at the base; ovary sessile or stalked, with usually numerous (rarely only two) ovules; style long and slender, ending in a minute stigma. Pod linear or oblong; flat or nearly cylindrical; straight, falcate, or twisted; opening by two valves or indehiscent. Seeds, more or less flattened, usually marked on each face with an oval or horseshoe-shaped depression, oblique spot or ring; funicle filiform or thickened into a flat aril under or around the seed.

About 450 species of *Acacia* are known, natives of the warmer parts of the world, and occurring in Africa, Asia, America, Australia, and Polynesia.

A considerable number of species are cultivated under glass in this country; but in the south-west of England, and in the south of Ireland, four or five species, some of which are shrubs, have succeeded out-of-doors. Two of these species, representative of the two kinds of foliage which occur in the genus, will now be described.

ACACIA DEALBATA, SILVER WATTLE

Acacia dealbata, Link, *Enum. Hort. Berol.* ii. 445 (1822); Loddiges, *Bot. Cab.* t. 1928 (1833); Loudon, *Arb. et Frut. Brit.* ii. 666 (1838); J. D. Hooker, *Fl. Tasm.* i. 111 (1860); Bentham, *Fl. Austral.* ii. 415 (1864); Gamble, *Indian Timbers*, 301 (1902); Rodway, *Tasm. Fl.* 43 (1903).
Acacia irrorata, Sieber, ex Sprengel, *Syst.* iii. 141 (1826).
Acacia decurrens, Willdenow, var. *dealbata*, Von Mueller ex Maiden, *Forest Flora N. S. Wales*, iii. 56 (1908).

An evergreen tree, attaining occasionally in Tasmania 100 ft. in height and

¹ These phyllodes are not leaves turned edgeways, as is shown by the fact that they are not twisted at the base. Moreover, phyllodes are occasionally produced, which bear bipinnate leaves at their ends. On seedlings of the species of *Acacia* with phyllode foliage, the first leaves are bipinnate; succeeding leaves have flattened stalks with fewer leaflets; ultimately only phyllodes are produced.

11 ft. in girth; but usually much smaller. Young branchlets angled, hoary, covered with a minute whitish pubescence. Stipules reduced to inconspicuous scales. Leaves equally bipinnate; rachis 3 to 4 in. long, hoary and pubescent like the branchlets, often glandular; pinnæ ten to twenty pairs, hoary and pubescent, each bearing thirty to forty pairs of crowded linear leaflets, which are about $\frac{1}{6}$ in. long, pubescent, glandular at the sessile base.

Flower heads, in axillary and terminal paniced racemes, globose, yellow, about $\frac{1}{6}$ in. in diameter; flowers twenty to thirty in a head, mostly pentamerous. Pods, straight or curved, flattened, 2 to 3 in. long, $\frac{1}{4}$ to $\frac{1}{2}$ in. wide, not or slightly constricted between the seeds, glaucous on both surfaces.

A. dealbata, which is known in Australia as the silver wattle, occurs in New South Wales, Victoria, and Tasmania. It is widely distributed in Tasmania, where it usually attains 50 ft. in height and 3 to 6 ft. in girth; and yields a timber of little value, which is used for making staves of cheap casks. The bark is not so rich in tannin as that of typical *A. decurrens*,¹ of which species *A. dealbata* is considered to be a variety by Maiden.

A. dealbata was introduced from Tasmania about 1820; and is now much cultivated on the Riviera for its flowers, which are sent in large quantities to Paris and London, under the popular name of "Mimosa." In France this species flourishes on the west coast as far north as Nantes, where, however, it is killed to the ground in severe winters, but nevertheless sends up shoots afterwards with increased vigour.²

(A. H.)

In England,³ it can be grown in the open air in the south-west; and has attained 50 ft. in height after seventeen years growth from seed at Abbotsbury, where it produces flowers annually in great abundance and good seed, from which plants have been raised. At Trebah in Cornwall there is a fine tree of about the same age.⁴ In Ireland, the finest we know is at Derreen (Plate 376), and is believed by the Marquess of Lansdowne to have been planted about thirty-two years. When I measured it in 1910, it was 48 ft. high, with four stems measuring 2 ft. 1 in. to 2 ft. 7 in. in girth.

This species is now completely naturalized in the Nilgiris,⁵ where it is useful for firewood. Gamble says that it is readily reproduced by suckers and coppice shoots. In France it does not thrive on soils containing lime.⁶

(H. J. E.)

¹ Typical *A. decurrens* has branchlets and foliage, which are nearly glabrous and not hoary; and is known in Australia as Green or Black Wattle. A plant, imported from Johannesburg, has been growing since 1909 in the open air at Blackmoor, Liss, Hants, and is now about 4 ft. high. *A. decurrens*, var. *mollis*, Lindley, has tomentose foliage, but the pubescence assumes a golden yellow tinge on the branchlets.

² Cf. Maiden, *Forest Flora N.S. Wales*, iii. 60 (1908).

³ A tree in the Temperate House at Kew is about 50 ft. high, but with a slender stem, about 6 in. in diameter; the bark is broken on the surface into small scales. In *Gard. Chron.* liii. 45 (1913) mention is made of a tree, 70 ft. high and 2 ft. 2 in. in girth, growing in the conservatory at Branksome Hall, Darlington, which was raised from a root-cutting twenty-five years ago.

⁴ *Gard. Chron.* lii. 44 (1912).

⁵ Brandis, in *Indian Forester*, viii. 26 (1882), quotes General Morgan's account of the remarkable change in the period of flowering of this species in the Nilgiris, where it was introduced by seed in 1845. The trees here flowered at first in October, which is the month in which the parents flower in Australia. In 1860, they began to flower in September; in 1870, they flowered in August; in 1878, in July; and in 1882, in June, which is the spring month in the Nilgiris corresponding with October in Australia.

⁶ Cf. Muttet, in *Rev. Hort.* 1896, p. 503.

ACACIA MELANOXYLON, BLACKWOOD

Acacia melanoxylon, R. Brown, in Aiton, *Hort. Kew.* v. 462 (1813); Sims, *Bot. Mag.* t. 1659 (1814); Loudon, *Art. et Frut. Brit.* ii. 663 (1838); J. D. Hooker, *Fl. Tasm.* i. 109 (1860); Bentham, *Fl. Austral.* ii. 388 (1864), and in *Trans. Linn. Soc.* xxx. 481 (1875); Gamble, *Indian Timbers*, 301 (1902); Rodway, *Tasm. Flora*, 42 (1903); Maiden, *Forest Flora N.S. Wales*, ii. 103, plate 57 (1907).

Acacia latifolia, Desfontaines, *Table École Bot. Paris*, 207 (1815).

Acacia arcuata, Sieber, ex Sprengel, *Syst.* iii. 135 (1826).

Acacia brevipes,¹ Cunningham, in *Bot. Mag.* t. 3358 (1834).

An evergreen tree, attaining occasionally, in Australia, 120 ft. in height, and 6 to 10 ft. in girth; but usually only about 80 ft. high. Young branchlets angled, minutely grey tomentose, or rarely glabrous. Stipules absent. Phyllodes coriaceous, glabrous, usually falcate, very variable in size, averaging $2\frac{1}{2}$ to 4 in. long and $\frac{1}{3}$ to $\frac{3}{4}$ in. wide; lanceolate or oblong, gradually tapering to an obtuse or acute apex, which is tipped with a cartilaginous point; much narrowed towards the base; with three or four conspicuous longitudinal veins, connected by anastomosing veinlets; margin entire, cartilaginous. True leaves often present erratically on young trees, bipinnate, with a tomentose rachis and secondary axes, the latter bearing oblong apiculate leaflets, about $\frac{1}{5}$ to $\frac{1}{4}$ in. long.

Flower heads, three to four in an axillary raceme, globose, yellow, about $\frac{1}{5}$ in. in diameter; peduncles $\frac{1}{8}$ to $\frac{1}{3}$ in. long, glabrous; flowers minute, thirty to fifty in a head, pentamerous, with coherent calyces and denticulate sepals; petals free. Pods linear, flat, often curved in a circle, 2 to 4 in. long, about $\frac{1}{3}$ in. broad, with thickened cartilaginous margins, and glaucous coriaceous valves. Seed small, nearly orbicular, with a long dilated pale red funicle, encircling it in double folds.

A. melanoxylon is known in Australia as blackwood, and is widely distributed in Tasmania, Victoria, and New South Wales, extending into South Australia and Queensland. It is most common on rich soil in valleys or grassy ranges; and ascends in the mountains to considerable elevations. It yields a timber of the highest class, which Gamble compares to light-coloured walnut. It is hard and close-grained, taking a fine polish; and is very beautiful when figured. It is used in Sydney and Melbourne for making billiard tables, furniture, gunstocks, coaches, and railway carriages; and is imported by English pianoforte manufacturers.²

(A. H.)

A. melanoxylon was introduced into England about 1808, and is occasionally grown out-of-doors in the south-west. At Abbotsbury, raised ten years ago from seed, it is about 35 ft. high; and seedlings have been raised from it. At Tregothnan, I saw several trees flowering well in 1911, one of which was 35 ft. high by 1 ft. 8 in. in girth.

In the south of France,³ it is the best of the acacias for avenues, as it forms a tall tree regular in habit; and at Hyères there are numerous natural seedlings. It was introduced in 1840 into the Nilgiris in India, where it is completely naturalised.

(H. J. E.)

¹ This is a variety, which appeared in cultivation at Kew, with longer and more falcate phyllodes, attaining 5 to 7 inches in length.

² Cf. Penny, *Tasm. Forestry*, 9 (1905).

³ Pottier, in *Le Jardin*, xxii. 75 (1908).

LAURELIA

- Laurelia*, Jussieu, in *Ann. Mus. Paris*, xiv. 134 (1809); Tulasne, in *Archiv. Mus. Hist. Nat. Paris*, viii. 414 (1855); A. de Candolle, *Prod.* xvi. pt. 2, p. 674 (1868); Bentham et Hooker, *Gen. Pl.* iii. 145 (1880); Perkins and Gilg, in Engler, *Pflanzenreich*, iv. 101, *Monimiaceae*, 76 (1901); Perkins, in Engler, *op. cit.*, Suppl. 46 (1911).
Pavonia, Ruiz and Pavon, *Fl. Peruv. et Chil. Prod.* 127, t. 28 (1794) (not Cavanilles).
Theyga, Molina, *Sag. Chile*, 163 (1810).
Thiga, Molina, *Sag. Chile*, 297 (1810).

EVERGREEN trees, belonging to the order Monimiaceæ; with opposite coriaceous fragrant serrate penninerved leaves, which are without stipules.

Flowers polygamous or diœcious; in simple or paniced axillary cymes; perianth with six to twelve spreading lobes in two or three series. Male flowers, with a flat receptacle, and five to twenty stamens; filaments short, each with two lateral glands at the base; anthers with two oblong lateral cells, which dehisce by valves opening upwards. Female and perfect flowers, with a receptacle at first cup-shaped, bearing stamens, which are often reduced wholly or in part to staminodes, and numerous fusiform villous ovaries, which are tipped with long hirsute styles, and are one-celled, containing an erect anatropous ovule. Fruit, consisting of the enlarged and almost closed receptacle, which has become globose, ovoid, or tubular, and ultimately opens by splitting irregularly into three or four valves; on these are placed the ripened ovaries or achenes, which are ovoid, pilose, and end in a long plumose unbranched style. The valves of the receptacle remain firmly closed in moist air, but spread widely when dry.

Three species of *Laurelia* are known, two of which, not being in cultivation, need only be briefly mentioned:—

1. *Laurelia Novæ-Zelandiæ*, Cunningham, in *Ann. Nat. Hist.* i. 381 (1838). A tree attaining 150 ft. in height in New Zealand.
2. *Laurelia sempervirens*, Tulasne, in *Arch. Mus. Hist. Nat.* viii. 416 (1855).

Laurelia aromatica, Poiret, in Lamarck, *Encycl. Meth. Suppl.* iii. 313 (1813).

Pavonia sempervirens, Ruiz and Pavon, *Syst. Veg. Pl. Peruv. et Chil.* 253 (1798).

This species, with which *L. serrata* has been much confused, has a more northerly distribution, occurring in Peru, as well as throughout Chile, where it is called *laurel* by the inhabitants. It differs from *L. serrata*¹ in having the leaves undulate serrate, with rather distant appressed obtuse teeth; flowers in loose panicles with long pedicels; fruit receptacles fusiform or ovoid; seed plumose throughout, even to the tip of the style. It is a tall tree, very abundant in the evergreen forests, and yielding wood that is easily worked and much used.² (A. H.)

¹ *L. serrata* has sharply serrate leaves; flowers in short crowded panicles, with short pedicels; fruit receptacles globose; seed with the style not plumose at the tip.

² Cf. Castello and Dey, *Jeog. Vej. Rio Valdivia*, 51 (1908).

LAURELIA SERRATA

- Laurelia serrata*,¹ Philippi, in *Bot. Zeit.* xv. 401 (1857); Castillo and Dey, *Jeog. Vej. Rio Valdivia*, 52, fig. 27 (1908); Stapf, in *Bot. Mag.* t. 8279 (1909); Perkins, in Engler, *Pflanzenreich*, iv. 101, *Monimiaceae*, Suppl. 47 (1911).
Laurelia aromatica, Masters, in *Gard. Chron.* xxxvi. 401, fig. 172 (1904) (not Poiret).

A tree, attaining in Chile about 70 ft. in height. Bark greyish, smooth, with persistent brown lenticels, and resembling that of *Zelkova crenata*. Young branchlets, with two pubescent furrows, which have slightly projecting margins. Leaves coriaceous, in opposite pairs, narrowly elliptic or broadly lanceolate, averaging 4 to 5 in. long, and $1\frac{1}{4}$ to $1\frac{3}{4}$ in. wide; tapering to an acuminate apex, usually tipped with a cartilaginous point; cuneate at the base; lateral nerves, ten to twelve pairs, dividing and looping before reaching the margin, which is entire towards the base, but is elsewhere serrate, with sharp teeth directed towards the apex of the leaf or slightly spreading and tipped with a glandular thickening; both surfaces glabrous, except on the slightly pubescent prominent midrib above; petiole $\frac{1}{8}$ to $\frac{1}{4}$ in. long, blackish, densely pubescent on the upper surface.

Flowers, three to nine, in simple or paniced silky cymes; pedicels about $\frac{1}{8}$ in. long. Receptacle in the fruiting stage, globose but constricted at the apex, ultimately splitting irregularly, ashy-grey externally; achenes ovoid, nearly $\frac{1}{2}$ in. long, densely hirsute with spreading hairs, except at the tip of the long and persistent style.

L. serrata is a native of the evergreen forests of southern Chile and northern Patagonia, occurring from Valdivia to the valley of the river Aysen. It is called *huan-huan* by the inhabitants, and seems to be a smaller and rarer tree than *L. sempervirens*; and is said by Castillo and Dey to have an inferior wood, which has an unsupportable odour when freshly cut, yet is much used.

L. serrata was probably introduced about 1860 by Pearce, who collected in Chile for Messrs. Veitch. It is one of the rarest trees in cultivation, and can only be propagated by seed or by layers, cuttings having always failed to take root at Kew. (A. H.)

The only specimens which we have seen are the following:—At Penjerrick, near Falmouth, the seat of R. Fox, Esq., there is a splendid tree in perfect health and looking as if it would become considerably larger, which was in flower in April, 1911, when it measured 47 ft. in height and 3 ft. 4 in. in girth. Another at Kilmacurragh, Co. Wicklow, is about 30 ft. by 3 ft.; but is not so handsome. This tree was procured by the late Mr. Acton from Messrs. Rollison of Tooting about 1868; and from it were drawn the figures cited above in the *Botanical Magazine* and in the *Gardeners' Chronicle*. (H. J. E.)

¹ *Laurelia serrata*, Bertero, in *Mercur. Chil.* 1829, manip. 15, p. 685, translated in *Amer. Journ. Sci.* xxiii. 89 (1833), is a name without any description.

ILEX

Ilex, Linnæus, *Sp. Pl.* 125 (1753); Bentham et Hooker, *Gen. Pl.* i. 356 (1862); Loesener, in *Nova Acta Ac. Leop. Carol.* lxxviii. 8 (1901); Schneider, in *Gartenflora*, lii. 452 (1903), and *Laubholzkunde*, ii. 157 (1907).
Prinos, Linnæus, *Gen. Pl.* 153 (1754).
Aquifolium, Haller, *Enum. Stirp. Helv.* i. 296 (1758).

TREES or shrubs belonging to the order Aquifoliaceæ, mostly evergreen, rarely deciduous. Leaves alternate, simple, usually short-stalked; margin entire, crenate, serrulate, or with spiny teeth; stipules minute, deltoid, often deciduous.

Flowers axillary, solitary or cymose, normally dicecious, regular, usually tetramerous, rarely pentamerous or hexamerous; calyx gamosepalous, hypogynous, with a short tube and four to six lobes, imbricate in the bud; corolla rotate, with four to six petals, free or connate at the base; disc absent. Male flowers, with four to six stamens, alternate with the petals and adhering to them at the base; anthers introrse, with two cells opening longitudinally; ovary rudimentary, either without cells or with empty cells containing no ovules, stigma absent. Female flowers, with four to six stamino-odes, like the stamens, but sterile and small; ovary free, superior, with usually two to four (rarely nine to twenty-two) cells, each usually containing one pendulous ovule; stigma sessile, with as many lobes as there are cells in the ovary. Fruit drupaceous, with the calyx and stigma persistent; epicarp fleshy, containing two to four (or more) one-seeded nutlets. Seed pendulous, with a minute embryo at the apex of the copious albumen.

The genus comprises about 270 species, which are distributed throughout the greater part of the tropical and temperate regions of the world. About twenty-five exotic species are cultivated in Britain, either shrubs or small trees, not coming within the scope of our work; but of these the following four species will be briefly described on account of their relationship to the common holly.

I. *Ilex Perado*, Aiton, *Hort. Kew.* i. 169 (1789); Loudon, *Arb. et Frut. Brit.* ii. 519 (1838).

Ilex maderiensis, Lamarck, *Encycl.* iii. 146 (1789).

A small tree, attaining 30 ft. in height. Young branchlets glabrous. Leaves obovate-oblong, yellowish green, $2\frac{1}{2}$ to 3 in. long, $1\frac{1}{2}$ to 2 in. broad, flat on the surface, thick and coriaceous; apex rounded or minutely cuspidate, and tipped with a slender spine; base rounded or cuneate, decurrent on the glabrous petiole, which has two longitudinal depressions on the lower side; margin not undulate, entire or with a few minute serrations, mostly towards the apex, each tipped with a slender

spine; under surface reticulate. Flowers reddish; fruit ellipsoid, reddish, with nutlets similar to those of *I. Aquifolium*.

I. Perado, in its typical form, is confined¹ to the Madeira Islands, whence it was introduced into England in 1760. It has usually been cultivated since in greenhouses; but Loudon states² that in the Chiswick Garden and several other places near London it bore uninjured the winter of 1837-1838 without protection. It has, however, when tried out-of-doors at Coombe Wood, been always killed in ordinary winters. It is perfectly hardy in Wicklow, where at Kilmacurragh a healthy shrub was bearing fruit in July 1908; and at Powerscourt, where a fine specimen is about 20 ft. high, with a diameter of spreading branches of 24 ft.

It is doubtful if this species has been one of the parents of any of the hybrid hollies.³

II. *Ilex platyphylla*, Webb and Berthelot, *Phyt. Canar.* ii. 135, t. 68 (1836); W. J. Hooker, *Bot. Mag.* t. 4079 (1844).

A tree, attaining 40 ft. in height. Young branchlets minutely pubescent above the insertions of the leaves. Leaves thick and coriaceous, yellowish green, much larger as a rule than in *I. Perado*, 4 to 6 in. long, 2 to 4 in. broad, ovate-oblong, flat on the surface; base rounded or cuneate, decurrent on the glabrous petiole, which shows two longitudinal furrows on the lower side; apex shortly acuminate and tipped with a slender spine; margin not undulate, entire or with few or numerous minute serrations ending in slender spines; reticulate beneath. Flowers white; fruit subglobose, reddish or blackish, with larger nutlets than in *I. Aquifolium*.

This is common in the Canary Islands, and also occurs in the Madeiras, in the latter case associated with *I. Perado*. From the latter species it differs mainly in the larger acuminate leaves. It does not seem ever to have been in cultivation⁴ in England except at Kew⁵ under glass; and there is no evidence that it was concerned in the origin of any of the hybrid hollies.

III. *Ilex balearica*, Desfontaines, *Hist. Arb.* ii. 362 (1809).

Ilex maderensis, Willdenow, *Enum. Pl. Hort. Berol. Suppl.* 8 (1813) (not Lamarck); Moore, in *Gard. Chron.* ii. 751 (1874).

Ilex Aquifolium, Linnæus, var. *balearica*, Lamarck, *Encycl.* iii. 145 (1789); Loudon, *Arb. et Frut. Brit.* ii. 516 (1838).

A small tree, attaining 30 or 40 ft. in height. Young branchlets stout, greenish, densely covered with a minute pubescence. Leaves thick and coriaceous, concave on the upper surface, 3 in. long, 2 in. broad, ovate, shortly acuminate at the apex, which ends in a slender spine; margin not undulate, either entire or with a few (three to ten) irregularly placed serrations, which end in slender spines; base of the blade rounded or cuneate, scarcely decurrent on the minutely pubescent petiole,

¹ *I. Perado*, var. *azorica*, Loesener, in *Nova Acta Acad. Leop. Carol.* lxxviii. 247 (1901), which is the holly of the Azores, differs from the typical form of the Madeiras in having smaller leaves.

² *Trees and Shrubs*, 161 (1842). Loudon, *Gard. Mag.* xiv. 226 (1838), records a shrub of *I. Perado* at Hendon Rectory which was $6\frac{1}{2}$ ft. high.

³ Cf., however, p. 1712, note 1.

⁴ Plants commonly cultivated under this name are, in my opinion, either *I. balearica* or one of its hybrids with *I. Aquifolium*.

⁵ A small specimen now growing in the Temperate House at Kew was sent from the Canaries by Dr. Perez.

which is convex on the lower side. Fruit and nutlets slightly larger than in *I. Aquifolium*.

This species occurs in southern Spain and in the Balearic Islands.¹ It is closely allied to *I. Perado*, but differs in having dense pubescence on the branchlets, and the base of the leaf is not decurrent on the petiole. It is very distinct from the common holly, which has leaves with very undulate margins and large sinuate teeth.

I. balearica is said to have been introduced into England in 1744, and was certainly cultivated in the Royal Garden at Versailles in 1789. It is usually propagated by budding or grafting upon the common holly, and is perfectly hardy at Kew, Cambridge, and Paris, but requires protection during winter in Germany.

This species regularly produces flowers² and fruit in England; and appears to have given rise, in conjunction with the common holly, to a series of hybrids, which began to be noticed about 1800, though they were considered at the time to be simply varieties of the latter species (see p. 1712).

IV. *Ilex opaca*, Aiton, *Hort. Kew.* i. 169 (1789).

A tree, attaining in America 50 ft. in height and 12 ft. in girth. Young branchlets minutely pubescent, becoming pale brown in their first year. Leaves elliptic, about 3 in. long and 1½ in. broad, convex and dull green above, concave and conspicuously reticulate beneath; margin with a few irregular spreading spiny teeth. Fruit dull red, ¼ in. in diameter; nutlets four.

This species, which somewhat resembles the common holly in foliage, is readily distinguishable by the brown branchlets; and is a native of the United States from Massachusetts to Florida, and westward to Indiana and Texas. It was introduced in 1744 into England, and forms a small tree in our climate, which produces flowers and fruit regularly. Though often grown with the common holly in nurseries and botanic gardens, there is no evidence that this species has taken part in the origin of the hybrid hollies. (A. H.)

ILEX AQUIFOLIUM, COMMON HOLLY

Ilex Aquifolium, Linnæus, *Sp. Pl.* 125 (1753); Loudon, *Arb. et Frut. Brit.* ii. 505 (1838); Willkomm, *Forstl. Flora*, 786 (1887); Mathieu, *Flore Forestière*, 58 (1897); Loesener, in *Nova Acta Ac. Leop. Carol.* lxxviii. 248 (1901); Schneider, *Laubholzkunde*, ii. 163 (1907).

A tree, occasionally attaining 50 to 70 ft. in height, and 9 to 12 feet in girth, often shrubby and then rarely over 30 ft. high. Bark smooth, greyish. Young branchlets green or purplish, minutely pubescent. Buds minute, with two acuminate outer scales. Stipules two, usually persistent as withered minute scales at the base of the petiole. Leaves persistent about fourteen months, coriaceous, thick, ovate,

¹ It is probably much more widely spread in the Mediterranean region, but I have been unable to study its distribution. *I. Aquifolium*, var. *platyphylloides*, Christ, in *Ber. Schweiz. Bot. Ges.* xiii. (1903), a tree 30 ft. high occurring on rocky cliffs on the west side of Lake Maggiore in Italy, is probably a form of *I. balearica*.

² In nurseries the male plant of *I. balearica* is sometimes called *I. maderensis*, following the erroneous view of Moore, in *Gard. Chron.* ii. 751 (1874), that it came from Madeira, while the name *I. balearica* is wrongly restricted to the female plant. *I. Aquifolium*, var. *platyphylla* of most nurseries, appears to differ in no respect from *I. balearica*; but see p. 1714.

oblong, or elliptic, 2½ to 4 in. long, 1 to 2 in. broad; acute or acuminate at the apex, usually broad and rounded at the base; dark green and shining above, paler and duller beneath; margin wavy, encircled by a cartilaginous rim, usually with sinuate teeth, each ending in a sharp spine, which spread in different planes; but on the upper branches¹ of old trees entire, or with one or two spinescent teeth towards the apex; primary veins pinnate, six to eight pairs, dividing and looping before reaching the margin; secondary and tertiary veins indistinct; petiole glabrous, short, rounded and not sulcate on the lower side, the base of the blade not being decurrent upon it.

Flowers small, in short axillary cymose fascicles, normally dioecious,² rarely polygamous; sepals four, greenish; petals four, white, placed crossways, slightly connate at the base; stamens four; ovary four-celled, one ovule in each cell. Fruit globose, red, about ⅓ in. in diameter, crowned by the four-lobed stigma, usually containing four nutlets.

The holly is usually bisexual, all the flowers on a tree being either exclusively staminate or pistillate; but, in rare cases, a few perfect flowers, containing both good pollen and well-formed ovules, are produced in addition.³ Dallimore states that female trees, which are isolated, often bear large quantities of berries; but in such cases most of the seed is infertile, and there appears to be no doubt that pollination is always effected by the pollen being brought from another tree by either insects or the wind.

The seeds when sown do not germinate for a long time, two or even three years elapsing before the appearance of the seedlings.⁴ These have two ovate entire obtuse shortly stalked cotyledons, about ⅔ in. long, which are raised above ground on a glabrous caulicle, about an inch in length. The glabrous angled stem gives off in the first year three to five simple alternate leaves, similar to the adult leaves in form, but much smaller, and with small sinuate spiny teeth. These leaves have minute ovate acute black stipules, which are soon deciduous.

VARIETIES

The common holly is variable in the wild state, there being two forms,⁵ one with green and the other with purple branchlets; moreover, differences in habit, in the spinescence of the foliage, and in the colour of the fruit, are not uncommon. The peculiar geographical forms,⁶ which occur wild in western Asia and in China, are not in cultivation. The horticultural varieties, that are usually given in nursery

¹ Kerner, *Nat. Hist. Plants*, Eng. Trans. 433 (1898), believes that the spiny leaves of holly are an adaptation against browsing by ruminants; and points to the fact that on adult trees leaves without spines are only produced on branches beyond the reach of these animals. Withering, *Arrange. Brit. Plants*, ii. 211, note (1796), long ago noticed the same fact, which was also referred to by the poet Southey. Mr. R. A. Phillips tells me that spineless leaves always commence about half-way up wild holly trees in Ireland; and Sir Herbert Maxwell mentions the same fact about wild holly in the wood between Murthly and Dunkeld.

² Darwin, *Forms of Flowers*, 297 (1892) states that the stamens in the female flowers, though quite destitute of pollen, are but slightly shorter than the perfect stamens in the male flowers. The male trees produce a greater number of flowers, and these have smaller corollas than occur in the other sex.

³ Masters, in *Gard. Chron.* xxiii. 27, fig. 8 (1885) and iv. 358 (1888) describes polygamous flowers; and states that occasionally a tree which has hitherto only borne staminate flowers becomes covered with berries.

⁴ Cf. Lubbock, *Seedlings*, i. 337, fig. 240 (1892).

⁵ Cf. Bromfield, in *Phytologist*, iii. 536 (1849).

⁶ Vars. *caspia* and *chinensis*, Loesener, in *Nova Acta Ac. Leop. Carol.* lxxviii. 262, 263 (1901).

catalogues, comprise both the hybrids, which we keep distinct as being of mixed origin; and the true varieties, due only to the common holly, which in many cases have arisen as branch sports, and been subsequently propagated by grafting. The latter usually revert, when old, in isolated branches on the tree, to the type of the common holly.

I. DIFFERING FROM THE TYPE IN HABIT.

1. Var. *pendula*, Loudon, *Trees and Shrubs*, 1113 (1842).

Branches pendulous; leaves as in the common holly. The original tree, from which this variety was propagated by Barron at Elvaston Castle, formerly existed in a private garden in Derby. Loudon also mentions¹ another weeping form, which was discovered about 1842 in Dalkeith Park. There are several good specimens of the weeping holly at Kew, which are clothed to the ground, and somewhat resemble the pendulous form of *Sophora japonica*. Dallimore states that as no leader is formed, it is necessary to keep a shoot tied up, in order to obtain a tall plant.

There are two variegated pendulous forms—var. *aurea pendula*, Waterer's weeping holly, and var. *argentea marginata pendula*, Perry's weeping holly.

2. Var. *fastigiata*, Loudon, *Gard. Mag.* xix. 442 (1843).

Branches erect. Loudon mentions two specimens, one in a garden in Edinburgh, and another in a garden in Derby. The fastigate holly is rare, but is represented at Kew by a small shrub.

II. DIFFERING FROM THE TYPE IN THE COLOUR OF THE FRUIT.

3. Var. *fructu luteo*, Loudon, *Arb. et Frut. Brit.* ii. 509 (1838).

Vars. *chrysoarpa* and *xanthocarpa*, Koch, *Dendrologie*, ii. pt. i. 210, 216 (1872).

Berries yellow. This is one of the oldest known varieties.² Seedlings have been raised in Waterer's and Paul's nurseries, which have produced orange-coloured fruit, and are supposed to have originated from crossing between the yellow and red-fruited forms.³ Loudon mentions a variety⁴ with white berries, and another variety⁵ with black berries, neither of which we have seen.

III. DIFFERING FROM THE TYPE IN FOLIAGE.

A. *Leaves, with both marginal and superficial spines.*4. Var. *echinata*, De Candolle, *Prod.* ii. 14 (1825).

Var. *ferox*, Aiton, *Hort. Kew.* i. 169 (1789); Loudon, *Arb. et Frut. Brit.* ii. 507 (1838).

Ilex echinata, Miller, *Gard. Dict.* ed. 8, No. 2 (1768).

Leaves ovate, about 2 in. long, with their edges rolled backwards; upper surface covered more or less with sharp prickles; margin with irregular large spines. This, which is called the Hedgehog Holly, is the oldest known variety, as it was mentioned by Parkinson⁶ in 1640, and was cultivated at Fulham about 1700. It occurs now only as a male plant; but Parkinson and Martyn refer to it as bearing berries, so that a female form was in all probability formerly in cultivation. Dalli-

¹ Loudon, *Gard. Mag.* xix. 442 (1843).

² In Cole's *History of Plants*, published in 1657, the yellow-berried holly is mentioned as having been found wild near Wardour Castle.

³ Moore, in *Gard. Chron.* ii. 520 (1874).

⁴ Koch, *Dendrologie*, ii. part i. 212 (1872) calls this var. *leucocarpa*, and speaks of it as common.

⁵ Cf. *Arb. et Frut. Brit.* iv. 2545 (1838).

⁶ *Theat. Bot.* 1486 (1640).

more¹ considers this variety to have originated from the typical form directly as a branch sport, which was subsequently propagated by grafting, and which by further sports has given rise to other varieties, like *crispa*.

Two variegated forms of this variety are known:—

Var. *ferox argentea*, Loudon, *op. cit.* 509. Spines and margin cream-coloured; known as the Silver-Striped Hedgehog Holly.

Var. *ferox aurea*, Loudon, *op. cit.* 509. Margin green; centre of the blade with a triangular yellow blotch; known as the Gold-blotched Hedgehog Holly.

B. *Leaves deformed; marginal spines abnormal.*

5. Var. *latispina*, Goepfert, in *Gartenflora*, iii. 318 (1854); Moore, in *Gard. Chron.* ii. 812, fig. 164 (1874).

Leaves thick in texture, broadly oval or quadrangular, with an acuminate apex ending in a long decurved spine; averaging 2 in. long and 1½ in. broad; margin with a few coarse spines, variable in number and direction. Dallimore considers that this variety originated probably as a branch sport from var. *crispa*.

6. Var. *trapeziformis*, Moore, in *Gard. Chron.* ii. 812, fig. 164 (1874).

This variety mainly differs from the last-mentioned in the slightly smaller leaves, which have the margin entire or with only one or two erratically placed spines.

7. Var. *monstrosa*, Goepfert, in *Gartenflora*, iii. 318 (1854); Moore, in *Gard. Chron.* ii. 750, fig. 147 (1874).

Leaves ovate-oblong, 3½ in. long, 1 to 1½ in. broad (exclusive of the spines), resembling var. *latispina* in the long acuminate apex with a deflexed spine, but with a longer blade and more numerous marginal spines, which project in all directions. Dallimore states that this originated in the Handsworth Nurseries.

8. Var. *albo-picta*, Loudon, *Arb. et Frut. Brit.* ii. 508 (1838).

Var. *argentea medio-picta*, Moore, in *Gard. Chron.* iv. 688 (1875).

Leaves similar to var. *monstrosa*, but slightly smaller and variegated; the centre of the blade having an irregular blotch of creamy white, the margin remaining green. This variegated holly is usually called "milkmaid" or "silver milkmaid," and has been known from an early period.

9. Var. *hastata*, Moore, in *Gard. Chron.* ii. 687, fig. 138 (1874).

Var. *kevensis*, Loesener, in *Nova Acta Ac. Leop. Carol.* lxxviii. 266 (1901).

Leaves dark green, coriaceous, ¾ to 1¼ in. long, with two or three pairs of long marginal spines towards the base; the upper half of the blade forming a large entire acuminate or emarginate triangular lobe. This is a dwarf shrub, with purple branches, which originated in the Handsworth Nurseries.

10. Var. *Beetii*, Moore, in *Gard. Chron.* ii. 520, fig. 107 (1874).

Leaves nearly orbicular, about 1½ in. in diameter, dark green, with a thickened margin, and a few (usually five or six) large spines, pointing in various directions. This originated in the Handsworth Nurseries.

¹ *Holly, Yew, and Box*, 68, 69 (1908).

11. Var. *crassifolia*, Aiton, *Hort. Kew.* i. 169 (1789); Loudon, *Arb. et Frut. Brit.* ii. 508 (1838); Moore, in *Gard. Chron.* ii. 752, fig. 152 (1874).

Leaves very thick in texture, lanceolate-oblong, $1\frac{3}{4}$ to 2 in. long, with the apex recurved; margin with triangular teeth, ending in coarse points. This, which is called the Leather-leaf or Saw-leaved Holly, is one of the oldest known varieties,¹ and is remarkably constant in character; no case of a branch reverting to the common holly having been noticed.² It is shrubby with purple branchlets; and always bears pistillate flowers, which ripen into peculiarly flattened fruit.

C. *Leaves small, less than 2 in. long, with regular marginal spines.*

12. Var. *lineata*, Moore, in *Gard. Chron.* ii. 752 (1874).

The form of the common holly with the smallest leaves, which are narrowly lanceolate, $\frac{3}{4}$ in. long, flat, with four or five minute spines on each side. This is a small compact bush with green branchlets. Var. *microphylla*, Moore, *loc. cit.*, appears to differ only in having purple branchlets.

13. Var. *recurva*, Aiton, *Hort. Kew.* i. 169 (1789); Loudon, *Arb. et Frut. Brit.* ii. 507 (1838); Moore in *Gard. Chron.* ii. 687, fig. 138 (1874).

Leaves ovate, acuminate, ending in a long spine, about $1\frac{1}{2}$ in long, curved from base to apex, and usually twisted to one side above the middle; spines divaricate and resembling those of the typical form. This is a dense shrub, and bears staminate flowers.

14. Var. *serratifolia*, Loudon, *Arb. et Frut. Brit.* ii. 507 (1838); Moore, in *Gard. Chron.* ii. 687, fig. 138 (1874).

Var. *myrtifolia*, Goepfert, in *Gartenflora*, iii. 320 (1854); Moore, in *Gard. Chron.* ii. 687, fig. 138 (1874).

Leaves ovate-lanceolate, $1\frac{1}{2}$ in. long, $\frac{1}{2}$ to $\frac{3}{4}$ in. broad, with divaricate spines similar to those of the type. This forms a dense pyramidal shrub.

Several variegated small-leaved forms are known, which may be mentioned here:—

Var. *myrtifolia aureo-maculata*; centre of the leaf with deep yellow blotches.

Var. *myrtifolia aureo-marginata*; centre of the leaf mottled, margin pale yellow.

Var. *myrtifolia elegans*; leaf with a green centre and a narrow golden edge; and

Var. *Ingrami*; leaf mottled with irregular white streaks, margin pinkish.

15. Var. *angustifolia*,³ Loudon, *Arb. et Frut. Brit.* ii. 507 (1838); Moore, in *Gard. Chron.* ii. 752, fig. 154 (1874).

Leaves lanceolate, about $1\frac{1}{2}$ in. long and $\frac{1}{2}$ in. broad, often ending in a long acuminate entire apex; spines numerous, regular, slender. This is a female tree, and is very distinct in its narrow erect almost fastigiate habit, and its elegant small leaves. At Kew, Tortworth, and elsewhere, there are specimens 30 to 40 ft. high,

¹ First described by Hanbury, *Complete Book of Gardening* (1770), as the saw-leaved holly.

² Cf. Dallimore, *Holly, Yew, and Box*, 67, 90 (1908).

³ Var. *angustifolia*, Hohenacker, in *Bull. Soc. Nat. Mosc.* iii. 319 (1838), was found wild in woods near Lenkoran, on the south-west coast of the Caspian Sea; and is a form of var. *caspia*, Loesener, differing from the horticultural variety here described.

as straight as a lance, and always very pointed at the top. It bears small, but not numerous berries.

Variegated forms of this are known:—

Var. *angustifolia albo-marginata*; a small shrub; leaves as in the green variety, but creamy white on the margin; and

Var. *angustifolia aureo-maculata*, centre of the leaf unevenly marked with yellow.

16. Var. *handsworthensis*, Moore, in *Gard. Chron.* ii. 520, fig. 108 (1874).

Leaves ovate, acuminate, $1\frac{1}{2}$ in. long, $\frac{3}{4}$ in. broad, with numerous regular strong spines, pointing towards the apex, the margin only slightly undulate. This has neat and elegant foliage, and originated in the Handsworth Nurseries.

17. Var. *ciliata*, Loudon, *Arb. et Frut. Brit.* ii. 507 (1838); Moore, in *Gard. Chron.* ii. 752, fig. 153 (1874).

Leaves ovate-lanceolate or ovate, $1\frac{1}{2}$ to 2 in. long, $\frac{1}{2}$ to 1 in. wide; margin scarcely undulate, with regular slender spines. This is a male tree at Kew, with purple branchlets and dark foliage.

18. Var. *ovata*, Moore, in *Gard. Chron.* ii. 752, fig. 149 (1874).

Ilex ovata, Goepfert, in *Gartenflora*, iii. 321 (1854); Koch, *Dendrologia*, ii. pt. i. 216 (1872).

Leaves ovate, with a broad truncate or rounded base, $1\frac{1}{2}$ to 2 in. long, $1\frac{1}{4}$ in. broad; margin slightly undulate with small sinuate teeth, tipped with minute spines. This remarkably distinct-looking holly is only known in the staminate form, and has purple branchlets. It is slow in growth. It is undoubtedly a sport of the common holly, as branches with ordinary leaves of the latter are often present on old specimens.

D. *Leaves 2 to 4 in. long, with regular marginal spines.*

19. Var. *Foxii*, Moore, in *Gard. Chron.* ii. 752, fig. 150 (1874).

Leaves broadly ovate, 2 to $2\frac{1}{2}$ in. long, $1\frac{1}{4}$ to $1\frac{1}{2}$ in. broad, with distant sinuate spinous teeth of moderate size on the slightly undulate margin. This variety, which is only known in the staminate form, is very distinct in appearance.

20. Var. *whittingtonensis*, Moore, in *Gard. Chron.* ii. 687, fig. 138 (1874).

Leaves lanceolate or narrowly elliptic, $2\frac{1}{2}$ to 3 in. long, 1 in. broad, dense shining green on the upper surface; margin undulate with numerous stiff divaricate spines. This is a distinct variety, bearing staminate flowers.

21. Var. *Fisheri*, Moore, in *Gard. Chron.* ii. 520, fig. 105 (1874).

Leaves ovate, with a broad base and an entire triangular apex, 3 in. long, $1\frac{1}{2}$ to 2 in. broad; dark shining green above; margin slightly undulate, with large sinuate spiny teeth, variable in number, one to eight on each side. This is a vigorous handsome tree, which originated in the Handsworth Nurseries. It has green branchlets and is a male.

22. Var. *aurea regina*, Moore, in *Gard. Chron.* v. 44 (1876).

Leaves similar in shape to var. *Fisheri*, but variegated; margin broad, well-defined, deep golden yellow; centre of the blade mottled with different shades of green. This beautiful holly is usually called "Golden Queen," and bears staminate flowers.

23. Var. *Lichtenthalii*, Simon-Louis, *Cat.* 1880-1881, p. 50.

Leaves oblong or narrowly elliptic, 4 in. long, 2 in. broad; dark dull green above; midrib beneath yellow; margin slightly undulate, and with large regular sinuate spiny teeth. This is a distinct large-leaved form, with purplish branches, and is possibly of hybrid origin.

24. Var. *alcicornis*, Moore, in *Gard. Chron.* ii. 433, fig. 90 (1874).

Var. *Robinsoniana*, Dallimore, *Holly, Yew, and Box*, 76 (1908).

Leaves narrowly elliptic, mostly with an entire cuneate base, about 3 in. long and 1 in. broad (exclusive of the spines); margin undulate, with numerous large spiny teeth, $\frac{1}{2}$ in. or more long, variously directed. This variety, which is distinct in appearance, has green branchlets, and is a free grower. It was originally sent out by Lawson.

E. *Leaves variable in margin, some quite entire, others with spiny teeth.*

25. Var. *donningtonensis*, Moore, in *Gard. Chron.* ii. 687, fig. 138 (1874).

Leaves lanceolate, $1\frac{1}{2}$ to 2 in. long, $\frac{1}{2}$ in. broad, very variable, either entire in margin or with a few irregular divaricate spines; usually recognisable by some of the non-spiny leaves bearing one or two peculiar curved lobes at the base. This variety, which has dark purple branchlets, always bears staminate flowers; and originated in the Handsworth Nurseries.

26. Var. *Smithiana*, Moore, in *Gard. Chron.* ii. 520, fig. 106 (1874).

Leaves lanceolate or elliptic, 2 to $2\frac{1}{2}$ in. long, $\frac{3}{4}$ in. wide, similar to the last in having leaves both entire and with a few irregular spines, but considerably larger and not showing the peculiar lobes at the base. This always has staminate flowers.

27. Var. *heterophylla*, Aiton, *Hort. Kew.* i. 169 (1789); Loudon, *Arb. et Frut. Brit.* ii. 506 (1838).

This name was originally given to the wild form of the common holly, in which spiny leaves occur near the ground and entire leaves in the upper branches of the tree; but it is now often applied to the next variety, and to intermediate forms.

Two variegated varieties occur:—

Var. *heterophylla aureo-marginata*; leaves of two kinds, entire and spiny, with an irregular golden margin; and var. *heterophylla aureo-picta*, leaves mostly entire and blotched with yellow in the centre.

28. Var. *integrifolia*, Goepfert, in *Gartenflora*, iii. 320 (1854); Moore, in *Gard. Chron.* ii. 812, fig. 164 (1874).

Leaves mostly ovate, entire; flat, but slightly twisted at the apex; about 2 in. long and 1 in. broad; acute, acuminate, or rounded at the apex. Leaves bearing a few spines are usually present. This variety occurs in both sexes.

29. Var. *Watereriana*, Moore, in *Gard. Chron.* vi. 232 (1876).

Leaves oval, 1 to $1\frac{1}{2}$ in. long, either entire or with a few irregular small spines; edged with a broad irregular band of golden yellow. Waterer's Golden Holly is a staminate form with green branchlets, which are striped with yellow. It is a neat, dense, slow-growing variety.

F. *Leaves all (or nearly all) entire in margin; spines absent, except at the apex, which usually terminates in a spiny point.*

30. Var. *laurifolia*, Loudon, *Arb. et Frut. Brit.* ii. 507 (1838); Moore, in *Gard. Chron.* ii. 812 (1874).

Leaves narrowly elliptic or oblong-lanceolate, entire, flat, about 2 to 3 in. long, and 1 in. broad; rarely a few leaves are present bearing one or two spines. This is known only as a male plant.

Several variegated forms are known:—

Var. *laurifolia sulphurea*; mottled green in the centre, with a broad band of sulphur yellow along the margin.

Var. *laurifolia aurea*, with a narrow bright golden yellow margin; and

Var. *laurifolia aureo-picta*, blotched in the centre with deep golden yellow.

31. Var. *marginata*, Loudon, *Arb. et Frut. Brit.* ii. 507 (not Moore).¹

Var. *scotica*, Moore, in *Gard. Chron.* ii. 812, fig. 164 (1874).

Leaves obovate or oblong, rounded and spineless, or with a slight cuspidate spine at the apex, 2 to $2\frac{1}{2}$ in. long, 1 to $1\frac{1}{2}$ in. broad; margin entire, undulate, strongly thickened; upper surface often marked near the apex with a cup-like depression.

This peculiar holly, which is occasionally cultivated under the erroneous name *I. Dahoon*,² is now generally named var. *scotica*, but seems to be without doubt the plant appropriately called var. *marginata* by Loudon. It is considered by Dallimore to have arisen as a branch sport from var. *crispa*, and often shows leaves approaching in character those of the latter variety; but in opposition to this view may be mentioned the fact that var. *marginata* is always female, while var. *crispa* is a staminate form.

Two variegated forms occur, which are known as:—

Var. *scotica aureo-picta*, a handsome variety which originated in the Cheshunt Nursery; it has leaves variegated with golden yellow in the centre; and

Var. *scotica aurea*, a dwarf form, having leaves with a broad golden edge.

32. Var. *crispa*, Loudon, *Arb. et Frut. Brit.* ii. 507 (1838).

Var. *calamistrata*, *revoluta*, and *contorta*, Goepfert, in *Gartenflora*, iii. 319 (1854).

Var. *tortuosa*, Waterer, ex Moore, in *Gard. Chron.* ii. 812, fig. 164 (1874).

Var. *marginata*, Moore, in *Gard. Chron.* ii. 812, fig. 164 (1874) (not Loudon).

Leaves spirally twisted and variously folded, about 2 in. long and 1 in. broad, shining green; margin much thickened, undulate, entire, or with one or two erratically placed spines; apex rounded or prolonged into a long stout decurved spine.

This variety, which is called the Screw-leaved Holly, is always a male tree, and is supposed by Dallimore to be a branch sport of var. *echinata*, as it occasionally bears leaves like those of the latter in having spines on the upper surface.

Var. *crispa aureo-picta* has leaves variegated with gold blotches. It often produces branches with green leaves, and occasionally has leaves with superficial spines.

¹ Var. *marginata*, Moore, is var. *crispa*, Loudon.

² *I. Dahoon*, Walter, is a native of the southern United States, and is apparently now not in cultivation. It was killed at Kew in the great frost of 1895. Cf. *Kew Bull.* 1896, p. 10.

G. Variegated Hollies.

Many of the variegated hollies have been mentioned above, where they are placed with the green varieties, which they resemble. Of these the most useful for ornament are var. *Watereriana* (see No. 29), var. *aurea regina* (see No. 22), and var. *argentea marginata pendula* (see No. 1). A few remain to be noticed.

33. Var. *aureo-marginata*, Loudon, *Arb. et Frut. Brit.* ii. 508 (1838). Leaves like the common holly, but yellow in margin, with the centre of the blade showing various shades of green. This includes a considerable number of sub-varieties, the most noteworthy of which are var. *aureo-marginata angustifolia* and var. *aureo-marginata bromeliæfolia*.

34. Var. *albo-marginata*, Loudon, *Arb. et Frut. Brit.* ii. 508 (1838). Leaves like the common holly, but with a silvery white or cream-coloured margin. Of the numerous sub-varieties, the best are var. *argentea regina*, "Silver Queen," and var. *handsworthensis argenteo-variegata*, "Handsworth New Silver Holly."

35. Var. *aureo-picta*, Loudon, *Arb. et Frut. Brit.* ii. 509 (1838). This variety, which is usually known as var. *aurea medio-picta*, or "Gold Milkmaid," has leaves like the common holly in shape, but with their centre irregularly marked with a large golden yellow blotch.

36. Var. *lutescens*, Petzold and Kirchner, *Arb. Musc.* 350 (1864).

Var. *flavescens*, Moore, in *Gard. Chron.* vi. 616 (1876).

Leaves like the common holly in size and shape, but differing in having a soft yellow tinge when young, which usually lasts throughout the season, but is best marked on the side of the tree which is most exposed to the light. This beautiful variety is known as Moonlight Holly, the dark central mass of green foliage with light yellow terminal shoots giving the effect of a shrub seen by moonlight.

HYBRIDS

The following, which are usually considered to be varieties of the common holly, are of hybrid origin, the parents being probably *I. balearica* and *I. Aquifolium*.¹ These hybrids are not known to produce branches which revert to the type of the common holly. They are vigorous trees, characterised by large leaves, with the margins flat or much less undulate than in the case of *I. Aquifolium*, the spinous teeth being also less sinuate, in these characters approaching *I. balearica*.

I. Leaves conspicuously reticulate beneath.

1. *Ilex Wilsoni*, Fisher, *ex Proc. Hort. Soc.* 1899, p. cxix.; Dallimore, *Holly, Yew, and Box*, 143 (1908).

Ilex Aquifolium, var. *latifolia*, Loudon, *Arb. et Frut. Brit.* ii. 507 (1838).

Ilex Aquifolium, var. *princeps*, Moore, in *Gard. Chron.* xiii. 45, fig. 8 (1880).

¹ Chambers, *Vestiges of Creation*, 310 (1851), quotes from the *Gardener's and Farmer's Journal*, 1848, p. 164:—"The following was related to us by Mr. M'Nab (of the Edinburgh Botanic Garden): he had sown the seeds of *I. balearica*, from which he had produced the common holly. He had also raised from the seeds of the tender Madeira holly (*I. Perado*) a variety identical with that known as Hodgins's holly; and although the offspring of a tender parent, yet like Hodgins's variety, it was also quite hardy." From this it would appear that *I. Perado* may have taken part in the origin of some of the hybrid hollies.

Leaves broadly ovate or oval, 3 to 5 in. long, 2½ in. wide, flat or slightly concave and shining above; conspicuously reticulate beneath; margin with numerous regular spiny teeth directed towards the apex, ¼ in. long, and lying in the plane of the blade.

This is one of the most ornamental hollies, and is a pistillate form, producing abundance of large berries. *I. Wilsoni* was exhibited in 1899 by the Handsworth Nurseries (where there is now a specimen 13 ft. high) as a new kind of seedling origin; but is apparently identical with var. *princeps*, from the same firm, described by Moore¹ a few years earlier. It seems also to be the same as var. *latifolia*, sold by Lawson in Loudon's time.

2. *Ilex Mundyi*, Dallimore, *Holly, Yew, and Box*, 142 (1908).

(?) *Ilex Aquifolium*, var. *nigra*, Moore, in *Gard. Chron.* ii. 433 (1874).

This differs mainly from *I. Wilsoni* in the dull and not shining upper surface of the leaf, the marginal spines of which are directed outwards rather than towards the apex. This is a male plant, which was sent out about twenty years ago by the Handsworth Nurseries, where the tallest specimen is now about 10 ft.

3. *Ilex Lawsoniana*, Dallimore, *Holly, Yew, and Box*, 141 (1908).

Ilex Aquifolium, var. *Lawsoniana*, Moore, in *Gard. Chron.* v. 624, fig. 110 (1875).

A variegated form, like *I. Mundyi* in the shape and texture of the leaf, which is, however, often sub-entire in margin; the centre of the blade is marked with broad irregular blotches of yellow. It is one of the handsomest of the golden hollies,² but often reverts to the green state.

II. Leaves not conspicuously reticulate beneath.

4. *Ilex attaclerensis*, Dallimore, *Holly, Yew, and Box*, 139 (1908).

Ilex Aquifolium, var. *ataclerensis*, Loudon, *Arb. et Frut. Brit.* ii. 507 (1838); Moore, in *Gard. Chron.* ii. 752 (1874).

Leaves broadly ovate, 3 to 3½ in. long, and 2 to 2½ in. wide, sub-entire, or with short spiny sinuate teeth variable in number and mostly near the apex of the blade; margin slightly undulate; petiole purplish, often ¾ in. long, with the base of the blade decurrent on it for a short distance.

This is a very fine male tree with purplish branchlets which originated at Highclere in the early part of the nineteenth century.

5. *Ilex Hodginsii*, Dallimore, *Holly, Yew, and Box*, 140 (1908).

Ilex Aquifolium, var. *Hodginsii*, Moore, in *Gard. Chron.* ii. 433 (1874).

(?) *Ilex Aquifolium*, var. *Shepherdii*, Goeppert, in *Gartenflora*, iii. 318 (1854) (not Moore³).

Leaves ovate or elliptic, 3 to 4 in. long, 2¼ to 3 in. broad, dark green and very shining above; margin undulate and with rather distant regular large triangular

¹ Moore states that var. *princeps* was raised from "the seed of *I. Aquifolium nigrescens* crossed with a male seedling from *I. balearica*."

² Gumbleton, in *Gard. Chron.* iii. 595 (1888), states that *I. Lawsoniana* originated in "Hodgen's nursery at Clough-jordan in Tipperary," whence grafts were sent to Messrs. Lawson at Edinburgh. This is an error, and should read "Hodgins's nursery at Dunganstown."

³ *Ilex Aquifolium*, var. *Shepherdii*, Moore, in *Gard. Chron.* ii. 751 (1874), judging from the description and Moore's specimen in the Kew Herbarium, was identical with *I. Hendersoni*, or only differed from it in the yellowish green leaves being shining and not dull above.

divaricate spiny teeth. This has purplish branchlets, and is very vigorous in growth. It is a staminate form, and is said¹ to be the best holly for planting in towns, being less affected by smoke than the other kinds.

Vars. *nobilis* and *belgica*, Moore, in *Gard. Chron.* ii. 433 (1874), are scarcely distinct from *I. Hodginsii*. A form of the latter, called *I. Hodginsii*, "King Edward VII.," with leaves mottled in the centre, and having a broad yellow margin, was put in commerce in 1898 by Messrs. Little and Ballantyne. Var. *nobilis variegata* has smaller leaves than *I. Hodginsii*, with a yellow blotch in the centre and a broad green margin.

I. Hodginsii is sold under the name *I. Shepherdii*, by the Handsworth Nurseries, who inform us that Mr. Shepherd, past curator of the Liverpool Botanic Garden, received two varieties of seedling hollies from Hodgins, nurseryman in the early part of the nineteenth century at Dunganstown near Wicklow.² The late Mr. Holmes obtained for the Handsworth Nurseries a stock of these varieties, one of which he named *I. Shepherdii* and the other *I. Hendersoni*, the latter name after a friend of the curator. Fine specimens of the original grafted plants still exist at Handsworth. Mr. Holmes always asserted that it was to the variety *I. Shepherdii* that other nurserymen subsequently applied the name *I. Hodginsii*.³

6. *Ilex nigricans*, Henry.

Ilex Aquifolium, var. *nigricans*, Goeppert, in *Gartenflora*, iii. 319 (1854).

Ilex Aquifolium, vars. *atrovirens* and *nigrescens*, Moore, in *Gard. Chron.* ii. 751, 752 (1874).

Leaves ovate, $2\frac{1}{2}$ to $3\frac{1}{2}$ in. long, $1\frac{1}{2}$ to 2 in. broad, dark shining green above; differing from *I. Hodginsii* in the margin being almost flat or only slightly undulate, with smaller sinuate teeth, ending in long slender spines, often very regular and numerous. Under this name may be included perhaps two or three distinct forms, sold as *maderensis*, *maderensis atrovirens*, *platyphylla*, etc., the nomenclature of which is at present confused in different nurseries.

7. *Ilex Hendersoni*, Dallimore, *Holly, Yew, and Box*, 140 (1908).

Ilex Aquifolium, var. *Hendersoni*, Moore,⁴ in *Gard. Chron.* ii. 752, fig. 148 (1874).

Leaves elliptic or ovate, $2\frac{1}{2}$ to 3 in. long, $1\frac{1}{2}$ to 2 in. broad, dull yellowish green above; mostly entire or sub-entire, or with a few short sinuate spinous teeth, the margin being only slightly undulate. This is a female tree, which produces large red fruit, but in no great abundance.

8. *Ilex camelliaefolia*, Henry.

Ilex Aquifolium, var. *camelliaefolia*, Koch, *Dendrologie*, ii. pt. i. 210 (1872); Moore, in *Gard. Chron.* ii. 812, fig. 164 (1874).

Leaves ovate-oblong, about 4 in. long and 2 in. broad, entire or with a few small sinuate spiny teeth, the margin being slightly undulate; upper surface deep green and very shining; petioles and branchlets purplish. This is a very vigorous tree, with dense foliage, and is a female, bearing larger and darker coloured fruits than the common holly.

¹ Hibberd, in Robinson, *Eng. Flower Garden*, 468 (1893).

² Cf. Loudon, *Arb. et Frut. Brit.* i. 116 (1838).

³ It is preferable to use *I. Hodginsii*, as it is now more commonly known, appearing as an alternative name in the Handsworth Catalogue. *I. Shepherdii* is ambiguous, having been applied to both varieties.

⁴ Cf. p. 1713, note 3.

I. Aquifolium, var. *Marnocki*, Dallimore, *Holly, Yew, and Box*, 84 (1908), differs mainly from the preceding in the leaves being peculiarly twisted about the middle. Messrs. Fisher, Son, and Sibray tell us that it arose at Handsworth as a chance seedling about forty years ago, and state in their catalogue that it "bears immense berries on the two- and three-year-old wood, forming sprays of vermilion red colour from 1 to 2 ft. long." Their largest specimen is about 16 ft. high.

DISTRIBUTION

The common holly is a native of western and southern Europe, and extends in two or three geographical forms into Asia Minor, the Caucasus, northern Persia, and China. It cannot live in regions¹ where the winter temperature is low, its distribution in Europe being limited to the north and eastward by the January isothermal line of 32° F., so that it is unknown in Russia and Sweden and in the eastern parts of Germany and Austria. It occurs in Norway only on the islands² and fjords along the west coast from Christianssund (lat. 63° 10') southwards, and is also met with in west Jutland and on the island of Rugen. It exists here and there in Germany, west of a line drawn from Mecklenburg to Bonn, and also in the Black Forest. It is more abundant in the Alps, where it ascends to 4000 feet elevation in Switzerland and in the Tyrol. In France³ it is most common in the central and southern departments, growing, according to Fliche, on all soils that are not marshy, but preferring those deficient in lime; it is usually shrubby, but attains large dimensions in Vendée and Corsica.⁴ Throughout its area it is most often seen as underwood or small trees in the shade of the broad-leaved forest; but it also grows in many places amidst scrub or in rocky situations in full sunlight.

(A. H.)

CULTIVATION

Though the holly is usually looked upon and treated as a shrub, yet in many parts of England it attains the dimensions of a forest tree, which on account of its beautiful foliage and berries has always been one of the greatest ornaments of our natural woodlands and hedgerows. As it is a most useful nurse to oaks, beeches, and other valuable timber trees, and forms excellent shelter for game, it should be encouraged and planted in all places where the soil suits it.

Holly is hardy in all parts of Great Britain; and though it will grow on almost any soil, thrives especially on deep sandy loam and on soils with cool subsoil, grows well on chalky and limy soils, and in very moist climates on thin rocky hillsides. It sows itself freely where rabbits are kept down, but grows slowly at first.

The berries should be gathered in winter, and mixed with sand or light soil in which they decay slowly; but as the seeds rarely germinate until a year has elapsed,

¹ Cf. A. de Candolle, *Geog. Bot. Rais.* i. 147, 162, pl. 1 (1855), who gives much information concerning the distribution of the holly.

² Holly grows on some of the islands near Bergen, in Hardanger and Sogn fjords; and attains on Amuglen over 30 ft. in height and 5 ft. in girth.

³ Cf. vol. iii. p. 560, note 4.

⁴ I have two specimens living at Colesborne, which I brought home in 1903 from the Sila mountains in Calabria, where holly grows at 4000 to 5000 ft. altitude.—H. J. E.

it is better to keep them in sand until the following spring, as is done with haws. When sown the beds should be covered with leaves, fern, or branches, to keep out the frost and drought until they begin to germinate. A rich light soil is best to encourage rapid growth when young, and after two years in the seed-bed the seedlings should be transplanted in the month of May with as little damage as possible to the tender roots. I have found that the seedlings grow faster under a wall with a north aspect than in the full sun. At four years old the seedlings should again be transplanted, and the strongest of them, which may then be 2 to 3 ft. high, can be planted out, either in early autumn if the soil is cool and moist enough, or just before growth commences in May. In the latter case a mulch will be desirable, as they suffer from drought after transplanting, and in my experience it is never wise to transplant¹ hollies between November and the end of March.

In forming holly hedges care must be taken to have the ground thoroughly clean and deeply dug beforehand, and to keep the young plants free from grass and weeds, which often choke the young trees. For want of this precaution, and even in spite of it, deaths occur on dry or poor ground which may permanently ruin the regularity of the hedge; and a great deal of money and time are wasted by planting holly hedges and not attending to them afterwards. Holly bears pruning well, and requires attention when young to make a regular and even hedge, and as the growth of the different varieties is very variable, it is important that all the plants should be from the same source.

When variegated hollies are required, they are budded or grafted; and as this is an operation requiring time, experience, and suitable stocks, it is better to purchase the varieties from a nursery. Messrs. Fisher, Son, and Sibray, of the Handsworth Nurseries near Leeds, have long been celebrated for their hollies, which may be transplanted successfully, if due care is taken, up to 5 or 6 ft. high.

The holly, though an indigenous species, suffers from cold in very severe winters, as in 1838, when the thermometer fell at Chiswick on 20th January to $-4\frac{1}{2}^{\circ}$ Fahr. Lindley² states that the holly in this year "was extensively affected in several places in the middle and north of England; this plant, however, offered very different powers of resisting cold, some of the varieties proving much hardier than others, and, according to Mr. M'Intosh, those which are variegated more so than the plain kinds." In 1837-1838 *I. balearica* was not in the least hurt about London.² Moreover, in 1905, when the temperature at Kew fell to 2° Fahr. on 8th February, none of the varieties of *I. Aquifolium* seems to have suffered.³

REMARKABLE TREES

The holly occurs in woods and copses throughout the greater part of the British Isles, ascending⁴ to 1000 feet in the Highlands, but seems to be commonest and of

¹ Cf. *Gard. Chron.* 1848, p. 99.

² Cf. *Kew Bull.* 1896, p. 9.

³ Moss, in Tansley, *Brit. Veg.* 126 (1911), states that "the holly is found in almost every oak wood on the Pennines, but although it sometimes produces flowers it rarely fruits." This is due no doubt to the altitude and prevalent low temperature in these woods.

² In *Trans. Hort. Soc.* ii. 226, 275 (1842).

its largest size in the moister and milder parts of Ireland, Wales, and southern England. It is a very characteristic tree of the New Forest, and is not uncommon in parts of the Chiltern Hills, where large specimens may be seen on the roadside between Wyfold and Reading.

There are few places in Great Britain where the holly grows in greater size and abundance, and forms such an important feature in the scenery, than in the New Forest, where, since the red deer were killed off, it has increased very fast; and in some of the old woods of oak and beech forms almost impenetrable thickets, which not only add to the beauty of the scenery, but protect many young oaks and beeches from being eaten off by the ponies. I am inclined to think that but for these hollies the number of saplings which are coming up would be so small that the timber trees would in time disappear, and though deer, sheep, and rabbits all browse on and bark hollies in winter, they bear the shade of oak very well. In Mark Ash some of the hollies are over 50 ft. high, with straight trunks, and the annual growths here are over a foot long.

In all the beautiful country about Midhurst and Haslemere the holly grows very well, and is cut by gypsies for whip-sticks, which when straight and slender are the best in England, being light and elastic. I have not seen here, however, any trees so remarkable for size as those which grow in Hertfordshire and Bedfordshire on sandy and gravelly loam. At Russells, near Watford, in 1907, I saw a group of trees in a thick shrubbery from 70 to 75 ft. high, but crowded by beech trees, and not well shaped. In Rod's Wood, Teppingley, near Ampthill, Henry measured in 1909 a fine specimen, 60 ft. high and $11\frac{1}{2}$ ft. in girth, at a foot from the ground, just below the point where it divided into about seven stems.

On the oolite of the Cotswold Hills it is common on old downs and in hedge-rows, but though often forming trunks of 4 to 5 ft. in girth does not attain as great height as on better soil.

On the coast of Suffolk the holly grows remarkably well on sandy soil in Orwell Park, where in a natural wood of oak and holly I saw many 50 ft. high and more, with clean stems 15 to 20 ft. high, and over 5 ft. in girth. Mrs. Rivis tells us that part of Staverton Wood, near Butley, consists of numerous old holly trees crowded together, and with their stems clear of branches to a considerable height.

At Rougham Hall, Norfolk, in 1907, I measured a splendid weeping silver holly 50 ft. by 4 ft. 11 in., with a bole 15 ft. high, the finest of the sort I have seen.

On the Steiperstone hills, south of Shrewsbury, a natural forest of hollies was said to have existed in which trees of great size were found; one is mentioned 14 ft. in girth;¹ but when I visited this place in 1909 I found that part of the land was now planted, and on the open part the hollies were injured by cattle, and by being lopped for Christmas decorations, so that I could find no old ones more than 20 to 30 ft. high, and few seedlings coming up.

At Doddington Hall, near Lincoln, Lord Kesteven in 1907 measured a splendid holly about 50 ft. high, and $9\frac{1}{2}$ ft. in girth at 4 feet from the ground.

¹ *Notes and Queries*, ser. v., xii. 508.

At Mount Edgumbe, Henry saw in 1911 a fine holly about 60 ft. high, with a clean stem of 25 ft., measuring 6 ft. in girth.

The longest holly hedge in England is probably one bounding the park at Tyntesfield, near Bristol, the seat of G. A. Gibbs, Esq. Planted on a bank 3 feet high it extends by the side of the public road for about two miles. It is about 4 ft. high and 3 feet thick, and is very dense and even. At Kew there is a fine holly hedge surrounding the shrub nursery,¹ which is 315 yards long, the greater part of it 9 feet high and 4 feet wide, but one portion as much as 12 feet high and 7 feet in width. A remarkable holly hedge² of great length at Keele Hall, Staffordshire, is 25 feet high and 30 feet in thickness. Near Bagshot a fine holly hedge³ around a private garden is 100 yards long and 40 feet high.

At Gorddinog, Llanfairfechan, North Wales, there is a remarkable avenue of yews, originally planted alternately with hollies, which the owner Colonel Henry Platt, C.B., considers to be very old, one yew tree bearing the date 1654 cut into the bark, with the figures stretched by age to a foot in length. Most of the hollies have died of old age, the largest one, which was 42 ft. high and 8 ft. 8 in. in girth, succumbing last year. A few remain, about the same height, all very decayed, and none exceeding 5½ ft. in girth.

The finest golden variegated holly that we know of is growing in the Isle of Man at Kirby Park, the seat of G. Drinkwater, Esq. In January 1913 it was 46 ft. high and 6 ft. 8 in. in girth at one foot from the ground, above which it divides into three stems, forming a beautiful narrow pyramid of foliage.

In Scotland the holly is quite as much at home as in England, and attains as great a size. Hutchison, who gives a complete list⁴ of the remarkable holly trees in Scotland, states that they are most abundant in Morayshire and Aberdeenshire, in the basins of the Findhorn, Spey, and Dee, where the climate is mild, and there are numerous woods of ancient date. In Darnaway Forest, Morayshire, there are thousands of hollies, many of large dimensions, the finest, measured by the forester in 1891, being 42 ft. high with a clean bole of 16 ft., girthing 9 ft. 4 in. at five feet from the ground. These grow amidst oaks in a soil of reddish clayey loam, and are supposed to be 200 years old. The most remarkable collection of varieties of the holly is at Ochertyre, Perthshire. Some of the oldest holly trees in Scotland appear to be at Glenkill, near Lamlash, in the Isle of Arran, the finest measuring in 1891 50 ft. in height and 8 ft. 3 in. in girth at three feet from the ground. An ash-tree, 30 ft. high and 2 ft. in girth, was growing, naturally grafted, on one of these hollies, the junction being about three feet from the ground, where the holly was 8 ft. 1 in. in girth.

Hunter records⁵ a grand holly tree at Gourdiehill, Perthshire, which had a stem

¹ Dallimore, *Holly, Yew, and Box*, 32 (1908).

² Cf. *Gard. Chron.* xiii. 10, fig. 5 (1893).

³ Described in *Gard. Chron.* xxvi. 424 (1899). A photograph of this is reproduced by Robinson, *English Flower Garden*, 467 (1893).

⁴ *Trans. Highland and Agric. Soc. Scotland*, iv. 80-94 (1892).

⁵ *Woods of Perthshire*, 495 (1883).

28 ft. long, as clean and smooth as a pillar, and holding a girth of 6½ ft. throughout its length.

Christison records¹ a holly at Fullarton House, near Troon, 30 to 40 ft. high, with a bole² 6 ft. long and 11 ft. 9 in. in girth, in 1891. Loudon³ mentions a holly at Blair Drummond which grew in sandy loam, and measured 59 ft. by 8 ft., but it is no longer living.

Sir Joseph Sabine in *Trans. Hort. Soc.* vii. 194 (1830), gives a long account of some remarkable holly hedges in Scotland, of which those at Tynninghame, East Lothian, the seat of the Earl of Haddington, extended altogether to a length of 2952 yards. The most striking were those on both sides of a grass walk 36 feet wide, extending from the North Berwick road to the mansion. This walk was 743 yards long, and the hedges 15 feet high, and 11 feet broad at the base; another was 170 yards long, 25 feet high, and 13 feet wide. Most of these were planted by Thomas, the sixth Earl, in 1712; but when I visited the place in 1905 I found that they had become old and ragged, many of the bushes having died. The largest tree that Sabine mentions here in 1830 was 54 ft. by 5 ft. 3 in. at three feet from the ground, but I measured one no less than 71 ft. by 4 ft. 9 in. drawn up among beech trees, but not a handsome specimen.

The most remarkable groups of hollies I have seen anywhere are on the holly bank at Gordon Castle, growing on a moist gravelly old red sandstone soil facing west. These are in clumps, and many have evidently sprung from the same stool. Sabine counted seventy-three groups, containing 508 trees, of which eighty-seven had clean trunks from 8 to 14 ft. long. The largest he measured, which grew at the bottom of the bank, were 52 ft. by 5 ft. 7 in. with a bole of 10½ ft., and 43 ft. 9 in. by 4 ft. 9 in. with a bole of 8½ ft. He mentions one clump which then contained fifty-five trees growing on an area 134 ft. in circumference, and from 1½ to 3½ ft. in girth, which I believe to be the same that I saw in April 1904, not knowing that it had been previously described. I counted fifty-four trees 30 to 40 ft. high, averaging about 3 ft. in girth, and containing about 6 to 7 feet of timber, so that on an area of about a quarter of an acre there must have been over 300 feet of timber.⁴ Plate 377 gives a very good idea of this wonderful group, which appeared to me, as it did to Sir J. Sabine, to have been the work of nature, but Mr. Webster, the gardener, could give me no record of their age and origin. The Duke of Richmond, however, tells me that they were flourishing in 1760, as they are alluded to in an account of Gordon Castle written at that time.

At Colinton House, Midlothian, the seat of J. Erskine Guild, Esq., there are some holly hedges, supposed to have been planted between 1670 and 1680, which are still in good health; and as I am informed by the gardener, Mr. Bruce, are

¹ *Trans. Bot. Soc. Edinburgh*, xx. 387 (1896). This tree was photographed by Paxton, who presented in 1894 to the library of the Edinburgh Botanic Garden a book of photographs and measurements of thirty remarkable trees in Ayrshire.

² Renwick, in *Trans. Nat. Hist. Soc. Glasgow*, vii. pt. iii. 263 (1904), gives the girth in 1903 as 11½ ft. at five feet from the ground.

³ *Gard. Mag.* xvii. 507 (1841), where a list of measurements in 1836 of all the remarkable trees at Blair Drummond is given.

⁴ In *Gard. Chron.* iii. 51 (1875), Mr. Webster says that one of the trees here measures 7 ft. 9 in. at three feet, and 7½ ft. at ten feet, and another 8½ ft. in the narrowest part of the trunk two feet from the ground.

now in better condition than they were twenty-five years ago. Some parts of them are solid green, and quite thick from base to top. The height of the tallest is 40 ft. after clipping, which is done once in two years. The broadest part at the base is 21 ft. through, and where protected from rabbits the leaves touch the ground. They grow on light dark loamy soil, with a sandy or gravel subsoil, but hollies here thrive equally well on clay with a rocky subsoil. These are supposed to be the oldest and the tallest holly hedges in Scotland, and perhaps in the whole of Great Britain.

The holly, according to Mr. R. A. Phillips, is distributed throughout Ireland, but is more abundant in the non-calcareous districts of the west, south, and south-east than elsewhere. It also occurs on the islands¹ off the west coast. In Ireland it formerly attained an enormous size, the most famous tree being one on Innisfallen Island, Killarney, which Hayes recorded² as 15 ft. in girth in 1794; but I could find no trace of it in 1909. There were also remarkable woods in which holly grew nearly pure, and produced valuable timber in quantity. The late Earl Annesley informed Henry that out of a wood of this kind by the lake at Castlewellaun his brother sold in 1871 more than £500 worth of holly timber; but in 1906 the largest tree which remained was scarcely 6 ft. in girth. Near Mount Usher, in Wicklow, Henry measured in a wood in 1904 a tree 70 ft. in height and 6 ft. in girth.

TIMBER, ETC.

The wood of the holly is white, hard, and heavy; and has a fine close grain, being very homogeneous in texture. It takes a good polish, and is used for making mathematical instruments, for inlaying, and for turnery. Pulley-blocks for ships were formerly made of holly. When dyed black, it is a cheap substitute for ebony. Dallimore states³ that snuff-boxes were, in the early part of the last century, made out of the knots and burrs that are sometimes found on the trunk. Young straight quickly grown shoots are used for making walking-sticks and whip handles.

Bird-lime is made out of the mucilaginous bark of the young shoots.

(H. J. E.)

¹ Praeger, in *Proc. R. I. Acad.* xxxi. pt. 10, pp. 19, 21, 25, records it for Clare Island.

² *Treatise on Planting*, 143 (1794).

³ *Holly, Yew, and Box*, 20 (1908).

BUXUS

Buxus, Linnæus, *Syst. Nat.* 9 (1735), *Gen. Pl.* 284 (1737), and *Sp. Pl.* 983 (1753); Baillon, *Monog. Buxac.* 58 (1859); Müller, in De Candolle, *Prod.* xvi. pt. i. p. 13 (1869); Bentham et Hooker, *Gen. Pl.* iii. 266 (1880); Pax, in Engler and Prantl, *Nat. Pflanzenfam.* iii. 5, p. 133 (1892); Van Tieghem, in *Ann. Sci. Nat.* v. 289 (1897); Hutchinson, in *Kew Bulletin*, 1912, p. 52.

EVERGREEN trees or shrubs belonging to the family Buxaceæ. Young branchlets quadrangular. Leaves opposite, coriaceous, simple, entire, penninerved, shortly stalked, without stipules. Flowers monœcious, without petals, in axillary clusters, which are composed of several staminate flowers, and usually a central single pistillate flower. Staminate flower: sepals four, in two opposite pairs; stamens four, each opposite a sepal, with a thick filament inserted beneath the rudimentary ovary, and with a two-celled anther, which dehisces longitudinally. Pistillate flower; sepals four to seven, occasionally ten, some of which may represent bracts, imbricated; ovary free, three-celled, crowned by three peripheral styles; ovules, two in each cell. Fruit,¹ a capsule, crowned by the three persistent styles, three-celled, each cell containing two seeds, or occasionally only one by abortion; capsule, when ripe, splitting longitudinally, through the three styles and the dorsal sutures, thus producing three two-horned valves; the endocarp afterwards opens down six lines, suddenly expelling the seeds, which are trigonous, shining, black, and smooth.

The above description is restricted to the section *Eu-buxus* of the genus,² which comprises about ten species, two, natives of tropical Africa and Socotra, and about eight species, natives of the Mediterranean region, Caucasus, Persia, Himalayas, China, and Japan. The following synopsis briefly deals with those which are in cultivation:—

I. *Branchlets glabrous, or occasionally with a few minute hairs near the nodes.*

1. *Buxus japonica*, Müller, in De Candolle, *Prod.* xvi. 1, p. 20 (1869); Shirasawa, *Icon. Ess. Forest. Japon.* ii. t. 38, figs. 16-32 (1908).

Buxus sempervirens, Linnæus, var. *japonica*, Makino, in *Tokyo Bot. Mag.* ix. 281 (1895), and xv. 169 (1901); Hayata, in *Journ. Coll. Sci. Tokyo*, xx. 3, p. 82, t. vi. c. (1904).

A shrub or small tree, with glabrous branchlets. Leaves coriaceous, very similar to those of *B. sempervirens* in size and appearance, but usually more oval and occasionally almost orbicular, $\frac{3}{4}$ to 1 in. long and $\frac{1}{2}$ in. broad, emarginate and rounded

¹ Cf. Marshall Ward, *Trees*, iv. 154, fig. 147 (1908).

² The other sections of the genus, which are sometimes regarded as distinct genera, are *Buxella*, which includes four species, natives of Madagascar, tropical and south Africa; and *Tricera*, comprising about a dozen species, natives of the West Indies.

at the apex; upper side of the short broad petiole pubescent, the leaf elsewhere being glabrous. Flowers of both sexes sessile, similar to those of *B. sempervirens*, but with the rudimentary ovary of the staminate flower much enlarged and as long as the inner sepals.

This is wild in the mountains of Japan, where it has given rise in cultivation to several peculiar forms, one of which with almost orbicular leaves, puckered and uneven on the surface, has been introduced into Europe. The typical form is rare; but is represented at Kew by a shrub about 3 ft. high.¹

2. *Buxus microphylla*, Siebold and Zuccarini, in *Abh. Ac. München*, iv. 2, p. 142 (1845).

Buxus sempervirens, var. *microphylla*, Blume, ex Miquel, in *Ann. Mus. Lugd. Bat.* iii. 128 (1867); Hayata, in *Journ. Coll. Sci. Tokyo*, xx. 3, p. 83, t. vi. D. (1904).

Buxus japonica, var. *microphylla*, Müller, in De Candolle, *Prod.* xvi. 1, p. 20 (1869).

A low shrub, with very slender branchlets, which are glabrous or with a few minute hairs above the nodes. Leaves thin and membranous, spatulate, lanceolate or elliptic, about $\frac{1}{2}$ in. long and $\frac{1}{6}$ to $\frac{1}{4}$ in. broad, emarginate at the apex, slightly pubescent on the upper side of the very short broad petiole. Flowers, as in *B. japonica*.

This species² occurs wild in Japan, in the provinces of Shimoso, Awa, and Tosa. It is a very distinct plant, with small thin leaves, and has lately been introduced into Kew.

3. *Buxus Harlandi*,³ Hance, in *Journ. Linn. Soc. (Bot.)* xiii. 123 (1873).

A small shrub, attaining 1 to 2 ft. in height, with densely crowded foliage. Young branchlets very slender, glabrous or occasionally with a few minute hairs above the nodes. Leaves oblanceolate, very narrow in proportion to their length, $\frac{3}{4}$ to $1\frac{1}{4}$ in. long, $\frac{1}{6}$ to $\frac{1}{4}$ in. wide, emarginate at the apex, very tapering at the base, quite glabrous throughout, or with slight pubescence on the upper side of the petiole. Flowers similar to those of *B. japonica*, sessile in both sexes, with the rudimentary ovary of the staminate flower as long as the inner sepals; but with the style of the pistillate flower as long as the ovary.

This shrub, which is very distinct in appearance, occurs in central and southern China, where it is found growing in the shingly or rocky beds of rivers and streams. It has been in cultivation about ten years at Kew, where it is a dwarf shrub.⁴

II. *Branchlets minutely puberulous.*

4. *Buxus balearica*, Lamarck, *Encyc.* i. 511 (1753); Willdenow, *Sp. Pl.* iv. 337 (1805).

Buxus sempervirens, var. *gigantea*, Loiseleur, in Duhamel, *Traité des Arbres*, i. 82, t. 23 (1801).

¹ *B. Fortunei rotundifolia*, of some French nurseries, is probably a prostrate form of *B. japonica*.

² *B. stenophylla*, Hance, in *Journ. Bot.* vi. 331 (1868), wild in the province of Fukien, in China, is closely allied to, if not identical with *B. microphylla*. *B. sempervirens*, var. *riparia*, Makino, in *Tokyo Bot. Mag.* xxvi. 293 (1912), a shrub 3 ft. high, growing beside the river Yoshino, in the province of Tosa, is said to be intermediate between *B. japonica* and *B. microphylla*.

³ This species was founded by Hance, on specimens gathered in Hong-Kong; but his sheet, No. 322, so-named, includes two different plants, one, the true *B. Harlandi*, and the other, resembling *B. japonica* in the shape of the leaves, but differing in having pubescent branchlets.

⁴ *B. Fortunei*, Carrière, in *Rev. Hort.* xlii. 519 (1871), also sometimes known as *B. longifolia*, Hort., judging from specimens cultivated under this name in France, is identical with *B. Harlandi*.

A shrub or small tree. Young branchlets with a minute pubescence, only visible with a strong lens. Leaves light green, coriaceous, larger than those of the common box, but similar in shape, elliptic, 1 to $1\frac{1}{2}$ in. long, $\frac{1}{2}$ to $\frac{5}{8}$ in. wide, emarginate at the apex, minutely pubescent on the upper side of the short petioles, but glabrous elsewhere. Staminate flowers shortly stalked; pistillate flowers with the styles as long as the ovary.

This species¹ occurs in the Balearic Isles, and in the province of Granada, in Spain, on the coast at Nerja, near Malaga, and on the Sierra de Almijara, at 2000 feet elevation. Loudon² states that it was introduced into England in 1780. It is perfectly hardy, the oldest specimen at Kew being about 23 ft. high.

III. *Branchlets densely pubescent.*

5. *Buxus sempervirens*, Linnæus. See p. 1724.

6. *Buxus Wallichiana*, Baillon, *Monog. Buxac.* 63 (1859); Hayata, in *Journ. Coll. Sci. Tokyo*, xx. 3, p. 84, t. vi. E. (1904).

Buxus sempervirens, J. D. Hooker, *Fl. Brit. Ind.* v. 267 (1887) (not Linnæus); Gamble, *Indian Timbers*, 592 (1902).

Buxus sempervirens, Linnæus, var. *liukiensis*, Makino, in *Tokyo Bot. Mag.* ix. 279 (1895), and xv. 169 (1901).

Buxus liukiensis, Makino, in *Tokyo Bot. Mag.* xvi. 179 (1902); Schneider, *Laubholzkunde*, ii. 140 (1907).

A shrub or small tree. Branchlets densely pubescent. Leaves lanceolate, 1 to $2\frac{1}{4}$ in. long, $\frac{1}{4}$ to $\frac{1}{2}$ in. wide, rounded or emarginate, with a short point at the apex; petiole densely pubescent, the pubescence spreading along the midrib on the upper side. Flowers of both sexes sessile; rudiment of the ovary in the male flower very short, dilated and slightly four-lobed at the apex; styles in the pistillate flower as long as the ovary, persisting elongated and erect on the fruit.

B. Wallichiana is widely spread in Asia, occurring in India in the Suliman and Salt ranges, and in the Himalayas from Kumaon to Bhutan (but not in Sikkim), at 4000 to 8000 feet. It is common in the mountainous districts of central and southern China, and is the only species known at present in the Liu Kiu Islands and Formosa. Its distribution³ in the Himalayas is local and peculiar; but it mainly grows along the banks of streams in moist and sheltered places, preferring a northerly aspect; and is met with on sandstone as well as on limestone. It often occurs in considerable quantity, attaining a large size, trees being recorded as much as 5 ft. in girth; but is slow in growth, averaging, according to Gamble, about twenty rings per inch of radius. In China,⁴ the box is known as *huang-yang*, and is of consider-

¹ *B. longifolia*, Boissier, *Diag. Fl. Orient.* 107 (1853), and *Fl. Orient.* iv. 1144 (1879), of which I have seen no specimens, is said to occur in the mountains of Syria; and appears to be closely allied to *B. balearica*. It is entirely distinct from *B. longifolia*, Hort., which appears to be a synonym of *B. Harlandi*. Cf. p. 1722, note 4.

² *Arb. et Frut. Brit.* iii. 1341 (1838). His account of the size and distribution of this species, which has been followed by Dallimore, *Holly, Yew, and Box*, 229 (1908), is erroneous. So far as I can learn, *B. balearica* is a small tree or shrub, not exceeding thirty feet in height; and does not occur wild except in the localities mentioned above. Nyman, *Consp. Fl. Europ.* i. 647 (1878), records it for Sardinia; but this is doubtful.

³ A dwarf box with very small leaves occurs in the Himalayas at high elevations; and has been referred to *B. japonica*, var. *microphylla*, Müller, by Hooker, *Flora Brit. India*, v. 267 (1887); but is much more pubescent than the Japanese plant, and is probably a distinct species.

⁴ The species of box in China require further study. *Buxus Henryi*, Mayr, *Fremdländ. Wald- u. Parkbäume*, 451 (1906), described from specimens (No. 3387) collected by me on cliffs near Ichang, in central China, has glabrous branchlets,

able economic importance in the mountains north of Ichang, in Hupeh, where it is a tree of considerable dimensions.

B. Wallichiana is very rare in cultivation; but thrives at Kew, where specimens, about 6 or 7 feet high, produce flowers and fruit regularly. (A. H.)

BUXUS SEMPERVIRENS, COMMON BOX

Buxus sempervirens, Linnæus, *Sp. Pl.* 983 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1333 (1838); Baillon, *Monog. Buxac.* 59 (1859); Müller, in De Candolle, *Prod.* xvi. 1, p. 19 (1869); Willkomm, *Forstl. Flora*, 802 (1887); Mathieu, *Flore Forestière*, 306 (1897).
Buxus arborescens, Miller, *Dict.* ed. viii. No. 1 (1768).

A shrub or small tree, attaining about 30 ft. in height and 3 ft. in girth. Young branchlets densely pubescent with short white hairs, which are more or less retained in the second and third years. Leaves persistent five or six years, coriaceous, opposite, oval or elliptic, averaging 1 to 1¼ in. long and ½ in. broad, rounded and usually emarginate at the apex; shining and dark green above; duller and yellowish green below; secondary nerves pinnate, often forked, conspicuous on the upper surface; margin entire; tapering at the base to a very short petiole, which is pubescent like the branchlets, the pubescence extending along the midrib on the upper surface, and on the edges of the base of the blade.

Flowers small, white; both sexes sessile; rudimentary ovary of the staminate flower scarcely half as long as the inner sepals; styles of the pistillate flower short, about half as long as the ovary. Capsule ovoid, longer than broad, brown when ripe, crowned by short spreading styles; seeds trigonous, smooth, shining, black. The seedling¹ has two oblong obtuse glabrous cotyledons about ½ in. long, raised above ground on a glabrous caulicle about 1½ in. long; primary leaves opposite, decussate, elliptic, shortly stalked.

VARIETIES

A considerable number of varieties of the common box are in cultivation, most of which have arisen in gardens and nurseries—the variation in the wild state² being slight.

1. Var. *angustifolia*, Loudon, *Arb. et Frut. Brit.* iii. 1333 (1838).

Buxus angustifolia, Miller, *Gard. Dict.* ed. viii. No. 2 (1768).

Leaves oblong-lanceolate, about 1 in. long and ½ in. wide. This is said to occur

lanceolate leaves as much as 3 in. long, and ¾ in. broad; staminate flowers on long pedicels, with a minute and linear rudimentary ovary. This species, which is allied to *B. balearica*, has remarkably fine foliage and conspicuous flowers; but has not yet been introduced. It has lately been fully described and figured by Dümmer, in *Gard. Chron.* lii. 423, fig. 182 (1912).

¹ Cf. Lubbock, *Seedlings*, ii. 481, fig. 639 (1892).

² The typical form of the species was distinguished as var. *arborescens*, by Linnæus, *Sp. Pl.* 983 (1753), a name kept up by Loudon, *Arb. et Frut. Brit.* iii. 1333 (1838). Var. *grandifolia*, Müller, in De Candolle, *Prod.* xvi. 1, p. 19 (1869), wild in Spain, Greece, and the Caucasus, is scarcely distinguishable, though occasionally the leaves are longer and more lanceolate than in the type.

wild in Algeria; and is commonly shrubby. An upright tall-growing form of this is known as var. *salicifolia elata*.

2. Var. *myrtifolia*, Loudon, *Arb. et Frut. Brit.* 1333 (1838).

Buxus myrtifolia, Lamarck, *Encyc. Meth.* i. 511 (1783).

Leaves dark green, oblong-lanceolate, smaller than in the last variety, about ¾ in. long and ¼ in. wide. This is a low shrub, which was described by Lamarck, from specimens obtained from M. Cels' nursery at Paris, where it probably originated.

3. Var. *myosotifolia*, Dallimore, *Holly, Yew, and Box*, 227 (1908).

Leaves resembling those of var. *myrtifolia*, but still smaller, about ½ in. long and ¼ in. broad, lanceolate, dark green. This is a dwarf shrub.

4. Var. *rosmarinifolia*, Baillon, *Monog. Buxac.* 61 (1859).

Leaves lanceolate or spatulate, more slender and thinner in texture than the last variety, about ½ in. long and ¼ in. wide, marked beneath with whitish dots and tubercles. This variety, which is also known as var. *thymifolia*, grows to be a bush 5 or 6 ft. high.

5. Var. *suffruticosa*, Linnæus, *Sp. Pl.* 983 (1753).

Buxus suffruticosa, Miller, *Gard. Dict.* ed. viii. No. 3 (1768).

Leaves oval or obovate, ½ in. long and ¼ in. wide. This is the well-known dwarf variety, which is used for edging beds in gardens. It has been in cultivation for several centuries at least, and is occasionally called var. *nana* or var. *humilis*.

6. Var. *latifolia*, Dallimore, *Holly, Yew, and Box*, 226 (1908).

Under this name are included several forms, in which the leaves are broader than usual, averaging 1 in. long and ¾ in. wide. In var. *latifolia bullata*, Späth, the leaves are uneven with peculiar swellings. Var. *handsworthensis*, Fisher, with broadly oval leaves, is vigorous in growth, and suitable for making hedges.

7. A considerable number of variegated forms are in cultivation. Those with leaves normal in size, or nearly so, are:—Var. *argentea* or var. *argenteo-marginata*, leaves white in margin; var. *aureo-marginata*, leaves yellow in margin; and var. *aureo-maculata*, leaves spotted with yellow. Var. *elegantissima*, Koch, *Dendrologie*, ii. pt. i. 477 (1872), is a distinct form with small oval leaves, variegated with white, and with many of the leaves deformed.

8. Var. *pendula*, Simon-Louis, *Cat.* 1869, p. 21. Tree-like in habit, and graceful in outline, the secondary branches and branchlets being pendulous.

9. Var. *pyramidalis*, Simon-Louis, *Cat.* 1869, p. 21. Pyramidal in habit, with upright branches.

DISTRIBUTION

The common box is a native of western Europe, the Mediterranean region, the Caucasus, and northern Persia. It is probably a true native of England; and in the south and east of France¹ is widely spread in the Jura, Dauphiné, Languedoc,

¹ Chatin, in *Bull. Soc. Bot. France*, viii. 364 (1861), considers the box to be naturalised in many localities in France, which are mainly in the neighbourhood of abbeys and castles that date from the middle ages. He mentions the forest of Marly, Vaux-de-Cernay, Neauphle-le-Château, Arthieul near Magny, Roche-Guyon, Chantilly, Nemours, Provins, and Jaux near Compiègne. He adds that it is abundant on the millstone grits and sandstones of Vaux-de-Cernay, near Paris, and on granite at Mauves-sur-Loire.

Provence,¹ and Pyrenees,² and occurs in a few scattered spots in the north of the departments of Meuse and Meurthe-et-Moselle, extending across the frontier into Belgium. It is recorded for Germany from one locality in Baden. Farther south it is common in the southern Tyrol, Istria, Dalmatia, the Balkan States, and Greece. It is also met with in Italy, Spain, and Portugal; and is a rare plant in the cedar forests of Algeria. In Europe, it is usually a gregarious shrub, often growing on arid hills or mountains on limestone³ soil in the Mediterranean region. It is cultivated in Norway as far as lat. 67° 56' on the coast, and in Sweden up to lat. 59° 7'.

The box attains its largest size in the Caucasus,⁴ where it is very common in the coast region along the Black Sea from Sotschi to Batoum, at elevations between sea-level and 4000 ft. It also grows wild in Talysch, but in other parts of the Caucasus is a doubtful native, though it is often planted, being considered a holy tree by the natives. The finest trees grow inland from the Black Sea, at about 2500 ft. altitude, where they are commonly 30 to 40 ft. in height, with stems 8 to 12 inches in diameter. Formerly still larger trees were known, Köppen⁴ mentioning 50 ft. in height and 2 ft. in diameter as the maximum size. Many large trees are of enormous age, 500 to 600 annual rings having been counted by Medwejew; but nearly all these are rotten at the heart. The box grows usually in the Caucasus in narrow bands along rivers and streams as undergrowth in the great forests of oak, ash, and beech; and is rarely found mixed with conifers. It thrives best in moist, rainy, sheltered, and shaded spots. The woods of box tree in Georgia are mentioned⁵ by Marco Polo. Until about 1890 the export of boxwood from the Black Sea to England, France, and Turkey, was enormous, averaging 2340 tons annually for the years 1883-1887.

Consul Stevens, in his *Trade Report⁶ for Batoum* for 1895, states: "Although all the private forests of boxwood have been exhausted, the Government up to the present still refuse to sell or allow boxwood to be cut in their extensive forests throughout Abkhasia; consequently the total exports from the Caucasus have not exceeded 1200 tons."

The box appears to be very common in the Elburz mountains in northern Persia, especially in the forests of Mazanderan, whence the export of boxwood in 1906 amounted to 125,864 pieces, weighing about 1560 tons.⁷

Whether the box is a native of England or not is doubtful; but it is certainly

¹ Tansley in *Gard. Chron.* lii. 113, fig. 51 (1912) describes the peculiar shrubby vegetation, which grows on the southern slopes of the hilly regions of Provence, at about 4500 ft. elevation. This consists of isolated bushes, with bare rock between them, of box, lavender, and *Genista cinerea*. The north slopes are covered with beech woods, in which there are holly and box, the latter being very abundant inland.

² On the south side of the Pyrenees, above Venasque at 5000 ft. altitude, I saw, in 1912, much box, forming dense scrub on sunny slopes; and it is the prevailing undergrowth in many of the valleys of the western Pyrenees on the French side. In the forest near Esterencby, south of St. Jean-Pied-de-Port, box attained 30 ft. high on limestone, and was being felled for making prayer-beads.

³ It is most commonly found on limestone; but occurs frequently on other soils, as in the cases mentioned (p. 1725, note 1) by Chatin; and according to De Candolle, *Geog. Bot. Rais.* i. 426 (1855), it grows on schist in the Pyrenees, on granite in Brittany, and on volcanic soil in Auvergne. Gèze, in *Bull. Soc. Bot. France*, lv. 464 (1908), states that at Villefranche it is not calcicole.

⁴ Cf. Radde, *Pflanzen-verb. Kaukasuslând.* 145, 182, 201 (1899), and Köppen, *Holgewächse Europ. Russlands*, ii. 1-9 (1889).

⁵ *Foreign Office Ann. Series*, No. 1717, p. 27.

⁶ Yule, *Marco Polo*, i. 50, 54 (1871).

⁷ *Consular Report for Resht*, No. 3864, p. 25.

naturalised, if not truly indigenous, in a few localities. It was cultivated¹ in Britain by the Romans; and as it seeds itself freely in the south of England, it may have spread from abandoned villas. It was well known in Anglo-Saxon times, the earliest mention, I was informed by the late Dr. Skeat, being in the "Corpus Glossary" of Latin and English words, which was written about 750 A.D. In this work *box* is given as the Anglo-Saxon equivalent of the Latin word *buxus*. The word *box* begins to appear early in place-names,² the oldest example known to Dr. Skeat being *Box-ōra* (i.e. box-bank), the old name of Boxford, Berks; and there must have been box trees here at an early date. In the thirteenth century, numerous names of places occur with *box*, as La Boxe, Le Boxe, Hundred de Boxe, Boxen, Boxford, Boxhale, Boxhey, Boxore, Boxley, Boxland, Boxstead. These place-names show that box was well known in former times; but whether it was wild or cultivated, there is no means of determining.

Professor Babington³ believed that the following extract from the beginning of Asser's *Life of King Alfred* showed that it was plentiful in Berkshire 1000 years ago: "Berrocsaire; quæ paga taliter vocatur a Berroc sylva, ubi *buxus* abundantissime nascitur." Gough's *Camden*, 155 (1789), says: "The last remains of Boxgrove⁴ in Sulham parish, near Reading, whence the county probably took its name, were grubbed up about forty years ago."

Gerard,⁴ writing in 1597, says: "The box tree groweth upon sundry waste and barren hills in England." Ray⁵ in 1696 records it growing at Boxhill near Dorking, at Boxley in Kent, and at Boxewell in the Cotswolds.

At the present day, box is apparently wild in several places in the south of England, the most famous being Box Hill in Surrey, where many acres on the western slopes are covered with a mixture of yew, box, and other trees. The occurrence of the box-tree here was first recorded by Merrett⁶ in 1666. Count Solms-Laubach suggests⁷ that the box and yew trees of Box Hill might probably be the remains of a native forest which originally clothed the North Downs. He urges the unlikelihood of such a soil as that of Box Hill being planted at all, and the improbability of any one hitting upon such a combination as yew and box for the purpose. Manning and Bray, *History of Surrey*, i. 560 (1804), give the following account: "The Downs, which rise from the opposite bank of the Mole, are finely chequered with Yew and Box trees of great antiquity, to a considerable height. Of the latter of these in particular there was formerly such abundance that that part of the Downs which is contiguous to the stream, and within

¹ Clement Reid, at a meeting of the Linnean Society, London, on 2nd December 1909, said that Box leaves have been found in three different rubbish heaps in the Roman remains at Silchester. The branches may have been used for wreaths.

² The names of places with box, given by Spelman, *Villare Anglicum* (1653) and by Adams, *Index Villaris* (1680) are Box (Wilts), Boxend (Beds), Boxford (Berks and Suffolk), Boxley (Kent), Boxted (Essex and Suffolk), Boxwell (Gloucester), and Boxworth (Berks and Cambridge). Some of these, as we know from the old spelling, do not indicate the box tree; thus Boxworth near Cambridge means the "farm of the buck." In some cases these places seem to be connected with the Roman occupation of Britain, as Boxmoor House (Herts), near which a Roman dwelling-house was discovered in 1851; but where the places occur on the chalk downs, the presumption is that the tree is indigenous.

³ *Phytologist*, iv. 873 (1853). Cf. Stevenson, *Asser's Life of King Alfred*, pp. 1, 156, 157 (1904), who states that Berroc Wood was identified with Boxgrove by Francis Wise in 1738.

⁴ *Herball*, 1225 (1597).

⁵ *Syn. Meth.* ii. 310 (1696). Box does not appear to be growing wild at the present time near Boxley in Kent.

⁶ *Pinax. Rerum Nat. Brit.* 18 (1666).

⁷ Cf. article by G. R. M. Murray, in *Journ. Bot.* xxxix. 27 (1901).

the precinct of this Maner, hath always been known by the name of Box Hill. Here was formerly also a Warren with its Lodge; in a lease¹ of which from Sir Matthew Brown to Thomas Constable, dated 25th August 1602, the Tenent covenants to use his best endeavours for preserving the Yew, Box, and all other trees growing thereupon; and in an account of the rents and profits for one year to Michaelmas, 1608, the receipt for Box trees cut down upon the Sheep Walk on the hill is £50. I have seen also an account of this Maner, taken in 1712, in which it is supposed that as much had been cut down² within a few years before as amounted to £3000."

E. S. Marshall³ says: "He must be very sceptical who doubts it being native on the steep slopes of Box Hill, above Burford Bridge. I have also seen it growing rather plentifully a mile or more away towards Betchworth." Bromfield⁴ says: "Box is profusely abundant on most parts of Sidon Hill, in Highclere Park (Hants), scattered over its shelving sides as if quite spontaneous, and said to disperse itself freely by seed;" but he avers that it was certainly planted here. Thus the natural appearance now of the box on Box Hill, Surrey, is no sure proof of its being indigenous there.

Another locality where the box occurs apparently wild is the Chiltern Hills; as on the chalk downs⁵ between Ashridge and Berkhamstead, where there are some very old-looking trees. Near here, on the top of Dunstable Downs, there is a place named Boxstead. On the Chequers Court estate, about half a mile from Ellesborough Church, near Wendover, box has all the appearance of being indigenous⁶ over a considerable area. Mr. Raffety of High Wycombe tells me that box is thickest here in two valleys, known locally as Ellesborough Warren and Kimble Warren, the bushes being about 20 ft., with numerous seedlings of all ages. It extends up over the adjoining spur of the Chiltern Hills to an altitude of 500 feet, the chalk subsoil being near the surface, and the exposure almost due south-west. Messrs. Sprague and Hutchinson state⁷ that some of the stems are 8 in. in diameter, and that the only tree which has obtained a place amongst the box thickets is the elder.

There is a place named Boxe in Domesday Book for Herts, section xxviii.; but the village⁸ so-called no longer exists, being now part of Wymondley. Mr. H. Clinton-Baker tells me of a field at the Priory, Wymondley,⁹ around which is a broad

¹ Barrington, in *Phil. Trans.* lix. 23 (1769) quotes from *A Journey through England*, printed in 1722: "Box Hill was first planted by that famous antiquary the Earl of Arundel, with box wood, designing to have a house there; but want of water made him alter his resolution and build one at Albury hard by." This is erroneous, as the Earl of Arundel was only sixteen years old in 1602, when Box Hill was already covered with box and yew, according to the lease cited above.

² Ellis, *Timber Tree Improved*, 103 (1745), says that "great quantities of box were felled off the Chalky Downs near Dorking in 1716, which paid its owner several hundred pounds."

³ In *Journ. Bot.* xlv. 346 (1907).

⁴ In *Phytologist*, iii. 817 (1850).

⁵ Cf. W. G. Smith, in *Journ. Bot.* xxxix. 73 (1901).

⁶ Loudon, *Derby Arboretum*, 50 (1840), says: "There are extensive native woods of the box tree on the estate of Sir Robert Russell at Chequers in Buckinghamshire."

⁷ *Gard. Chron.* lii. 404 (1912). The southern end of Ellesborough Warren is Velvet Lawn, a favourite meet of the hounds.

⁸ Chauncy, *Hist. Antig. Herts.* ii. 126 (1826), says: "The Vill or Parish of Box was situated between the parishes of Stevenage, Chivesfield, and Walkerne; and this parish was called Box from a great wood which retains the name to this day." Boxbury Farm and Box Wood are in the parish of Walkern; but there are no box trees in these places at the present time.

⁹ It is worth recording here that a chestnut tree, mentioned in Domesday book, still survives at Wymondley. Mr. H. Clinton-Baker tells me that it is a mere shell, no less, however, than 19 ft. in diameter, and still bearing fruit.

belt (about 10 yards in width) of box trees, which average 20 ft. in height, some being 2 feet in girth. (A. H.)

REMARKABLE TREES

Though a native of countries much hotter than Britain, and known to most people only as a bush, box is capable of attaining large dimensions in England, and may under favourable circumstances become a small tree. The largest I have seen in this country are in the Hermitage Road in Hitchin, where there is a row of about forty trees, many of which attain 25 to 30 feet in height, and 2 to 2½ ft. in girth, the largest being 35 feet by 2 ft. 10 in. Mr. Seebohm informed me that this line of trees formerly grew on private property¹ which he bought, and opened a new road on which they now stand between an old wall and iron railings which protect them.

At Beckford Hall, Gloucestershire, there is a walk 3 yards wide on each side of which a line of box trees grow which are from 30 to 31 feet high and 20 to 30 inches in girth. A monastery once stood here, and the trees are supposed to be about 800 years old, which is probably twice or three times their real age.

At Boxwell Court,² Gloucestershire, the seat of the Rev. O. Huntley, a wood of box trees exists which must be of very great age. Mr. Huntley showed me in the will of his ancestor, Henry Huntley, dated 1556, the following passage: "I will that it shall be lawful for the said Anne my wife, to cut and fell all my boxe, reserving the young store, at any time or times at her pleasure within the space of the said five years." It is thus clear that 350 years ago this wood was looked on as a valuable possession; and that the trees were coppiced, as they are now. It is possible that they were planted by some monk or returned Crusader, and are not, as some have supposed, wild. This wood lies on a steep slope just below the level plateau of the Cotswolds at an elevation of 500 to 600 feet and extends for about 800 yards along the slope which faces south. They grow very thickly and form a dense shade under which nothing grows, and show every sign of having been regularly cut over and reproduced from the stool; in one place fresh plants have been planted in rows, 5 feet apart, which now form tall slender poles clean to 10 or 15 feet high, many of which have died from overcrowding. In other parts the shoots average 20 to 25 ft. high, and though the average girth is not above 6 to 8 in. yet there are a few stems of 2 ft. and over, the thickest that I measured being 2 ft. 10 in. and 3 ft. 4 in. in girth. Mr. Huntley tells me that, though an uncle of his is reputed to have sold a

¹ W. Wilshire, M.P., who owned this property, states in Loudon, *Gard. Mag.* xv. 236 (1839), that these box trees were, in 1839, sixty in number, forming a hedge about 180 ft. long. They then averaged 36 ft. in height, and 3 ft. 3½ in. in girth at 2 ft. from the ground; and were very old, thin, and ragged. They were supposed to have been planted as a border, and allowed to grow up through neglect; but their exact history was unknown. Cf. J. E. Little, in *Journ. Hitchin Nat. Hist. Club*, May 1891, who adds that in the park at Ilxton, near Hitchin, box is very luxuriant, forming tall hedges along the drives.

² Rudge, *History of the County of Gloucester* (1803), states: "Boxwell, anciently Boxewelle. This name is derived from a box wood of about 16 acres, within a warren of 40 acres, from which arises a considerable spring. This is the most considerable wood of the kind in England, excepting Boxhill in Surrey; and from the name, which has now been on record for more than seven centuries, it must have been of long standing."

Ray, *Syn.* ii. 310 (1696), speaking of box trees, says: "At Boxwel in Coteswold in Gloucestershire, and at Boxley in Kent, there be woods of them.—*Mr. Aubrey's Notes.*" Cf. p. 1727, note 5.

quarter of an acre for £70, between 1858 and 1863, yet now he can only get £1 a ton for the wood, and at that low price no one seems to want it. In parts of the wood where rides have been cut, or openings made by the falling of trees, seedlings spring up abundantly; but the growth of the shoots from the stool seems very slow, owing perhaps to the rabbits, which are hard to keep out.

Mr. Cedric Bucknall describes¹ another wood of box trees, between Wotton-under-Edge and Alderley, clothing the hill-side for a considerable distance, and with abundance of natural seedlings.

In Ireland perhaps the best specimens of box are those growing in the grounds of the Earl of Rosse at Birr Castle.

TIMBER

The wood of the box tree is dense and homogeneous, with a very fine grain; and is said to be the nearest approach to ivory of any wood known. Boxwood is unrivalled for wood-engraving, and is used for turnery and inlaying, and for making rules, scales, and other mathematical instruments. It is also employed in making shuttles and rollers that are used in textile factories. A good account of boxwood, with information about the best modes of felling, seasoning, and shipping, is given by Gamble,² who quotes largely from a letter written by Messrs. J. Gardner and Sons, Liverpool. Boxwood from the Caucasus, whence formerly the main supply was drawn, is now being replaced, except for the very best articles, on account of its increasing cost, by "West Indian boxwood,"³ by *Buxus Macowani* from South Africa, and by other woods, belonging to different and often quite unallied genera.

(H. J. E.)

¹ In *Journal of Botany*, xxxix. 29 (1901). Cf. also J. H. White, *Flora of Bristol*, 523 (1912).

² *Manual of Indian Timbers*, 592-593 (1902).

³ Sir David Prain, Director of Kew Gardens, informs me that "West Indian boxwood" is not really shipped from the West Indies, but from Venezuelan ports; and that its botanical origin is still unknown. It was erroneously stated in *Kew Bull.*, 1904, p. 11, to be *Tabebuia pentaphylla*, Bentham and Hooker, a Bignoniaceous tree, which is known in the West Indies as "white cedar." H. Stone, *Timbers of Commerce*, 169, plate xii. fig. 105, gives an account of the so-called "West Indian boxwood," which he confuses with "white cedar," although he rightly questions the accuracy of the determination of *Kew Bull.*, 1904, p. 11. "West Indian boxwood" is used for making parasol and umbrella handles, shuttles, rulers, thermometers, etc.—A.H.

CRATÆGUS

Cratægus, Linnæus, *Sp. Pl.* 475 (1753); Bentham et Hooker, *Gen. Pl.* i. 626 (1865); Koehne, *Deut. Dend.* 227 (1893); Sargent, *Trees N. Amer.* 363 (1905); Schneider, *Laubholzkunde*, i. 766 (1906).

Oxyacantha, Medicus, *Phil. Bot.* i. 150 (1789).

Azarolus, Borkhausen, *Först. Bot.* ii. 1224 (1803).

Mespilus, sub-genus *Cratægus*, Ascherson and Graebner, *Syn. Mitteleurop. Flora*, vi. pt. ii. 12 (1906).

TREES or shrubs, belonging to the order Rosaceæ, usually armed with simple or branched spines, which are either axillary accompanying a bud, or terminate a short shoot. Leaves usually deciduous, alternate, simple, stalked, usually lobed, serrate; stipules often foliaceous and persistent on the long shoots. Buds small, globose, with numerous imbricated scales.

Flowers, in corymbs, which are terminal on short lateral leafy branchlets; with quickly deciduous linear bracts and bractlets; pedicellate, regular, perfect; calyx superior, with an urceolate, campanulate, or obconic calyx-tube, and five lobes, which are reflexed after the flower opens and either fall off or persist enlarged on the fruit; petals five, inserted with the stamens on the edge of a disc lining the calyx-tube; stamens 5, 10, 15, 20, or 25, with filaments broad at the base and incurved; ovary composed of one to five carpels, concealed in the bottom of the calyx tube and adnate to it; styles, one to five, free, with dilated truncate stigmas; ovules two in each cell, erect. Fruit, a false berry or haw, usually umbilicate at the apex, and often crowned by the marcescent calyx-teeth, composed of the fleshy calyx-tube, which encloses one to five stones or nutlets, each containing one seed, the other ovule having aborted.

This genus is widely spread in the extratropical regions of the northern hemisphere, occurring in Europe, Asia Minor, Siberia, Himalayas, China, and Japan; and with numerous species in North America. Schneider admits about 150 species in all; but Sargent and other American botanists have already described over 500 species in America alone, most of which may be regarded as varieties or hybrid forms. At least sixty species are in cultivation, all of which are either shrubs or small trees, not coming within the scope of our work. The native Whitethorn, which is described below, is now usually considered to comprise two species.

Cratægus is closely allied to *Mespilus*, of which it has been made a section by some botanists. The following hybrids, one of which is doubtful, between the two genera are worthy of brief mention.

1. *Mespilus grandiflora*, Smith, *Exot. Bot.* i. 33, t. 18 (1814).

Mespilus lobata, Poiret, in Lamarck, *Encyc. Meth. Suppl.* iv. 71 (1816); W. J. Hooker, in *Bot. Mag.* t. 3442 (1835).

Mespilus Smithii, De Candolle, *Prod.* ii. 633 (1825); Loudon, *Arb. et Frut. Brit.* ii. 878 (1838).

Cratægus lobata, Bosc, *Nouv. Cours. Agric.* ii. 223 (1821).

Cratægus grandiflora, Koch, in *Verh. Ver. Bef. Gartenb.* i. 227 (1853).

Cratægus oxyacantho-germanica, Gillot, in *Bull. Soc. Bot. France*, xxiii. p. xiv. (1876).

Pyrus lobata, Nicholson, *Kew Hand-list Trees*, 195 (1894) (not Koch).

Cratæmespilus grandiflora, Camus, in *Journ. de Bot.* xiii. 326 (1899).

A tree, attaining about 25 ft. in height. Branchlets pubescent, with short aborted spines. Leaves very variable in shape, entire or three- to five-toothed near the apex, or five- to seven-lobed and finely serrate, pubescent beneath. Flowers large, white, fragrant like a hawthorn, solitary or two to five in a corymb; calyx segments lanceolate, soon reflexed; petals five; stamens twenty; styles one to four; disc lobed. Fruit ovoid or globose, reddish brown, $\frac{1}{2}$ in. in diameter, crowned by the sepals, with usually two or three nutlets, which are sterile.

This tree, the origin of which is unknown, is considered by most botanists to be an accidental hybrid between *Cratægus oxyacantha* and *Mespilus germanica*; but Koehne¹ considers it to be an independent species, possibly native of the Caucasus. Five apparently wild shrubs were found in 1875 at Saint-Sernin-du-Bois, near Autun, in Seine-et-Loire, in a hedge around the ruins of an old priory, by Dr. Gillot,² whose interesting article should be studied. This remarkable tree, of which there is a good specimen³ at Kew, near the Director's office, was in cultivation at Paris about 1800; and possibly earlier in England, as Loudon mentions old trees at Syon and other places near London.

2. Two very remarkable graft hybrids⁴ originated about 1885 in the garden of M. Dardar, at Bronvaux, near Metz; and have been propagated by Simon-Louis. On a very old medlar tree, that had been grafted on a stock of hawthorn, two peculiar branches⁵ were observed to arise just beneath the graft. One of these branches, from which has been propagated the form known as *Cratægo-Mespilus Dardari*,⁵ differed from the medlar in the branches being spiny, and the flowers in corymbs; while the leaves and fruit were like those of the medlar but smaller. The other branch, which has been propagated as *Cratægo-Mespilus Asnièresi*,⁶ was more like the hawthorn, the leaves being lobed and the flowers like *Cratægus monogyna* in form and arrangement; but the branchlets and leaves were pubescent as in the medlar. These two graft hybrids, which are now in cultivation at Kew, are said by Mr. Bean⁷ to be very different in appearance. The *Asnièresi* form has remained true to type, and is a small tree of great elegance and beauty. The *Dardari* form, according

¹ *Deut. Dend.* 230 (1893).

² *Cf. Rev. Hort.* lxxi. 470 (1899), where Dr. Gillot states that it resembles *Mespilus* more than *Cratægus*, and is of undoubted hybrid origin.

³ There are several trees in the Green Park, London, and a fine one at Tortworth.

⁴ The history of these graft hybrids has been given by Simon-Louis and by Bellair in *Revue Horticole*, lxxi. 403, 482, 530 (1899); and by Koehne, in *Gartenflora*, l. 628 (1901). R. P. Gregory, in *Gard. Chron.* l. 185, fig. 86 (1911), gives Baur's explanation of their anatomical structure.

⁵ A third branch was subsequently produced on the original tree at Bronvaux, also from the junction of the stock and scion; but on the opposite side to that occupied by the first two branches. It had at its base pure hawthorn; but was transformed towards the extremity into the *Asnièresi* form.

⁶ Jouin, in *Le Jardin*, 1899, p. 22.

⁷ Bean, in *Kew Bull.* 1911, p. 268, figs. 1 and 2.

to Mr. Bean, behaves to some extent like *Laburnum Adami*, and bore at Kew in 1911 three distinct kinds of foliage and flowers on the same specimen. One of its branches was like the *Asnièresi* form; another branch was a pure medlar; and all the other branches were the *Dardari* form. Neither of the two hybrids has as yet shown a branch of pure hawthorn. (A. H.)

CRATÆGUS MONOGYNA, HAWTHORN, WHITETHORN

Cratægus monogyna, Jacquin, *Fl. Austr.* iii. 50, t. 292, fig. 1 (1775); Willkomm, *Forstl. Flora*, 835 (1887); Mathieu, *Flore Forestière*, 162 (1897); Schneider, *Laubholzkunde*, i. 781 (1906).

Cratægus oxyacantha,¹ Linnæus, *Sp. Pl.* 477 (1753) (in part); Druce, *List of British Plants*, 26 (1908).

Cratægus oxyacantha, Linnæus, var. *monogyna*, Loudon, *Arb. et Frut. Brit.* ii. 834 (1838).

Cratægus oxyacantha, Linnæus, sub-species *monogyna*, Hooker, *Student's Flora*, 127 (1870).

Mespilus monogyna, Allioni, *Fl. Pedem.* ii. 141 (1785); Willdenow, *Enum. Pl. Hort. Berol.* i. 524 (1809); Ascherson and Graebner, *Syn. Mitteleurop. Flora*, vi. 2, p. 27 (1906).

A shrub or small tree, attaining occasionally about 40 ft. in height. Bark greyish, broken on the surface into small scales. Young branchlets glabrous or with scattered pubescence. Leaves, variable in shape and size, usually broadly ovate, averaging $1\frac{3}{4}$ in. long, and $1\frac{1}{2}$ in. wide at the broad almost truncate or occasionally cuneate base; pinnatifid with five or seven deep lobes, separated by narrow sinuses; margin serrate; upper surface with scattered white hairs; lower surface pale green, with similar pubescence mainly on the midrib and nerves; petiole slender, $\frac{1}{2}$ to 1 in. long, slightly pubescent.

Flowers, variable in number in the corymb; calyx-tube and pedicel pubescent; sepals five, triangular, soon reflexed, persistent on the fruit; petals five, usually white, but occasionally pink, even in the wild state;² stamens fifteen or twenty; style one.³ Fruit, ellipsoid or ovoid, reddish, with one stone, which is either smooth or marked with shallow furrows.

The seeds, when sown, do not germinate till the second year. The seedling⁴ has two obovate-oblong cotyledons, which are about $\frac{2}{3}$ in. long, $\frac{1}{4}$ in. broad, shortly stalked, glabrous, obscurely three-nerved, and raised above ground by a glabrous caulicle about 1 to $1\frac{1}{2}$ in. long. The pubescent stem bears alternate serrated leaves, the first three of which are small, cuneate, and three-lobed; those succeeding becoming larger and deeply five-lobed.

¹ *C. oxyacantha*, Linnæus, included both species; but this name was early limited to the two-styled species by Jacquin, who separated the one-styled species as *C. monogyna*. All botanists until lately have followed Jacquin's nomenclature of the two species, which is adopted by us. Recently much confusion has been caused by one or two writers, who restrict the name *C. oxyacantha*, Linnæus, to the one-styled species. These authors are obliged to use another name, *C. oxyacanthoides*, Thuillier, for the two-styled species.

² Briggs, *Flora of Plymouth*, 143 (1880), records a bush with pink flowers, and another with deep red flowers. In hedges near Cambridge shrubs with pink flowers are not uncommon.

³ *C. kyrtostyla*, Fingerhut, in *Linnaea*, iv. 372, t. iii. fig. 1 (1829), is a form of *C. monogyna*, in which the flowers have a peculiar curved or deflexed style. F. A. Lees, *Flora of W. Yorkshire*, 231 (1888), states that most old gnarled thorns in parks and pastures show this peculiarity.

⁴ Cf. Lubbock, *Seedlings*, i. 500, fig. 324 (1900), where the seedling of this species is described under the name *C. oxyacantha*.

This species is more pubescent than *C. oxyacantha*, has a differently shaped leaf, and is readily distinguishable, apart from the single style, in the flower and solitary stone in the fruit. It is apparently much more variable in the wild state than the other species; but some of the supposed varieties may be due to hybridising. Certain forms, which are plainly intermediate in various ways between the two species, are recognised as hybrids by continental botanists¹ under the names: *C. media*, Bechstein, *Diana*, i. 88 (1797); and *C. intermixta*, Beck, *Fl. Niederr. Oesterr.* ii. 1, p. 706 (1892).

The commonest hybrid form in England has leaves like those of *C. monogyna*, but with flowers having a glabrous calyx-tube and pedicel. White states² that there are several trees of this kind near Bristol, one of which on Leigh Down was noticed to be the last to bloom in 1881, a year remarkable for the abundant blossom of the hawthorn.

In south-eastern and southern Europe there are peculiar races or allied species, which are not in cultivation in this country, and need not be more than alluded to.³

The following varieties have arisen in cultivation:—

A. Differing from the type in habit.⁴

1. Var. *flexuosa*, Dippel, *Laubholzkunde*, iii. 459 (1893).

Cratægus oxyacantha, var. *flexuosa*, Loudon, *Arb. et Frut. Brit.* ii. 835 (1838).

Branches spinescent, dense, flexuose, twisted or like a corkscrew. This peculiar variety originated in Smith's nursery at Ayr, and is represented at Kew by a shrub about 15 ft. high.

2. Var. *salisburyifolia*, Nicholson, *Kew Hand-list Trees*, 205 (1894).

Cratægus oxyacantha, var. *salisburyifolia*, Späth, *Cat.*, No. 59, p. 61 (1884).

Branches similar to those of var. *flexuosa*, but without spines. Leaves with few and obtuse lobes somewhat like those of a Ginkgo tree in shape. This is represented at Kew by a shrub about 5 ft. high, which was planted in 1885.

3. Var. *pendula*, Dippel, *Laubholzkunde*, iii. 459 (1893).

Cratægus oxyacantha, var. *pendula*, Loudon, *Arb. et Frut. Brit.* ii. 832 (1838).

Branchlets pendulous. Several forms are known. One is said by Loudon to have been picked out of a bed of seedlings at Somerford Hall. Anderson, curator of the Chelsea Botanic Garden in 1830, obtained several pendulous varieties by grafting shoots which were taken from the witches' brooms, that are occasionally

¹ Focke, who describes the hybrid in Koch, *Syn. Deutsch. Flora*, i. 859 (1892), says that it is common in northern and central Germany, where it is more generally distributed in hedges and plantations than the true species.

² *Flora of Bristol*, 300 (1912).

³ *C. azarella*, Grisebach, *Spicil. Fl. Rum.*, i. 88 (1843) is a very pubescent form, which occurs in the Balkan States, Hungary, and Transylvania. *C. hirsuta*, Schur, *Enum. Fl. Trans.* 206 (1866), is very similar and widely distributed in the Mediterranean region. The following are peculiar local forms:—*C. Insegnae*, Bertolini, *Fl. Ital.* vii. 629 (1847), a native of Sicily; *C. granatensis*, Boissier, *Elenchus*, 41 (1838), wild on the Sierra Nevada in Spain; and *C. brevispina*, Kunze, in *Flora*, 1846, p. 737, a native of southern Spain.

⁴ In *Kew Hort.* 1899, p. 489, it is stated that a form without spines was found in 1893 as a seedling in M. Hémeray-Proust's nursery at Orleans; but I have not seen it in commerce. A compact dwarf spineless variety (var. *inermis compacta*) is advertised by Simon-Louis.

found as conglomerations of slender branches on old trees.¹ A weeping tree² at Edinburgh, reputed to be over 300 years old and a favourite of Queen Mary, survived till 1836; and from it was propagated a form known as var. *reginæ*, or Queen Mary's Thorn.

Var. *pendula variegata*, a weeping form with variegated leaves; and var. *pendula rosea*, a weeping shrub with pink flowers, are also in cultivation.

4. Var. *ferox*, Schneider, *Laubholzkunde*, i. 781 (1906).

Cratægus oxyacantha, var. *ferox*, Carrière, in *Rev. Hort.* 1859, p. 348.

Cratægus oxyacantha, var. *horrida*, Carrière, in *Flore des Serres*, xiv. 201, t. 1468 (1861); Regel, in *Act. Hort. Petrop.* i. 119 (1870); Lynch, in *Gard. Chron.* xxiv. 13, fig. 5 (1898).

Branches pendulous, and armed with tufts of several spines. Carrière, who was unaware of the origin of this variety, states that seedlings raised from its seeds in the Jardin des Plantes at Paris reverted to the ordinary form.

5. Var. *stricta*, Nicholson, *Kew Hand-list Trees*, 205 (1894).

Cratægus oxyacantha, var. *stricta*, Loudon, *Arb. et Frut. Brit.* ii. 832 (1838).

Fastigate in habit, with upright branches. This was discovered in 1826 in a bed of seedlings in Ronalds's nursery at Brentford, and was said by Loudon to resemble the Lombardy poplar in shape. A tree so named at Kew, about 20 ft. high, is pyramidal, with ascending branches, but is not fastigate. The truly fastigate form is sold by Smith of Newry and by Späth of Berlin.

6. Var. *ramulis aureis*, Nicholson, *Kew Hand-list Trees*, 205 (1894).

Var. *xanthoclada*, Zabel, ex Späth, *Cat. No.* 148, p. 91 (1911-1912).

Branchlets of a bronze colour, conspicuous in winter. A shrub of this at Kew, obtained from Simon-Louis in 1885, is about nine feet high.

B. Differing from the type in foliage.

7. Two variegated forms, mentioned by Loudon,—var. *foliis argenteis*, leaves mottled with white, and var. *foliis aureis*, leaves variegated with yellow,—are still in cultivation, but are of little ornamental value.

8. Var. *laciniata*, Dippel, *Laubholzkunde*, iii. 459 (1893).

Cratægus oxyacantha, var. *laciniata*, Loudon, *Arb. et Frut. Brit.* ii. 830 (1838); Regel, in *Act. Hort. Petrop.* i. 119 (1870).

Leaves deeply pinnatifid, with irregularly serrated lobes. This occurs in hedgerows, in company with the typical form. F. A. Lees states³ that in Yorkshire, Worcestershire, Lincolnshire, and Berkshire, it flowers much less freely than the other forms.

9. Var. *filicifolia*, Koehne, *Deut. Dend.* 238 (1893).

Cratægus oxyacantha, var. *filicifolia*, Van Houtte, *Flore des Serres*, xx. 51, t. 2076 (1874).

Leaves broad, fan-shaped, deeply divided into numerous curled segments. This beautiful variety, which resembles *Adiantum farleyense* in foliage, does not

¹ Cf. Loudon, *Gard. Mag.* ix. 596 (1833).

² Figured by Loudon, *Arb. et Frut. Brit.* ii. 833, fig. 556 (1838).

³ *Flora W. Yorkshire*, 231 (1888). It is recorded for Warwickshire by Bagnall, *Flora of Warwickshire*, 107 (1891).

seem to be in cultivation¹ in England. There are several other varieties² with peculiar cut leaves, none of which I have seen.

C. Differing from the type in flowers.

10. Var. *semperflorens*, Dippel, *Laubholzkunde*, iii. 460 (1893).

Crataegus oxyacantha, var. *semperflorens*, André, in *Rev. Hort.* liv. 354 (1882) and lv. 140, fig. 26 (1883).

A low bushy shrub, which numerous flowers, which appear more or less continuously throughout the season from May to autumn. This was found about 1879 at Poitiers by M. Bruant, in a bed of seedlings of the common hawthorn, and was subsequently propagated by grafting. A shrub at Kew is about 2 ft. high.

11. Var. *præcox*, Dippel, *Laubholzkunde*, iii. 459 (1893). Glastonbury Thorn.³

Crataegus oxyacantha, var. *præcox*, Loudon, *Arb. et Frut. Brit.* ii. 833 (1833).

Flowers, usually appearing at Christmas or early in January, and not ripening into fruit, the leaves being somewhat later; a second crop of flowers, which produce fruit, is borne in May and June. The original tree,⁴ which grew at Glastonbury, was mentioned by Turner in 1562, and by Gerard in 1597, and had the appearance of a very old tree, when it was seen by Withering⁵ in 1793. From this tree the variety was propagated. A specimen, growing near the Temperate House at Kew, is irregular in the time of flowering, which depends upon the nature of the season. Bean states⁶ that, with a mild November and December, the tree at Kew will flower about Old Christmas Day (6th January); but if cold weather sets in before New Year, the flowers may not open till March or April. In 1908, owing to the unusual warmth of the autumn, it was in full blossom in the first week of November, before the leaves had fallen, so that it was carrying flowers, fruit (derived from the flowers of the preceding May), and foliage simultaneously.

D. Differing from the type in fruit.

12. Var. *eriocarpa*, Dippel, *Laubholzkunde*, iii. 460 (1893).

Crataegus oxyacantha, var. *eriocarpa*, Loudon, *Arb. et Frut. Brit.* ii. 831 (1838).

¹ Var. *filicifolia* is advertised by Späth, *Cat.* No. 148, p. 91 (1911-12).

² Var. *pinnatifida*, Dippel, *Laubholzkunde*, iii. 458 (1893), is identified by Schneider, *Laubholzkunde*, i. 785 (1906), with *C. microphylla*, Koch, *Die Weissdorn*, 68 (1884), which is a Caucasian species, not apparently in cultivation, though it is given in the Kew Hand-list. Koehne, *Deut. Dendr.* 238 (1893), however, considers it to be a hybrid between *C. monogyna* and *C. oxyacantha*.

³ Chevallier, in *Ann. Soc. Agric. Sci. Départ. Indre et Loire*, xxx. 70 (1850), describes a similar sport of *Prunus spinosa*, to which is attached a similar legend. At the Château du Chabrol, St. Patrice, on the Loire, midway between Saumur and Tours, there is a large blackthorn, called *Pépine miraculeuse*, which flowers every year in the last week in December, even in the severest seasons. The legend is that St. Patrick, while on his way to Tours in A.D. 395, reposed one night in winter under the shade of this tree, which burst forth into flowers and leaves to shield him from the cold. The tree did not appear to be very old in 1850, but is now of considerable size, judging from a photograph sent me by M. Hickel. This curious variety, which may be named *Prunus spinosa*, var. *præcox*, does not seem ever to have been propagated.

⁴ Parkinson, *Theat.* 1025 (1640), mentions other trees of the same kind at Romney Marsh and at Nantwich. Plot, *Nat. Hist. Oxfordshire*, 159 (1705), mentions a very old tree, which flowered at Christmas, in Lord Norrey's park in Oxfordshire; but was uncertain whether it was a graft from the Glastonbury tree or an original specimen of the variety.

⁵ *Arr. Brit. Pl.* 459 (1793). Cf. Loudon, *Gard. Mag.* ix. 122 (1833). However, James Howel, *Dodona's Grove*, 55 (1644), implies that the original thorn was destroyed by Puritan fanatics, one of whom "was well served for his blind zeale, who, going to cut down an ancient white Hawthorne tree, which, because she budded before others, might be an occasion of Superstition, had some of the prickles flew into his eye and made him Monocular."

⁶ *Kew Bull.* 1908, p. 452. Cf. also J. W. White, *Flora of Bristol*, 302 (1912), who mentions a specimen at Ipswich, which flowered 14th November 1885, and another at Evesham, which was in flower on 26th November, 1899.

Fruit woolly pubescent. This variety is rare; but is occasionally found in the wild state, as in the Isle of Wight, where it is recorded by Bromfield.¹ It is said² to occur near Breslau, in Silesia.

13. Var. *maurianensis*, Didier, in *Bull. Soc. Dauph.* ix. 385 (1882).

Fruits very large, $\frac{1}{2}$ to 1 in. long, and $\frac{2}{3}$ in. or more wide. This variety was described from specimens found in Savoy, and occurs also in hedges near Toulon.³

Mr. J. W. White records⁴ two trees, with branches bending down under the weight of numerous large haws, which were found in 1909 near Bristol, one on a low cliff near Walton-by-Clevedon, the other in Chelvey Batch wood. The fruits were very handsome, and four times larger than the typical form, averaging $\frac{3}{8}$ in. long and $\frac{1}{2}$ in. wide.

As both *C. monogyna* and *C. oxyacantha* have been much confused, it is impossible to give an accurate account of their separate distribution. The common hawthorn, comprising both species, is a native of Europe, and of the mountains of Algeria and Morocco; and extends from Asia Minor and the Caucasus, through Armenia, Persia, and Afghanistan to the western Himalayas, where it grows between 6000 and 9000 feet elevation.⁵ It grows wild in Norway as far north as lat. 62° 55', in Sweden as far as Upsala, lat. 59° 52', and in Finland to lat. 61° 30'. In Russia, it is common in Livland, Kazan, and Orenburg, and throughout the southern provinces except in the Steppes. It occurs mainly in hedges, waste places, and on the margins of woods, ascending in the Alps to about 3000 feet altitude.

C. monogyna is by far the commoner of the two species in Britain, where it is found in hedges and woods from Moray and Islay southwards; and it is met with in all districts in Ireland. It is the most commonly planted hawthorn either for hedges or for ornament; and most of the large trees in parks are referable to this species, though some of them look as if of hybrid origin.

The hawthorn lives to a great age, probably to three or four hundred years.⁶ Old trees often grow irregularly, so that ribs are formed upon their stem, which assume a vertical or a spiral direction. As years go on, these rib-like projections become larger, and the intervening channels deeper. Ultimately, when decay begins at the heart and spreads outwards, the projecting parts become separated and appear to be a number of subordinate stems, which are, however, united at the base, and bear on their inner surface, instead of bark, remains of the decayed heart-wood.⁷

(A. H.)

¹ In *Phytologist*, iii. 288 (1848).

² Ascherson and Graebner, *Syn. Mitteleurop. Flora*, vi. pt. ii. 30 (1906).

³ Described as var. *macrocarpa*, Reynier, ex Albert and Jahandiez, *Plantes Vasc. du Var*, 185 (1908).

⁴ *Flora of Bristol*, 300 (1912), where these two trees are assigned to var. *splendens*, Druce, a name which cannot be retained, as var. *splendens*, Koch, *Dendrologie*, i. 159 (1869), much earlier in date, was applied to forms with pink and scarlet flowers. Mr. White identifies this large-fruited variety with *Oxyacanthus folio et fructu majore* from Oxfordshire of Merrett's *Pinax* (1667). Ray, *Syn.* 454 (1724), states that it was also found by Sherard in Northamptonshire.

⁵ The forms in southern Europe, northern Africa, and Asia, are apparently very distinct varieties or allied species; and require further study. Cf. Schneider, *Laubholzkunde*, i. 782 (1906).

⁶ Lees, in *Gard. Chron.* iii. 688 (1875), states that he counted over 300 annual rings in the stem of a tree about 1 ft. in diameter, that grew on the Malvern Hills.

⁷ Cf. Purchas, in *Journ. of Bot.* iii. 366 (1865), who points out that stems growing close together, which have commenced as independent trees in a hedge, are surrounded on all sides by bark, and are thus readily distinguishable from the peculiar stems described above. Lees, in *Gard. Chron.* iii. 688, figs. 142, 143 (1875), gives illustrations of trees with divided stems at Garnstone, Herefordshire, and at Upper Wyck, near Worcester.

CULTIVATION

The hawthorn, though it grows on almost all soils, succeeds best in a rich loam, and does well on strong clay. It is propagated by seeds, which as they lie over for a year, should be mixed with ordinary soil or sand in pits or heaps, where they are kept until the second year following, when they may be sown in February or March. Young plants should be removed from the seed bed at the end of the first year, and after standing in nursery lines for two years, be planted out. The varieties are budded or grafted on seedlings of the common species.

The most important use of the hawthorn is as a hedge plant. Though hedges appear to have been in use in England from the time of the Romans, they were not generally planted to enclose ordinary fields and meadows till about the end of the seventeenth century. Dr. Walker states¹ that the first hedges in Scotland were planted by Cromwell's soldiers in East Lothian and Perthshire.

Fine old hawthorns, with trunks of great girth and wide-spreading branches, exist in many parks throughout the country; and tall slender specimens are occasionally seen, drawn up in woods. We may mention a few, remarkable for age, though doubtless there are many quite as large that we have not heard of.

An immense old thorn, at Hethel in Norfolk, was first mentioned by Marsham, who, in a letter to the Bath Society about 1740, made its girth 9 ft. 1 in. at four feet from the ground. Grigor² states on the authority of H. Gurney, Esq., that the first Sir Thomas Beevor, who owned the place towards the end of the eighteenth century, put a railing round it, which was subsequently repaired, and the spreading limbs propped up by Mr. Gurney. Grigor says that the trunk measured 12 ft. 1 in. at one foot, and 14 ft. 3 in. at five feet, whilst the branches, though several large ones had been lost, spread over an area 31 yards round. Both the trunk and the large branches were then hollow, but the wood sound and hard. Sir Hugh Beevor in 1895 found it to be 13½ ft. at eighteen inches from the ground where the girth was least. Miss Eaton sent me a photograph in 1903 which showed branches supported by numerous props. Mr. Edwards, who photographed the tree in September 1912, tells me that the tree now consists of several stems formed by the splitting of the original trunk. The branches, which now measure 37 yards round, are sound and covered with leaves and fruit, though bearing many tufts of mistletoe. It is protected from cattle by a rail; and the branches are supported by numerous props (Plate No. 378).

In the park at Holwood House, Kent, Mr. A. D. Webster records³ a tree, which in 1888 was 14 ft. 6 in. in girth at three feet from the ground, above which it divided into six limbs, measuring at a yard from the fork, 4 ft. 2 in., 4 ft., 5 ft. 8 in., 2 ft. 8 in., 4 ft. 4 in., and 3 ft. 5 in. respectively. Its height was 42 ft., with a spread of branches 63 ft. in diameter. This tree was growing in strong clayey loam, and was in perfect health.

Mr. Edwin Lees described⁴ a remarkable hawthorn at Lenchford, in Worcester-

¹ *Essays on Nat. Hist.* 54 (1812).

² *Eastern Arboretum*, 282 (1841).

³ *Trans. Roy. Scot. Arbor. Soc.* xii. 311 (1889).

⁴ *Gard. Chron.* iii. 688, figs. 141, 146 (1875).

shire, which was 60 ft. high and 9 ft. in girth in 1875; and another in Downton Park, Herefordshire, which was over 50 ft. in height. He also mentioned others of considerable size in the same counties.

At Chideock Manor, Dorset, there is a remarkable thorn, about 25 ft. high and 6 ft. in girth, with wide-spreading branches and very pendulous branchlets, the diameter of the spread being about 40 ft.

In Lilford Park, Northamptonshire, where there are many fine thorns, I measured, in 1906, a tree no less than 51 ft. in height, but only 5 ft. in girth.

In the pleasure grounds of Hatfield House, Herts, there is a tree, which Henry measured in 1911 as 48 ft. by 3 ft. 8 in. In Ware Park, in the same county, Mr. H. Clinton Baker found in 1910 a tree 30 ft. by 12 ft. 5 in.

Within the walls of Rothesay Castle, in the island of Bute, there was growing in 1878 a remarkable thorn which Mr. James Kay described¹ as follows: "Though the tree was blown down thirty-nine years ago, it is still vigorous and healthy. The extreme length of the tree as it now lies, measuring from the original surface of the root, is 47 ft.; present vertical height, 28 ft.; circumference, three feet up, 6 ft. 8½ in.; four and a half feet up, 6 ft. 6½ in.; six feet up, 6 ft. 10 in." This tree dates from some time after 1685, when the Castle was burnt; and its age in 1878 did not probably exceed 190 years.

TIMBER

The wood of the hawthorn is white, often tinged with red; and is hard, heavy, and difficult to work, but with a fine grain and susceptible of a good polish. It is not much used, as it seldom can be obtained of sufficient size, and is usually spoiled by defects or knots. It is occasionally employed by turners, and was formerly found suitable for teeth of mill-wheels. Mr. W. G. Smith, who made many woodcuts for the *Gardeners' Chronicle*, states² that hawthorn wood is quite as good for engraving as ordinary boxwood, and possesses a far better colour. The best box, however, cuts a little smoother, as it has a somewhat closer grain. (H. J. E.)

CRATÆGUS OXYACANTHA, HAWTHORN, WHITETHORN

Cratægus oxyacantha,³ Linnæus, *Sp. Pl.* 477 (1753) (in part); Jacquin, *Fl. Austr.* iii. 50, t. 292, fig. 2 (1775); Loudon, *Arb. et Frut. Brit.* ii. 829 (1838); Willkomm, *Forstl. Flora*, 838 (1887); Mathieu, *Flore Forestière*, 163 (1897); Schneider, *Laubholzkunde*, i. 780 (1906).

Cratægus oxyacantha, var. *vulgaris*, De Candolle, *Prod.* ii. 628 (1825).

Cratægus oxyacantha, sub-species *oxyacanthoides*, Hooker, *Student's Flora*, 127 (1870).

Cratægus oxyacanthoides, Thuillier, *Fl. Envir. Paris*, 245 (1799).

Mespilus oxyacantha, Crantz, *Stirp. Austr.* i. 39 (1763); Allioni, *Fl. Pedem.* ii. 141 (1785); Willdenow, *Enum. Pl. Hort. Berol.* i. 524 (1809); Ascherson and Graebner, *Syn. Mitteleurop. Flora*, vi. 2, p. 25 (1906).

A shrub or small tree, similar to *C. monogyna* in bark and habit. Young branchlets glabrous. Leaves obovate or ovate, usually with three shallow lobes, the terminal

¹ *Trans. Roy. Scot. Arbor. Soc.* ix. 76 (1879).

² In *Gard. Chron.* iii. 689, note (1875), it is stated that figures 142 and 143 on p. 688 were engraved on hawthorn wood.

³ Cf. p. 1733, note 1.

one being often lobulate; margin irregularly serrate; upper surface dark green, shining, glabrous; lower surface pale green, glabrescent or slightly pubescent on the midrib; petiole slender, usually glabrous.

Flowers, variable in number in the corymb; peduncle, pedicel, and calyx-tube glabrous; sepals five, triangular, spreading, persistent on the fruit; petals five, white; stamens fifteen or twenty; styles usually two, rarely in some flowers one or three. Fruit ovoid or globose; stones two or three, rarely one, flattened on the inner surface, convex with deep longitudinal furrows on the outer surface.

This species is very distinct in appearance, and in England as a rule comes into flower a fortnight earlier than *C. monogyna*.

VARIETIES

This species is apparently much less variable in the wild state¹ than *C. monogyna*, but has given rise to some remarkable garden forms.

1. Var. *multiplex*, Loudon, *Arb. et Frut. Brit.* ii. 832 (1838).

Var. *flore pleno albo*, Rodigas, in *Flore des Serres*, xv. t. 1509, fig. 2 (1862).

Crataegus monogyna, var. *alba plena*, Rehder, in Bailey, *Cyc. Amer. Hort.* i. 396 (1900).

Flowers white, double, produced in great profusion and dying off a beautiful pink colour.² This variety, the origin of which is unknown, differs little from the type in other respects, having two-styled flowers with glabrous pedicels and calyx-tubes, and glabrescent three-lobed leaves.³

2. Var. *rosea*, Loudon, *Arb. et Frut. Brit.* ii. 832 (1838).

Petals pink, with white claws; in other respects similar to the type. This is a single pink variety, which is occasionally found wild.

3. Var. *punicea*, Loddiges, *Bot. Cat.* t. 1363 (1828); Loudon, *Arb. et Frut. Brit.* ii. 832 (1838).

Var. *flore punicea*, Rodigas, in *Flore des Serres*, xv. t. 1509, fig. 2 (1862).

Petals larger than in var. *rosea*, dark red and without white on the claws. This is the handsome single crimson variety, which was first raised in Scotland, and afterwards propagated by Loddiges, who budded it upon the common whitethorn.

4. Var. *Gumpperii bicolor*, Van Houtte, in *Fl. des Serres*, xvi. t. 1651 (1866).

Flowers single; petals white, edged with a pink margin. This originated at Stuttgart about 1860, and is probably of hybrid origin, as the flowers, while having a glabrous calyx-tube, bear only one style.

¹ Var. *integrifolia*, Wallroth, *Sched. Crit.* 219 (1822), a name given to shrubs having obovate leaves with three very shallow lobes, can scarcely be retained as a variety, as such leaves are common in the typical form of the species. Similarly, var. *auriculata*, Dippel, *Laubholzkunde*, iii. 457 (1893), said to have persistent large stipules, is doubtfully distinct, as the retention of the stipules depends on the vigour of the branches, and is common enough in the ordinary form of the species.

² Späth, *Cat.* No. 148, p. 91 (1911-1912), advertises var. *candido-plena*, a new variety with double flowers that remain pure white.

³ M'Nab, in *Trans. Bot. Soc. Edin.* vi. 284 (1860) gives an account of a tree with double white flowers in the Edinburgh Botanic Garden, which retained most of its leaves during the preceding winter, some remaining green till 12th May 1859. It then flowered and produced normal single flowers.

5. Var. *punicea flore pleno*, Loudon, *Arb. et Frut. Brit.* ii. 832 (1838), and *Trees and Shrubs*, 377 (1842).

Var. *flore rubro pleno*, Rodigas, in *Flore des Serres*, xv. t. 1509, fig. 3 (1862).

Flowers double, pink. This is said by Loudon to have been imported about 1832 by Masters of Canterbury, and to bear flowers not so brilliant in colour as the single crimson variety. It differs from typical *C. oxyacantha* in the pubescent leaves and calyx-tube, and is possibly a hybrid.

6. Var. *coccinea flore pleno*, Paul, in *Florist and Pomologist*, vi. 117 (1867).

Var. *floribus coccineis plenis*, Lemaire, in *Illust. Hort.* t. 536 (1867).

Crataegus monogyna, var. *Pauli*, Rehder, in Bailey, *Cyc. Amer. Hort.* i. 396 (1900).

Flowers double, deep scarlet. This originated about 1858 in Mr. Christopher Boyd's garden near Waltham Cross, as a single branch on a tree of the double pink variety, which was about 25 years old and nearly 30 feet high. This branch was observed to bear flowers of a deep scarlet colour, year after year, whilst all the other branches on the tree continued to produce flowers of the original pink colour. It was propagated by Messrs. Paul, who showed it at the International Horticultural Exhibition in 1866, under the name "Paul's New Double Scarlet Hawthorn," by which it is still known.

7. Var. *Gireoudi*, Späth, *Cat.* No. 104, p. 89 (1899-1900).

Young shoots pink, bearing new leaves, which are mottled with white and pink. This is represented at Kew by a spreading bush about 6 ft. high, received from Späth in 1899.

8. Var. *aurea*, Loudon, *Arb. et Frut. Brit.* ii. 831 (1838).

Var. *xanthocarpa*, Lange, *Rev. Spec. Crategi*, 71 (1897).

Fruits yellow. This variety, which has been in cultivation over a hundred years, bears freely and is very showy.

9. Var. *leucocarpa*, Loudon, *Arb. et Frut. Brit.* ii. 831 (1838).

Fruit white. Plot, *Nat. Hist. Oxfordshire*, 158 (1705), mentions¹ a tree with white haws in a hedge near Bampton; but it does not appear to have been propagated, and this variety was unknown to Loudon.

The following is either a geographical form or a closely allied species:—

10. *Crataegus polyacantha*, Jan, *Elench. Hort. Parm.* 8 (1826).

Crataegus oxyacantha, sub-species *monogyna*, var. *polyacantha*, Nicholson, *Kew Hand-list Trees*, 343 (1902).

Leaves small, about $\frac{3}{4}$ in. long and broad, tri-lobed. Young branchlets, petioles, peduncles, pedicels, and calyx-tubes densely covered with white woolly pubescence. This is a small shrub, native of Sicily and Calabria. It is in cultivation at Kew.

¹ Cf. Ray, *Syn. Meth.* 453 (1724). A form with fruit larger than usual, occurring in the south of France and Switzerland, has been distinguished as var. *macrocarpa*, Le Grand, *Stat. Bot. Forez*, 119 (1873), ex Rouy and Camus, *Flore de France*, vii. 4 (1901), identical with *C. macrocarpa*, Hegetschweiler, *Fl. Schweiz*, 464 (1840).

DISTRIBUTION

C. oxyacantha is widely spread throughout Europe, occupying nearly the same territory as *C. monogyna*, but being much less common. Willkomm believes it to be more prevalent in the north than in the south of Europe. In France, according to Mathieu, it does not grow in the region of the olive; while elsewhere it is comparatively rare, and scarcely ever attains the dimensions of a tree. I saw it in 1912 in the interior of the Forest of Orleans, forming a large shrub, and growing in shade, as it does in the Gamlingay Wood, near Cambridge.

It is doubtfully wild in Scotland and Ireland; and is apparently indigenous only in the midland, eastern, and south-eastern counties of England. It is recorded for many stations in Kent, Surrey, Middlesex, Oxfordshire, and Cambridgeshire. It is not mentioned as a native plant for the northern or western counties in any of the published floras in which the two species are distinguished. In England, as far as we know, it is usually a shrub; and we have no records of any large trees of this species.

(A. H.)

SALIX

Salix, Linnæus, *Sp. Pl.* 1015 (1753); Forbes, *Salic. Woburn.*, 1-294 (1829); Andersson, *Monog. Salic.* 1-180 (1863), and in De Candolle, *Prod.* xvi. 2, p. 191 (1868); Bentham et Hooker, *Gen. Pl.* iii. 411 (1880); Buchanan White, in *Journ. Linn. Soc. (Bot.)* xxvii. 333-457 (1890); Camus, *Saules d'Europe*, 9-40 (1904); Schneider, *Laubholzkunde*, i. 23 (1904).

TREES or shrubs, with scaly bark, and slender terete branchlets, which are often easily separated at the joints. True terminal buds are not developed,¹ the top of the branchlet dying off in summer, and leaving a minute scar close to the uppermost axillary bud, which prolongs the branch in the following season; buds apparently covered by one scale, which is composed of two scale-like leaves fused together, as indicated by their keeled margins. Leaves deciduous,² alternate, rarely sub-opposite, simple, variable in shape, penni-nerved, stalked; stipules oblique, serrate, either small and early deciduous, or large, leafy, and persistent, often conspicuous on barren vigorous young branches. On branches from which the leaves have fallen the leaf-scars are crescentic and 3-dotted, and accompanied on each side by a minute stipular scar.

Flowers, appearing in some species before the leaves, in others after the leaves, dioecious, in catkins, each of which terminates a short shoot, and bears numerous flowers on a slender axis; each flower, with one or two honey-glands, placed front and back at its base, and subtended by a scale, which is usually entire in margin. Staminate flowers, with two or three to twelve stamens, inserted on the base of the scale, with slender filaments, free or more or less connate, and two-celled anthers opening longitudinally. Pistillate flowers; ovary free, stalked or sessile, one-celled, with four to eight ovules on each of the two placentæ; crowned by a style, which is often extremely short or obsolete, with two stigmas, which are either entire or bifid. Fruit, an acuminate capsule, separating when ripe into two recurved valves. Seeds minute, narrowed at the ends, dark brown or nearly black, furnished with long silky hairs.

About 160 species of *Salix* are known, distributed from the Arctic regions southwards to the Andes of Chile in the New World, and to South Africa, Madagascar, Himalayas, Burma, Malay Peninsula, Java, and Sumatra in the Old World. Most of the species are shrubs or small trees; and in the following account we have only dealt with the few species in cultivation which attain a large size, including *S. Caprea*, on account of its interest to foresters. These may be distinguished as follows:—

¹ However, in § *Chamaelia*, Dumortier, in *Bijdr. Naturk. Wetensch.* i. 56 (1826), which includes Arctic and Alpine under-shrubs, like *S. reticulata*, Linnæus, there are true terminal buds, giving rise to catkins in the following year. The species of this section in some respects are intermediate between *Salix* and *Populus*.

² *S. Bonplandiana*, H. B. K., a native of Mexico, is said to have persistent leaves. Cf. Dode, in *Bull. Soc. Dend. France*, 1909, p. 151.

I. *Leaves ovate or oval.*

1. *Salix Caprea*, Linnæus. See p. 1745.
Leaves oval, elliptic or ovate, 2 to 3 in. long, $1\frac{1}{2}$ in. broad, irregularly crenate; lower surface bluish grey, tomentose.
2. *Salix pentandra*, Linnæus. See p. 1747.
Leaves fragrant when bruised, ovate to ovate-lanceolate, about 3 in. long and $1\frac{1}{4}$ in. broad, abruptly acuminate, minutely serrate, glabrous on both surfaces.

II. *Leaves lanceolate.*

A. *Mature leaves not ciliate in margin, green above, green or glaucous beneath.*

* *Leaves broadly lanceolate, with coarse serrations, which are not close together.*

3. *Salix speciosa*, Host. See p. 1756.
Leaves, broader than in *S. fragilis*, 4 to 6 in. long, $1\frac{1}{4}$ to $1\frac{1}{2}$ in. broad, glabrous except for a few scattered hairs on the slightly glaucous under surface. Young branchlets pubescent or glabrescent.
4. *Salix fragilis*, Linnæus. See p. 1754.
Leaves about 4 in. long, $\frac{3}{4}$ to 1 in. broad, glabrous except for a few scattered hairs on the glaucous under surface. Young branchlets pubescent.
- ** *Leaves narrowly lanceolate, with fine close serrations.*
- (a) *Young branchlets crimson, glabrous; clay-coloured in the second year.*
5. *Salix decipiens*, Hoffmann. See p. 1755.
Leaves, 2 to 3 in. long, $\frac{1}{2}$ to $\frac{3}{4}$ in. broad, similar to those of *S. fragilis*, but smaller and green beneath.
- (b) *Young branchlets green, becoming a brilliant yellow in winter and the following year.*
6. *Salix vitellina*, Linnæus. See p. 1768.
Leaves, 2 to $2\frac{1}{2}$ in. long, $\frac{3}{8}$ to $\frac{1}{2}$ in. broad, green above, glaucous beneath; with scattered appressed hairs, sparse above, more abundant beneath. See No. 11A.
- (c) *Young branchlets green, becoming olive green or brownish grey in the second year.*
7. *Salix babylonica*, Linnæus. See p. 1749.
Leaves, $2\frac{1}{2}$ to 4 in. long, $\frac{1}{2}$ to $\frac{3}{4}$ in. wide, tapering to a long slender filamentous apex; when mature, glabrous and glaucous beneath. Branchlets pendulous, always injured in England by spring frost.
8. *Salix elegantissima*, Koch. See p. 1751.
Leaves similar to those of *S. babylonica*, but broader, and more coriaceous, and less glaucous on the lower surface. Branchlets pendulous, uninjured in England by spring frost.
9. *Salix Salamonii*, Carrière. See p. 1750.
Leaves similar to those of *S. babylonica*, but with scattered appressed long hairs on both surfaces. Branches ascending, with pendulous branchlets, which are not injured by frost in England.

B. *Mature leaves ciliate in margin, covered more or less on both surfaces with appressed silky hairs.*

10. *Salix alba*, Linnæus. See p. 1759.
Leaves 2 to $2\frac{1}{2}$ in. long, $\frac{3}{8}$ to $\frac{1}{2}$ in. wide, covered with silky pubescence, densest on the whitish under surface. A wide-spreading male or female tree, with pendulous or spreading branchlets; ovary and fruit sessile.
11. *Salix cœrulea*, Smith. See p. 1763.
Leaves similar to those of *S. alba*, but thinner in texture, more translucent, less pubescent, the lower surface being bluish grey and not white. A pyramidal female tree, with ascending branches and erect terminal branchlets; ovary and fruit shortly pedicellate.
- 11A. *Salix vitellina*, Linnæus. See No. 6.
Leaves occasionally ciliate till autumn, with both surfaces more or less appressed-pubescent. This is readily distinguishable by the bright yellow branchlets in winter. (A. H.)

SALIX CAPREA, SALLOW, GOAT WILLOW

Salix Caprea, Linnæus, *Sp. Pl.* 1020 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1561 (1838); Anderson, *Monog. Salic.* 75 (1863), and in De Candolle, *Prod.* xvi. 2, p. 222 (1868); Willkomm, *Forstliche Flora*, 487 (1887); Buchanan White, in *Journ. Linn. Soc. (Bot.)* xxvii. 385 (1890); Mathieu, *Flore Forestière*, 465 (1897); Camus, *Monog. des Saules*, 202 (1904).

A small tree, occasionally attaining 40 ft. in height. Bark smooth and greenish at first, ultimately ridged and fissured. Young branchlets, with a minute tomentum, becoming more or less glabrescent in the second year. Buds ovoid-conic, minutely tomentose or glabrous. Leaves oval or elliptic, about 2 to 3 in. long and $1\frac{1}{4}$ to $1\frac{3}{4}$ in. broad; apex acuminate, with the point usually directed to one side; base broadly cuneate, often unequal; upper surface light green, slightly shining, glabrous except for slight pubescence on the midrib and nerves; lower surface bluish grey, reticulate, covered with a whitish tomentum; margin irregularly crenulate, undulate, or rarely almost entire; petiole more or less tomentose; stipules oblique, reniform or half cordate, dentate.

Flowers appearing early, before the leaves; catkins sub-sessile, with scale-like leaves at the base, very silky, on account of the spatulate scales, brown or blackish towards the apex, and pubescent with long hairs. Staminate flowers; stamens two, free, glabrous. Pistillate flowers; ovary tomentose on a long pedicel, much surpassing the gland in length; style short, with two stigmas, which are usually emarginate or rarely bifid. Capsules on long pedicels, narrow, elongated, covered with greyish silky hairs.

VARIETIES AND HYBRIDS

I. *S. Caprea* is variable in the wild state. The catkins, which are usually sessile or sub-sessile, are occasionally provided with leafy peduncles. The branchlets and

buds, which are normally glabrous, are occasionally pubescent. Varieties, differing in the leaves, have been distinguished:—

1. Var. *orbiculata*, Kerner, in *Verh. Zool. Bot. Ges. Wien*, x. 248 (1860). This is the typical form of the species, in which the leaves are broadly oval, slightly cordate at the base, and with the apex bent to one side.

2. Var. *elliptica*, Kerner, *loc. cit.* Leaves elliptic and tapering at both ends. This is said to be the more common form in northern and mountainous districts.

3. Var. *sphaelata*, Wahlenberg, *Fl. Carpat.* 319 (1814).

Var. *alpina*, Gaudin, *Fl. Helv.* vi. 240 (1830).

Salix sphaelata, Smith, *Brit. Bot.* iii. 1066 (1805), *Eng. Bot.* t. 2333 (1812), and *Eng. Flora*, iv. 224 (1828); Loudon, *Arb. et Frut. Brit.* iii. 1563 (1838).

Leaves small, tomentose on both surfaces. This is an alpine form, which occurs in the Highlands of Scotland.

4. Var. *pendula*, Petzold and Kirchner, *Arb. Musc.* 576 (1864).

Salix Kilmarnocki, Nicholson, *Kew Hand-list Trees*, ii. 213 (1896).

Pendulous in habit, usually grafted on a stock about 4 ft. high, and forming a weeping shrub, which is known as the Kilmarnock Willow. This was discovered¹ in 1840 on the banks of the river Ayr, and was propagated by Lang, nurseryman at Kilmarnock. The original tree died of old age about 1884.

II. *S. Caprea* is closely related to both *S. cinerea* and *S. aurita*, which are bushy species. Intermediate forms, which are often difficult to discriminate, have been referred to the following hybrids:—

5. *Salix Reichardtii*, Kerner, in *Verh. Zool. Bot. Ges. Wien*, x. 249 (1860).

This hybrid between *S. Caprea* and *S. cinerea* is rare, only a few examples from Perthshire, Fifeshire, Worcestershire, and Kent being recorded by Buchanan White. Both parents are common; but they do not flower at the same time, and are rarely met with together, as *S. Caprea* is most frequent in woods, whilst *S. cinerea* grows chiefly on river banks.

6. *Salix capreola*, Kerner, *ex* Andersson in De Candolle, *Prod.* xvi. 2, p. 223 (1868).

This hybrid between *S. Caprea* and *S. aurita* is also rare, as the periods of flowering of the two species are not identical. There are pistillate specimens at Kew from Derbyshire and Surrey; and Buchanan White mentions other localities in Perth, Worcestershire, and Somerset.

DISTRIBUTION

The common sallow or goat willow is widely distributed, occurring in Europe, the Caucasus, Siberia, Amurland, Manchuria, and Korea. In Europe it exists in every country, extending as far north as Iceland and Lapland, and as far south as southern Spain, Italy, and Greece. It is most commonly found in woods on the plains and lower hilly regions, but reaches 3300 feet elevation in Norway and 4500 feet in the Carpathians. It grows on almost all soils, on those which are moist, marshy, or even peaty, as well as in dry rocky or stony ground. It attains its largest

¹ Cf. Rev. Dr. Landsborough, in *Ann. Kilmarnock Glenfield Ramblers' Soc.*, 1893-1894, p. 20.

size in East Prussia, Lithuania, and the Russian Baltic provinces, where, according to Willkomm, it is often a fine tree, 30 to 50 ft. in height. It is naturally regenerated by seed, and when cut down produces vigorous coppice shoots. It can be propagated by cuttings and by sets. (A. H.)

The sallow is common in all parts of the British Isles, growing in woods and copses, and in waste places, but rarely attains a large size. It is often 20 to 30 ft. in height, and sometimes produces a trunk a foot in diameter, but seems to be a short-lived tree. The finest which I have seen is growing by the roadside two miles below the lodge at Guisachan, Inverness-shire, and measured in 1910 about 50 ft. by 6 feet. It is the only willow which commonly grows from seed, and in some of my plantations is so abundant that it may be called a forest weed.

It is usually looked upon by foresters as a useless tree; but it has proved valuable in fixing loose and shifting soil on river embankments and similar situations, as it is so readily propagated by cuttings. Mitchell¹ says: "It is the best underwood that we have. It makes good fences, and sheep hurdles made of it will always last a year or two longer than those made of hazel; and no soil or situation comes wrong to it, wet or dry." In Sussex it is used for making truck-baskets and handles of rakes, and also for fencing, as it is light and tough, and splits easily.²

Though the wood is of a nice pinkish colour, it is too small, as a rule, to have any recognised value. In northern Russia (as well as formerly in Scotland) the bark, which contains 7 per cent of tannin, is sometimes used for tanning leather.

(H. J. E.)

SALIX PENTANDRA, BAY WILLOW

Salix pentandra, Linnæus, *Sp. Pl.* 1016 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1503 (1838); Andersson, *Monog. Salic.* 35 (1863), and in De Candolle, *Prod.* xvi. 2, p. 206 (1868); Willkomm, *Forstliche Flora*, 475 (1887); Buchanan White, in *Journ. Linn. Soc. (Bot.)* xxvii. 359 (1890); Mathieu, *Flora Forestière*, 449 (1897); Camus, *Monog. des Saules*, 84 (1904).
Salix fragrans, Salisbury, *Prod.* 393 (1796).

A tree, occasionally attaining 30 to 40 ft. in height, but often shrubby in the wild state. Young branchlets glabrous, dark brown, shining as if varnished. Buds ovoid, pointed, dark brown, shining, viscid. Leaves fragrant when bruised, ovate, ovate-oblong, or ovate-lanceolate, averaging 3 in. long and 1¼ in. broad, glutinous when young, coriaceous when fully grown; rounded at the base, abruptly acuminate at the apex; glabrous on both surfaces, dark green and very shining above, pale and dull beneath; margin closely and finely serrate, the serrations tipped with dark red glands; petiole, about ½ inch long, glabrous, with two or three glands near its junction with the blade, and expanded at its origin from the branchlet, where there are one or two glands probably representing stipules.

Catkins, appearing with or after the leaves, terminating a branchlet which bears four or five leaves, spreading; axis pubescent. Staminate catkins 1½ in. long, densely

¹ *Dendrologia*, 56 (1827). Cf. Smith, *Eng. Flora*, iv. 227 (1828), who states that the wood and branches make the best hurdles, being tough, flexible, and durable. The wood was also used for the cutting-boards of shoemakers.

² *Gard. Chron.* xlv. 19 (1909).

crowded with flowers; scales pubescent at the base; stamens usually five, rarely four to ten, unequal in length, with long hairs on the base of the filaments; and with two glands, the one beneath the scale often three-lobed, the other quadrate or broadly crescentic. Pistillate catkins, $1\frac{1}{2}$ in. long; scales about half as long as the ovary, fringed with long hairs; ovary stalked, glabrous, about $\frac{1}{5}$ in. long, narrowly conic-subulate, with a short style, dividing into two arms, each of which is bifid; glands¹ two, one minute beneath the scale, the other quadrate and half the length of the pedicel. Capsules, $\frac{1}{4}$ inch long, on distinct pedicels, glabrous, narrow and elongated.

This species varies in the size and shape of the leaf, broad-leaved and narrow-leaved forms being distinguished by Andersson as vars. *latifolia* and *angustifolia*; but intermediate forms are common. Buchanan White states that in Britain, *S. pentandra* is a bushy shrub in the wild state, but that when cultivated, it becomes a tree with broader and larger leaves than those of the wild plant.

The bay willow is a very distinct-looking species, on account of its broad glabrous shining leaves, which resemble those of a *Prunus*; but is readily recognised to be a willow by its buds with a single scale. The flowers are fragrant, with an odour similar to that of the bay or true laurel (*Laurus nobilis*); and the leaves exhale the same fragrance, especially when bruised.

The following hybrids have *S. pentandra* as one of the parents:—

1. *Salix Meyeriana*, Rostkovius, ex Willkomm, *Berlin Baumz.* 427 (1811).

Salix cuspidata, Schultz, *Prod. Fl. Starg. Suppl.* 47 (1819); Borrer, in Smith and Sowerby, *Eng. Bot. Suppl.* v. tt. 2961-2962 (1863); Buchanan White, in *Journ. Linn. Soc. (Bot.)* xxvii. 360 (1890).

Salix tinctoria, Smith, in Rees, *Cycl.* xxxi. No. 13 (1815).

Leaves similar to those of *S. pentandra*, but narrower and more cuspidate at the apex. Pistillate catkins more slender and more tapering, and bearing narrower and more cylindrical capsules with longer pedicels. Stamens usually four.

This hybrid, of which the parents are supposed to be *S. pentandra* and *S. fragilis*, is said to be somewhat common on the Continent; but in England is rare in the wild state. It is recorded as a pistillate plant in Shropshire by Buchanan White. There are also specimens in the Kew Herbarium collected in 1895 on Wybunbury Bog in Cheshire by Linton. Dr. Moss adds to this distribution Herefordshire and Westmoreland in England, and Co. Mayo and Co. Kildare in Ireland; and tells me that it is occasionally planted in osier beds in Cambridgeshire and Suffolk. There is a fine tree in the Glasnevin Botanic Garden, about 40 feet high by 4 ft. in girth in 1912. Sir F. Moore states that it was obtained from Smith of Worcester, as the Purple King Willow, a name given to it on account of its purplish shoots. He adds that it is a quick grower, flowering early in spring, with beautiful large staminate catkins, the twigs being useful for house decoration.

2. *Salix hexandra*, Ehrhart, *Beit.* vii. 138 (1791); Buchanan White in *Journ. Linn. Soc. (Bot.)* xxvii. 361 (1890).

Salix Ehrhartiana, Smith, in Rees, *Cycl.* xxxi. No. 10 (1815).

Leaves lanceolate, long acuminate at the apex, silky pubescent at first, but

¹ Fraser, *Proc. Roy. Hort. Soc.* xxxv. p. cxv (1909), showed specimens of flowers of *S. pentandra*, with proliferation of the posterior gland, giving rise to two or three additional pistils.

soon becoming glabrous; dark green and very shining on the upper surface; minutely glandular-serrate; petiole slender, nearly $\frac{1}{2}$ in. long. Stamens four to six.

This hybrid, the parents of which are supposed to be *S. pentandra* and *S. alba*, is known on the Continent in the staminate form. Buchanan White refers to it two specimens: one, a shrub with pistillate catkins, growing near Duddingston, Edinburgh, and the other, a barren specimen from a bush at Restennet, near Forfar. It has recently been found¹ in the Lake District in Cumberland and Westmoreland.

S. pentandra is a native of nearly the whole of Europe—except the extreme south—the Caucasus, and northern Asia, as far east as Kamtschatka and Amurland, and apparently extending to the province of Yunnan, in China. It grows mainly on river banks, and in marshy places, ascending in peat mosses in the Alps to 4000 ft. elevation. It grows in similar situations in Britain² from Argyle and Moray southwards to Derbyshire, ascending in Northumberland³ to 1300 ft. In Ireland,⁴ it is frequent and native in the north, becoming less common southwards, till in Kerry and Cork it appears only as an introduction. (A. H.)

The bay willow makes a handsome tree, with very distinct foliage, but is rather slow in growth. The finest specimens we have seen are:—one at Kew, on the lawn near the Palm House, which measured, in 1907, 58 ft. by 9 ft. 8 in. at eighteen inches above the ground, its trunk forking at three feet. Another at Woburn was 50 ft. by 5 ft. in 1908, with a short bole. A handsome tree at Beauport, Sussex, measured in 1911 about 35 ft. by 6 ft., with a bole 6 ft. long, another near the keeper's lodge not being quite so large. (H. J. E.)

SALIX BABYLONICA, WEEPING WILLOW

Salix babylonica, Linnæus, *Sp. Pl.* 1017 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1507, and iv. 2588 (1838); Andersson, *Monog. Salic.* 50 (1863), and in De Candolle, *Prod.* xvi. 2, p. 212 (1868); Willkomm, *Forstliche Flora*, 471 (1887); Mathieu, *Flore Forestière*, 453 (1897); Burkill, in *Journ. Linn. Soc. (Bot.)* xxvi. 526 (1899); Camus, *Monog. des Saules*, 65 (1904).

Salix pendula, Moench, *Meth.* 336 (1794).

Salix propendens, Seringe, *Saules de la Suisse*, 73 (1815).

Salix Napoleonis, Schultz, *Arch. Fl.* 239 (1856).

A tree, attaining 30 to 40 ft. in height, with rough ridged bark, and usually with a short trunk, and wide-spreading branches, the ultimate branchlets being very long and pendulous. Branchlets slender, glabrous except near the nodes. Leaves linear-lanceolate, about $2\frac{1}{2}$ to $3\frac{1}{2}$ in. long, and $\frac{1}{2}$ to $\frac{3}{4}$ in. broad, tapering at the apex into a long slender acuminate thread-like point, cuneate at the base, slightly pubescent when young, perfectly glabrous when fully grown, bright green and shining above, pale and covered with a glaucous bloom beneath; margin finely serrate, the serrations often ending in minute sharp incurved points; petiole $\frac{1}{6}$ in. long, without glands, glabrous or slightly pubescent; stipules early deciduous.

¹ *Journ. Bot.* xxviii. 229 (1900).

² Hooker, *Student's Flora*, 355 (1878).

³ Baker and Tate, *Fl. Northumberland and Durham*, 248 (1868), state: "Frequent in damp woods and by stream sides, ascending in Coquetdale to Harbottle, in Allendale to 450 yards, and in Teesdale to the junction of the Whey Sike with Harwood Beck."

⁴ Praeger, in *Proc. Roy. Irish Acad.* vii. 282 (1901).

Only female trees are known in cultivation. Catkins terminating branchlets with one, two, or three leaves, very slender, green, curved, about 1 in. long; axis pubescent; scale about $\frac{2}{3}$ rds the length of the ovary, pilose at the base, ciliate, ovate-acuminate; ovary sub-sessile, about $\frac{1}{10}$ in. long, ovate, glabrous, ending in a very short style, which is divided into two stigmatic arms, each of which is bilobed; gland posterior, quadrate, emarginate or bilobed.

VARIETY AND HYBRIDS

I. The following variety is known in cultivation:—

1. Var. *annularis*, Ascherson, *Fl. Brandenburg*, 630 (1864).

Var. *crispa*, Loudon, *Arb. et Frut. Brit.* iii. 1514 (1838).

Salix annularis, Forbes, *Sal. Woburn*. 41, t. 21 (1829).

Leaves folded and rolled up, so as to form a ring or spiral, otherwise as in the type. This remarkable variety, which is called the ring-leaved willow, is of unknown origin;¹ but undoubtedly is a sport of *S. babylonica*, and like it is a female tree. W. Masters of Canterbury stated² that his father gave fifteen shillings for a plant 6 in. high, but had no clue as to where or how the variety had originated. He mentions an instance of a ring-leaved willow, which after being planted twenty years, produced a single branch with leaves of the ordinary form, which continued to be borne for years afterwards on the same branch and its ramifications.

There is a fine specimen on the lawn near the Palm House at Kew, which was, in 1912, 56 ft. high with a trunk 11 ft. in girth at three and a half feet from the ground, above which it divides into two stems. Lord Kesteven measured in 1906 a fine specimen, 57 ft. by 7 ft., on a farm near Caythorpe, Grantham.

II. The following trees, often considered to be varieties of *S. babylonica*, are probably hybrids:—

2. *Salix Salamonii*, Carrière, in *Rev. Hort.* xl. 463 (1869) and xlix. 444 (1877).

Salix babylonica Salamonii, Simon-Louis, *Cat.* 1869, p. 85; Carrière, in *Rev. Hort.* xlv. 115 (1872).

A tree with a tall straight stem, and ascending branches, forming when young a pyramidal crown; ultimate branchlets pendulous, but not so long as in *S. babylonica*. Young branchlets pubescent near the nodes, becoming glabrous. Leaves similar in shape, size, and colour to those of *S. babylonica*, but pubescent with scattered appressed long hairs on both surfaces. Only pistillate trees are known; catkins similar to those of *S. babylonica*, but with the axis more pubescent and the scales furnished with long cilia.

This remarkable tree, which is supposed to be a cross³ between *S. babylonica* and *S. alba*, is very distinct in habit, forming when young a handsome pyramidal tree, which grows with astonishing vigour and is not injured in our climate by frost

¹ Dole, in *Bull. Soc. Dend. France*, 1909, p. 153, believes that this may have originated from a witches' broom; and states that he obtained a similar sport as a cutting, which was taken from an abnormal growth on a *Salix alba*.

² *Gard. Chron.* 1855, p. 726. Cf. Darwin, *Animals and Plants under Domestication*, i. 408 (1890).

³ Schneider, *Laubholzkunde*, i. 36, note (1904), supposes it to be identical with *S. sepulcralis*, Simonkai, in *Termes. Füz.* xii. 157 (1890), said to have been found in Hungary. Camus, *Monog. Saules*, 235 (1904), identifies with the last-named, *S. alba*, var. *tristis*, Trautvetter, *Fl. Alt.* iv. 255 (1833), described from an Altai specimen.

in spring, as is almost invariably the case with the common weeping willow. Though not so pendulous in habit as the latter, it has graceful drooping branchlets.

This tree originated on the estate of Baron de Salamon, near Manosque (Basses Alpes) some time before 1869, when it was put on the market by Simon-Louis of Metz. Carrière recommended this tree, on account of its vigour,¹ for the production of timber; and stated that it grew on all soils, even on dry soils and on limestone, where the weeping willow refused to grow, or remained stunted and yellow. *S. Salamonii* comes nearly as early into leaf and retains its foliage almost as late in the season as *S. babylonica*.

There are several old trees of *S. Salamonii* on the borders of the lake at Kew. The exact age of these is unknown; but they much surpass in size the true weeping willows beside them.² At Casewick, where Lord Kesteven has planted *S. Salamonii* as a park tree, it thrives well, and has attained 35 ft. in height at eighteen years old.

3. *Salix pendulina*, Wender, in *Schrift. Natf. Ges. Marburg*, ii. 235 (1831).

Salix blanda, Andersson, *Monog. Salic.* 50 (1863), and in De Candolle, *Prod.* xvi. 2, p. 212 (1868); Camus, *Monog. Saules*, 232 (1904).

Salix elegantissima, Koch, in *Wochschr. Ver. Bef. Gartb.* xiv. 380 (1871), and *Dendrologie*, ii. pt. i. 505 (1872).

Under these names are possibly included three slightly different hybrids of the same parentage, *S. babylonica* and *S. fragilis*. They are wide-spreading trees, with long and pendulous branchlets, differing only slightly in habit from *S. babylonica*, but much more hardy than this species, and on that account often cultivated in Germany where the true weeping willow is killed by severe frost. I have not been able to study the three forms; but a tree at Kew, labelled *S. elegantissima*,³ obtained from Dieck in 1889, has leaves more coriaceous and slightly broader than those of *S. babylonica*; both surfaces glabrous, slightly glaucous beneath. Catkins occasionally androgynous,⁴ usually only pistillate, shorter than in *S. babylonica*; axis pubescent; ovary shortly pedicellate, about $\frac{1}{10}$ in. long, slightly pubescent at the base, with two stilar arms, each arm bilobed; scale two-thirds the length of the ovary, very pilose; glands irregular, usually two,—one narrowly oblong between the scale and the ovary,—the other, posterior, nearly quadrate, and occasionally bilobed.

Koch states that this tree, which on the Continent is often sold in commerce as *S. Sieboldii*, is fast in growth, with very long branchlets, almost reaching to the ground. There is a thriving specimen at Glasnevin, about 25 ft. high, which is labelled *S. blanda*. In the Botanic Garden at Leyden there is a handsome tree, about 40 ft. by 3 ft. in 1912, which is labelled *S. Petzoldii pendula*.⁵

¹ In *Garden and Forest*, x. 497 (1897), it is said to be the fastest-growing willow in California, where, at the Chico Forestry Station, stems cut back in February 1896 to 2 ft. from the ground, were 31 to 32 ft. high in August 1897.

² A vigorous young tree on the bank of the Cam, Trinity College, Cambridge, was 35 ft. high by 4 feet in girth in 1912. Its pyramidal crown with ascending upper branches contrasts much with the older but lower adjacent weeping willows, which have broad flattened crowns and spreading branches.

³ Both *S. blanda* and *S. elegantissima* were described as having perfectly glabrous ovaries; but notwithstanding this, the Kew tree, received from Dieck, is probably *S. elegantissima*. Ascherson and Graebner, *Syn. Mitteleurop. Flora*, iv. 73 (1908), correctly describe *S. elegantissima* as having a pubescent ovary; and on that account doubt its being a hybrid between *S. babylonica* and *S. fragilis*. Following Koch, they believe that it was introduced from Japan by Siebold; and if this is the case, *S. fragilis* could scarcely have been one of the parents.

⁴ As Camus points out, androgynous catkins are common in the hybrids *S. blanda* and *S. sepulcralis* which he describes.

⁵ Cf. Lauche, *Haupt-Katalog Muskauer Baumschulen*, 1905, p. 32.

DISTRIBUTION

S. babylonica was the name given by Linnæus¹ to the common weeping willow cultivated in Europe, which he erroneously supposed to have been identical with the trees growing by the rivers of Babylon, which are mentioned in Psalm cxxxvii. 2. The latter are, without doubt,² a species of poplar, *Populus euphratica*. The original home of the weeping willow appears to be central and southern China, where it is commonly found on the banks of rivers and canals, as well as in gardens. Fortune³ observed this tree, identical in all respects with that cultivated in Europe, in the neighbourhood of Shanghai and Canton, and also near Ningpo, where it is sometimes planted around graves.

The typical form of the species, that long cultivated in Europe and prevalent in central and southern China, is always a female tree, with long pendulous branchlets. In the neighbourhood of Peking⁴ a variety is more common, which may be distinguished as var. *pekinensis*, Henry. This is an upright tree, with ascending branches, which is known in both sexes. The foliage is practically identical⁵ with that of the typical form; but there is a marked difference, not only in habit, but in the pistillate catkins, which are extremely short and compact in this variety, not exceeding $\frac{1}{2}$ in. in length, often on leafless peduncles; ovaries wider, ending in two short undivided stigmas; scales nearly glabrous. Var. *pekinensis* is represented at Kew by a tree, about 15 ft. high, originally from Peking, which was obtained from the Arnold Arboretum in 1905. This tree, like the common weeping willow, is injured regularly by spring frosts.

From China the weeping willow was early introduced into Japan, where it is now cultivated and naturalised in many places.⁶ During the Middle Ages it was probably carried westward to Persia, Asia Minor, and Turkey; and it is now also "cultivated in Baluchistan, Northern India, and the Punjab, and less commonly in the plains farther east, and also in Kurdistan."⁷

The first mention of the tree in European literature is by Petiver,⁸ who refers to a specimen gathered in China by Cunningham in 1701, but which cannot now be found in the British Museum. The first mention of the tree in the Levant was by Tournefort⁹ in 1719; and it is possible that either he or Wheler, who travelled in Asia Minor and Greece in 1675-1676, introduced it into western Europe.

¹ First described by Linnæus, in *Hort. Cliff.* 454 (1737).

² Cf. Koch, *Dendrologie*, ii. pt. i. 507 (1872). *S. babylonica* is not now found in Babylonia. See p. 1771, note 4.

³ *Wanderings in China*, 118, 136 (1847), and *Residence Among the Chinese*, 52 (1857). The weeping willow is apparently depicted by Nieuhoff, *L'Embassade des Provinces Unies vers China*, i. 189 (1665), in a view of Tonnau, a village on the river Wei in the province of Shantung.

⁴ Cf. Bretschneider, in *Journ. N. C. Branch, R. Asiat. Soc.* xv. 15, 30 (1880), and *Bot. Sinic.* ii. 359 (1892). The name of *S. babylonica* in China is *yang-liu*. The weeping form is rare at Peking, where it is distinguished as *ch'ui-yang-liu*.

⁵ The serrations of the leaves in var. *pekinensis* are more distantly placed, and without the cilia, which are present in the typical form. These slight differences may be due to the different ages of the specimens.

⁶ Franchet et Savatier, *Enum. Pl. Jap.* i. 459 (1875).

⁷ Brandis, *Indian Trees*, 637 (1906).

⁸ *Mus. Petiv. Cent.* 997 (1703), where it is referred to as follows: "Yang-diu chinensibus. Arbor salicis folio ramulis pendulis. Frequently painted on Japan work. Of the wood they make arrows."

⁹ *Corollarium*, 41 (1719), where it is described as follows: "*Salix orientalis, flagellis deorsum pulchre penitentibus, hujus etiam meminit Wheler Itin.*" Wheler, *Journey to Greece and Asia Minor*, 217 (1682), saw near Brusa, and not far from Mt. Olympus in Asia Minor, a tree which appears from his description to have been a weeping willow.

The weeping willow was introduced into England some time before 1730, as it was on sale in London, according to a catalogue¹ published in that year. Collinson states² that it was introduced by Mr. Vernon, Turkey merchant at Aleppo, who planted it at his seat in Twickenham Park, where Collinson saw it in 1748. The latter says that this tree was the original of all the weeping willows in England; and adds that he measured one in 1765 at Mr. Snelling's at Godalming, which, though only fifteen years old, was 6 ft. in girth.

There was a famous weeping willow, planted by Pope in front of his villa at Twickenham, which was felled³ in 1801, when the story was given in *St. James's Chronicle*, August 25-27, of that year,⁴ that this tree was the first one planted in England, having been introduced as a withy round a package from Spain; but doubtless Pope's tree was a cutting from Mr. Vernon's willow.

Another celebrated tree was the weeping willow in St. Helena, which was planted in 1810, and was a favourite of Napoleon. After his death cuttings were brought to England, and planted in many places, where they were called Napoleon's willow, but differed in no respect from the ordinary form.⁵ There is a weeping willow at the Fountain Pond, Cassiobury, which formerly bore a plate⁶ stating that it had been a cutting from the tree in St. Helena. This tree fell and sustained considerable damage; but it has been replanted, and, according to Mr. Daniel Hill, who measured it in 1912, is 36 ft. high and 4 ft. 7 in. in girth. (A. H.)

The weeping willow strikes freely from cuttings, and grows rapidly in good soil beside water; but is very liable to have the young shoots killed by frost, and is not nearly so hardy as the hybrid *S. Salamonii*. It is one of the earliest trees to come into leaf, and the latest in retaining its foliage, being frequently green in December.

The finest trees known to Loudon were those at various places on the banks of the Thames, which were 50 to 60 ft. high in 1838; but it is doubtful if any of these now survive, as it is not a long-lived tree. The best that I have seen is perhaps a tree (Plate 379) on the Promenade, Cheltenham, which was planted about 1860, and is still thriving, although its limbs have been supported by iron rods for some years. It measured in 1911 about 75 ft. by 9 ft., and on 24th November 1911, after a severe frost, it still retained most of its leaves.

There are several picturesque trees,⁷ but of no great height, growing on the banks of the Cam, behind the Colleges of Cambridge. These are exceeded in size by one

¹ Miller, *Catalogus Plantarum, a Catalogue of Trees, Shrubs, Plants, and Flowers, which are propagated for sale in Gardens near London*, p. 71 (1730), where it is mentioned as "*S. orientalis*, T. Cor. 41. The weeping willow *vulgo*."

² Dillwyn, *Hortus Collins.* 48 (1843), quoted by Loudon, *Gard. Mag.* xix. 64 (1843). Aiton, *Hort. Kew.* v. 356 (1813), states that the weeping willow was first cultivated in 1692 in the Royal Garden at Hampton Court, but gives no authority for this. If true, the introduction into Western Europe was probably made by Wheler. Aiton quotes Plukenet, *Phytographia*, t. 173, fig. 5, which is not the weeping willow.

³ Corbett, in *Mem. Twickenham*, 285 (1872), states that this tree perished and fell to the ground in 1801. The wood was worked up by an eminent jeweller into all sorts of trinkets and ornaments, which had an extensive sale. The Empress of Russia took cuttings from Pope's willow in 1789 for the gardens at St. Petersburg.

⁴ Phillips, *Sylva Florifera*, ii. 263 (1823).

⁵ Loudon, *Arb. et Frut. Brit.* iv. 2588 (1838), and *Trees and Shrubs*, 758 (1842). Forbes, *Salic. Woburn.* 43 (1829) states that a plant raised from a cutting of the St. Helena tree was identical with the common weeping willow.

⁶ D. Hill, in *Trans. Herts. Nat. Hist. Soc.* xiv. pt. ii. 132 (1911).

⁷ These trees are comparatively young, and have replaced the original trees, which were planted in 1760. Cf. Willis and Clark, *Archit. Hist. Univ. Camb.* ii. 646 (1886).

in the Fellows' Garden of King's College, which was about 45 ft. high and 10 ft. in girth in 1912, with the trunk decayed and mended with cement.

The weeping willow attains¹ a much greater size and beauty in warm countries than it does in England. I have seen none finer than in Chile, where it is often planted by the sides of the irrigation canals, and enjoys a long and warm summer.

(H. J. E.)

SALIX FRAGILIS, CRACK WILLOW

Salix fragilis, Linnæus, *Sp. Pl.* 1017 (1753); Smith, *Fl. Brit.* iii. 1051 (1804), *Eng. Bot.*² t. 1807 (1808), and *Eng. Flora*, iv. 184 (1828); Andersson, *Monog. Salic.* 41 (1863), and in De Candolle, *Prod.* xvi. 2, p. 209 (1868); Willkomm, *Forstliche Flora*, 472 (1887); Buchanan White, in *Journ. Linn. Soc. (Bot.)* xxvii. 368 (1890); Mathieu, *Flora Forestière*, 450 (1897); Camus, *Monog. des Saules*, 76 (1904).

A tree, attaining about 70 ft. in height. Bark rough, strongly ridged, and divided into broad deep fissures. Young branchlets slightly pubescent, glabrous in the second year. Buds appressed to the branchlet, compressed, shining, glabrous. Leaves lanceolate, about 4 in. long and $\frac{3}{4}$ in. broad, gradually tapering above into a long caudate oblique acuminate apex, cuneate at the base, silky when young; upper surface in summer glabrous, shining; lower surface glaucous or glaucescent, with scattered silky appressed hairs; margin coarsely serrate, each serration tipped with a conspicuous reddish brown gland; petiole $\frac{3}{8}$ in. long or more, pubescent, usually with two glands at the insertion of the blade.

Catkins appearing with the leaves, terminating short branchlets, which bear three or four usually entire leaves; axis densely pubescent. Male catkins, about 2½ in. long; scales concave, oblong, truncate or cuspidate, glabrous within, pubescent without, margin fringed with long hairs; stamens two, filaments as long as the scale, slightly pubescent at the base, anthers yellow; glands two, the posterior transversely oblong, the anterior half its size and narrowly oblong. Female catkins about 2 in. long; scales concave, lanceolate, pilose at the base, ciliate, with long hairs; ovary distinctly stalked (pedicel $\frac{1}{5}$ in. long), one-third longer than the scale, fusiform, glabrous, $\frac{1}{6}$ in. long, gradually narrowing to the apex, which ends in a short style, divided into two arms, each of which is bilobed; only one gland,³ which is posterior, usually present, quadrate, entire in margin, much shorter than the pedicel. Fruiting catkins about 3 in. long, with a pubescent axis, and distinctly stalked capsules.

S. fragilis is called crack willow, on account of the ease with which the branchlets disarticulate, especially in spring. It is readily distinguishable by its

¹ *Salix Safsaf*, Dode, in *Bull. Soc. Dend. France*, 1906, p. 62, fig. (not Forskal), received from Palermo, where it was introduced by Schweinfurth from Egypt, is indistinguishable from *S. babylonica*; but is remarkably fast in growth and may be a hybrid. A specimen in the nursery of the Jardin des Plantes at Paris, which I saw in 1912, though only three years old from a small cutting, was 20 ft. high and 15 in. in girth. M. Dode states that this is perfectly hardy at Paris, none of the shoots being damaged by frost.

² One of the male flowers in *Eng. Bot.* t. 1807, has three stamens; and it is possible that the male plant figured is a hybrid like *S. speciosa*.

³ The presence of two glands in the pistillate flower of *S. fragilis* is very rare, and abnormal.

nearly glabrous coarsely glandular-serrate large leaves, ending in a long point directed to one side. When adult the stem is covered with a much rougher bark than that of *S. alba*, the depressions between the ridges being broad and deep; on this account buyers of willow timber usually designate it as the "open-bark willow." It is of no value for making cricket bats, as its wood lacks the necessary strength, lightness, and elasticity.

VARIETIES AND HYBRIDS

True *S. fragilis* does not seem to be a very variable plant; but peculiar forms, more or less resembling it, are known, which are supposed to be of hybrid origin. These are described below. The twigs in some trees become dull grey in the second year, whilst in others they assume a brilliant orange colour. Varieties founded on the size of the leaf or on the colour of its lower surface are not sufficiently distinct to be worth naming; and the two forms, vars. *britannica* and *genuina*, Buchanan White, in *Journ. Linn. Soc. (Bot.)* xxvii. 368 (1890) based on the relative length of the bract and flower, are untenable, as this depends simply on the age at which individual flowers are observed.

The following are supposed to be hybrids:—

1. *Salix decipiens*, Hoffmann, *Hort. Sal.* ii. 9, t. 31 (1791); Smith, *Eng. Bot.* t. 1937 (1808); Forbes, *Sal. Woburn.* t. 29 (1829); Buchanan White, in *Journ. Linn. Soc. (Bot.)* xxvi. 348 (1890).

Salix fragilis, var. *decipiens*, Koch, *Syn. Fl. Germ.* 643 (1837).

Salix cardinalis, Veitch, *Cat. Trees and Shrubs*, 1910, p. 75.

A shrub or small tree. Young branchlets crimson or dark red, glabrous; becoming in the second year polished and yellowish white or of a clay colour. Leaves glabrous, smaller than those of *S. fragilis*, 2 to 3 in. long, $\frac{1}{2}$ to $\frac{3}{4}$ in. broad, more oblong, more parallel-sided, usually less narrowed and often rounded at the base; under surface pale dull green, scarcely glaucous; serrations finer, sharper, and closer together than in *S. fragilis*. This is supposed to be a hybrid between *S. fragilis* and *S. triandra*, and occurs in both sexes. The catkins of the female plant are intermediate between these two species; while the number of stamens in the male plant is usually two, rarely three.

S. decipiens, according to Buchanan White, is widely spread, but not abundant in Britain; and is usually found growing in company with *S. triandra* and *S. fragilis*. He mentions various localities from Perth to Somerset. There are specimens in the Kew Herbarium from Dorset, Sussex, and Essex. This species was said by Forbes¹ to be cultivated for basket-work, producing when cut crimson-coloured annual shoots, which are very remarkable in appearance. It appears² to be largely used at the

¹ *Sal. Woburn.* 57, t. 29 (1829). Cf. also Loudon, *Arb. et Frut. Brit.* iii. 1515 (1838). Smith, *Eng. Bot.* t. 1937 (1808), states that Crowe found it in several osier beds in Norfolk and Cambridgeshire, where it was known as white Welsh osier.

² Cf. Ellmore and Okey, in *Journ. Board Agric.* xviii. 915 (1912), who refer to it as *Salix alba*, var. *cardinalis*.

present time for the same purpose in Belgium; and when imported is called "Belgian red willow." It is occasionally planted for ornament, appearing in some nursery catalogues under the name *S. cardinalis*.

2. *Salix speciosa*, Host, *Sal.* 5, t. 17 (1828); Buchanan White, in *Journ. Linn. Soc. (Bot.)* xxvii. 353 (1890).

Salix fragilis, var. *latifolia*,¹ Andersson, in De Candolle, *Prod.* xvi. 2, p. 209 (1868).

A large tree, similar in bark and habit to *S. fragilis*. Young branchlets slightly pubescent, glabrous in the second year. Leaves longer and broader than those of *S. fragilis*, up to 6 in. long and $1\frac{3}{4}$ in. wide; broadly lanceolate, with a long acuminate often curved apex; pubescent when young; when mature, upper surface dark green, shining, glabrous; lower surface pale, glabrescent, or with scattered appressed hairs; margin coarsely glandular-serrate; petiole $\frac{3}{4}$ in. long, often with one to four glands at the junction with the blade.

Staminate catkins, $2\frac{1}{2}$ in. long; flowers crowded on the densely pubescent axis; scale, shorter than the stamens, and covered with long white silky hairs; stamens usually two, rarely three, glabrous or pilose at the base; glands two, variable, entire or lobed. Pistillate flowers not seen.

The above description is drawn up from an old tree¹ on the side of the lake at Kew, which has been named *S. triandra* \times *fragilis*,² by Linton. It is identical with some trees, which have been called "open-bark willow," by Carter, and is perhaps not very rare in Britain.

3. *Salix viridis*, Fries, *Nov. Pl. Suec.* 283 (1828); Andersson, in De Candolle, *Prod.* xvi. 2, p. 210 (1868); Buchanan White, in *Journ. Linn. Soc. (Bot.)* xxvii. 364, 371 (1890).

(?) *Salix rubens*, Schrank, *Baier Fl.* i. 226 (1789)

Salix excelsior, Host, *Sal.* 8, tt. 28, 29 (1828).

Salix palustris, Host, *Sal.* 7, tt. 24, 25 (1828).

Salix montana, Forbes, *Sal. Woburn.* 37, t. 19 (1829).

Salix fragilis-alba, Wimmer, *Denkschr. Schles. Ges.* 156 (1853).

A tree similar in size to the reported parents, *S. alba* and *S. fragilis*, with spreading branches, and usually more or less pendulous branchlets. Young branchlets variable, glabrous or pubescent. Leaves intermediate between these two species, variable in size, shape, colour, and pubescence; darker green, less shining, more finely serrated, and less oblique at the apex than those of *S. fragilis*; longer and broader than those of *S. alba*, and soon becoming glabrescent.

Staminate catkins narrower and larger than in *S. fragilis*. Pistillate catkins more slender than in that species; ovary shortly but distinctly pedicellate; capsules intermediate in size between *S. alba* and *S. fragilis*.

¹ Specimens which were sent from Kew to Buchanan White in 1887 and 1888, and are now preserved in his herbarium at Perth, show that this tree was then labelled *S. fragilis*, var. *latifolia*, a name accepted by White.

² *S. alopecuroides*, Tausch, *Ind. Hort. Canal.* (1821), ex Andersson, in De Candolle, *Prod.* xvi. 2, p. 203 (1868); A. Kerner, in *Verh. Z. B. Ges. Wien*, 69 (1860); Koch, *Dendrologie*, ii. pt. i. 516 (1872), is the name given to the hybrid *S. triandra* \times *fragilis*, which occurs on the continent. This, judging from Tausch's specimen, preserved in the Cambridge Herbarium, is quite distinct from *S. speciosa*, Host.

Numerous forms of *S. viridis*¹ occur, some being close to *S. fragilis*, others nearer to *S. alba*; and no exact definition of this hybrid is possible; but it is easy to recognise when *S. alba*, *S. fragilis*, and *S. cœrulea* are excluded. According to Buchanan White, *S. viridis* is widely distributed in Britain, occurring from Cornwall and Surrey to Perth; but it is less abundant and more local than the parents, *S. alba* and *S. fragilis*. The second-class bat willow is often *S. viridis*.

S. viridis doubtless grows to as large a size as either of the parents, with which it is generally confused. The largest² we know are growing beside a stream at Thornbury, Gloucestershire. One tree is 60 ft. high by 18 ft. in girth. Near it are two trees growing from the same root, one of which is 65 ft. by 11 ft. 6 in. and the other 60 ft. by 15 ft. 7 in., according to measurements which were kindly taken for us by Mr. Samuel Fudge in July 1912.

4. *Salix Russelliana*, Smith, *Fl. Brit.* iii. 1045 (1804), *Eng. Bot.* t. 1808 (1808), and *Eng. Flora* iv. 186 (1823); Forbes, *Sal. Woburn.* 55, t. 28 (1829); Loudon, *Arb. et Frut. Brit.* iii. 1517, fig. 1311 (1838).

Salix fragilis, var. *Russelliana*, Koch, *Syn. Fl. Germ.* 643 (1837).

A tree, remarkably vigorous in growth, with long, straight and slender branches, not angular in their insertion like those of *S. fragilis*. Leaves in the young state white and silky pubescent beneath; when fully grown, lanceolate, acuminate, $3\frac{1}{2}$ in. long, $\frac{5}{8}$ in. wide, finely serrate, with scattered appressed hairs on the under surface near the midrib. Pistillate trees only known, with flowers similar to those of *S. fragilis*, having pedicellate ovaries and bipartite styles, but with looser catkins.

This seems, judging from the type specimens in Smith's herbarium at the Linnean Society, to be a form of *S. viridis*, which is not clearly known to botanists³ at the present time. The normal leaves are well figured by Loudon (fig. 1311); those depicted by Sowerby (*Eng. Bot.* t. 1808) from coppice shoots are larger than the normal leaves, and have the glands on the petiole often developed into slender leaflets.

S. Russelliana was sent to Woburn about 1800 by Mr. Bakewell from Leicestershire, and was called the Dishley or Leicester Willow. It seems to have been extraordinarily vigorous, as Lowe, *Agric. Survey of Notts*, p. 118, is quoted⁴ for the fact that "this willow in a plantation yielded at eight years' growth poles which realised a net profit of £214 per acre." It was also remarkable for the large per-

¹ Scaling mentions in his pamphlet, *Salix or Willow*, i. *Cat.* p. 8 (1871) and ii. 19 (1872) two willows, which he sent out in 1871 from his nursery at Basford, Notts:—(1) *S. sanguinea*, the branches of which were brilliant red in winter. This was obtained by Scaling some years previously in the Ardennes, where it was known as the red willow. (2) *S. basfordiana*, with branches of a deep orange colour. This appeared as a seedling in the nursery, and grew with great vigour.

Salter, in *Gard. Chron.* xvii. 298, figs. 41, 42 (1882), apparently confused these two distinct trees, which he described as *S. basfordiana*. There are two trees at Kew under this name—a male, No. 58, which is a form of *S. viridis*, and a female, No. 80, which is identical with *S. vitellina*. Whether these correspond to Scaling's *S. sanguinea* and *S. basfordiana* is uncertain.

² These trees have pubescent leaves, simulating those of *S. alba*, but larger and thinner. They also differ from the latter species in having distinctly pedicellate fruit.

³ *S. Russelliana* has been misunderstood by most botanists since Smith's time. White's view that it was true *S. fragilis*, while Smith's *S. fragilis* was *S. viridis*, is untenable.

⁴ Duke of Bedford, in Forbes, *Sal. Woburn.*, p. v (1829). The frontispiece represents Johnson's Willow.

centage of tannin contained in the bark, which exceeded, according to Mr. Biggin's analysis,¹ even that of the oak.

The Rev. W. Dickenson assured the Duke of Bedford and Sir James Smith that the tree known as Johnson's Willow,² which grew between Lichfield and Stow Hall, was *S. Russelliana*. This tree, which was so called because Dr. Johnson frequently rested under its shade, was figured by Loudon, *Arb. et Frut. Brit.* iii. figs. 1312, 1313, who states that it was about 60 ft. high, with a great bole, about 20 ft. in length, which girthed,³ in 1810, 21 ft. at six feet from the ground. It contained 130 cubic ft. of timber, and was perfectly sound. It was blown down in 1829, when it was supposed to have been 130 years old.

Mr. L. Fosbrooke, of Ravenstone Hall, Ashby de la Zouch, believes that *S. Russelliana* still occurs in Leicestershire in the Trent valley, where the trees are supposed to be female *S. fragilis*. They differ in foliage from male trees of true *S. fragilis*, according to Mr. Fosbrooke, who tells me that though they grow fast when young, they become round-topped as they approach maturity, and are certainly not nearly as vigorous as *S. caerulea*. I have not been able to examine specimens of these trees; and cannot say whether they are identical with the original *S. Russelliana*, which may have been a solitary sport or hybrid of exceptional vigour, now lost to cultivation.

DISTRIBUTION

The distribution of *S. fragilis* in the wild state cannot be determined with certainty, as it has been largely planted outside of its original area; but it is supposed to be indigenous in the greater part of Europe and in western Asia. It is not wild in Norway, but occurs there as a planted tree as far north as lat. 64° 5'. In Sweden it is also only known in cultivation, the male tree being seen occasionally in Werm-land and Schone, and the female tree in the district round Kalmar. It is wild in Jutland, in the island of Oesel, and in Russia,⁴ where it extends as far north as Esthonia, Livland, Kostroma, and Kazan; but is absent from the Crimea. It is widely spread in the Caucasus, Persia, and Asia Minor. Farther east it is cultivated⁵ in the Kuram valley, in Gilgit, Ladak, and Lahaul, as well as at Quetta, where it was found by Lace at 5600 ft. elevation.

In Europe it extends southwards to Spain and Portugal, Sicily, and Greece. It is planted largely in northern and central Germany, where it is wild in many localities; but in southern Germany, Austria, and Hungary, it is only seen in river valleys, where it prefers a deep loamy soil; and ascends along the edges of streams in the mountains, as high as 1700 ft. altitude in the Bavarian Alps, and 2500 ft. in Transylvania. In order to succeed it requires considerably more moisture in the soil than *S. alba*, and on this account is most often seen on the Continent generally, on the banks of rivers, streams, and lakes, being rare in the interior of the forests.

¹ Davy, *Agric. Chem.* 89 (1814) analysed the bark of a large tree of the "Leicester Willow" and found it to contain more tannin than any other British tree, having a little more than coppice oak, and three times as much as the "common willow."

² See note 4, p. 1757.

³ Withering, *Arr. Brit. Plants*, ii. 68 (1818) gives these measurements on the authority of Rev. W. Dickenson. Loudon, *Derby Arboretum*, 55 (1840), states that a young tree, raised from the branches of Johnson's Willow, was growing at Lichfield in 1836, when it was 20 ft. high.

⁴ Köppen, *Holzgew. Europ. Russlands*, ii. 257 (1889).

⁵ Brandis, *Indian Trees*, 637 (1906).

The crack willow is probably wild in marshy ground in Britain from Perthshire southwards; but it is extremely difficult to decide in what stations it is really indigenous. It is supposed to have been introduced¹ into Ireland, where however it is often seen as a planted tree. (A. H.)

This species occasionally attains as great dimensions as *S. alba*. In *Gard. Chron.* i. 447 (1874), E. Lees figures some remarkable old willows. The largest of these (*S. fragilis*) grew in the Wye valley near Ross, and was over 70 ft. in height, with a girth of 24 ft. at two feet from the ground. Mr. H. Marshall can find no trace of this tree at the present time.

Jackson, *Syon House Trees and Shrubs*, 29 (1910), mentions an immense tree on the south side of the lake in a decaying condition. "Judging from the length of the bole, which is now prostrate, this may well have been the specimen mentioned by Loudon² (p. 1521) as being 89 ft. high and about 13 ft. in girth, and called by him *Salix Russelliana*."

In Messrs. Samson's nursery at Kilmarnock there was a crack willow, which in 1904 measured, according to Mr. Renwick, 80 ft. high, with a bole 22 ft. in length and girthing 16 ft. 1 in. at five feet from the ground. This tree was blown down in November 1911, when the trunk was found to be much decayed at the heart. No shoots have sprung from the root since. Mr. Renwick³ records a tree at Bruntwood Mains near Galston, Ayrshire, which measured 13 ft. 1 in. in girth in 1902, when it was reputed to have been 62 years old. (H. J. E.)

SALIX ALBA, WHITE WILLOW

Salix alba, Linnæus, *Sp. Pl.* 1021 (1753); Smith, *Eng. Bot.* t. 2430 (1812), *Eng. Flora*, iv. 231 (1828); Forbes, *Sal. Woburn.* 271, t. 136 (1829); Loudon, *Arb. et Frut. Brit.* iii. 1522 (1838); Andersson, *Monog. Salic.* 47 (1863), and in De Candolle, *Prod.* xvi. 2, p. 211 (1868); Willkomm, *Forstliche Flora*, 469 (1887); Buchanan White, in *Journ. Linn. Soc. (Bot.)* xxvii. 370 (1890); Mathieu, *Flore Forestière*, 451 (1897); Camus, *Monog. des Saules*, 69 (1904).

A tree, attaining about 90 ft. in height and 20 ft. in girth, with more or less ascending branches, but with spreading or pendulous ultimate branchlets. Bark less deeply fissured than in *S. fragilis*, the depressions between the ridges being narrower and shallower than in that species. Young branchlets covered with whitish appressed pubescence, partly retained in winter and in the following year. Buds flattened, appressed against the twig, silky pubescent. Leaves lanceolate, 2 to 2½ in. long, rarely exceeding ½ in. in width, tapering to a long acuminate, straight or curved apex; upper surface greyish green, more or less covered with silky white appressed pubescence; lower surface whitish, densely covered with similar pubescence; margin densely ciliate, and with minute glandular serrations; petiole short, pubescent.

Catkins, appearing with the leaves, on short lateral leafy branchlets; axis densely tomentose; flowers crowded. Staminate catkins, about 1½ in. long;

¹ Praeger, in *Proc. Roy. Irish Acad.* vii. 283 (1901).

² Loudon's identifications of these large willows are very uncertain.

³ *Trans. Nat. Hist. Soc. Glasgow*, vi. pt. iii. 353 (1902).

stamens two, united and pubescent at the base; glands two, anterior quadrate and entire, posterior small and ligulate; scale concave, ciliate, half the length of the stamens. Pistillate catkins, $1\frac{1}{2}$ in. long; ovary sessile, glabrous, about $\frac{1}{10}$ in. long, ovoid, abruptly narrowed towards the apex; style short, the two arms apparently undivided (really slightly bilobed); scale, fringed with long hairs, and as long as the ovary; gland, one, posterior, quadrate. Fruiting capsules sessile, $\frac{1}{8}$ in. long.

S. alba appears to be very variable in the size and pubescence of the leaves; but doubtless some of the varieties attributed to *S. alba* are forms of the hybrid, *S. viridis*, in which the characters of *S. alba* are dominant. The following form is in cultivation:—

1. Var. *argentea*, Wimmer, *Sal. Europ.* 17 (1866).

Var. *splendens*, Andersson, in De Candolle, *Prod.* xvi. 2, p. 211 (1868).

Var. *leucophylla*, Simon-Louis, *Cat.* 1869, p. 85.

Var. *regalis*, Beissner, in *Gartenflora*, xxvi. 40 (1877).

Salix splendens, Bray, ex Opiz, *Boehm. Gew.* 110 (1823).

Salix regalis, Wesmael, in *Bull. Cong. Bot. Brux.* 1864, p. 280.

Young branchlets and leaves on both sides covered with dense silvery white tomentum. This is highly effective in beds in gardens when cultivated in masses, the single stems being kept about 12 ft. high by pruning. At Glasnevin there is a thriving tree about 35 ft. high.

DISTRIBUTION

S. alba is widely spread through central and southern Europe, extending southwards to Algeria and Morocco, and eastwards to western and northern Asia. It is impossible to define its northern limit in Europe, as its natural area has been much extended by planting; but, according to Schübeler, it is not wild in Scandinavia, where it is occasionally planted as far north as lat. $63^{\circ} 52'$ in western Norway. In Russia,¹ it is probably wild as far north as southern Livonia, Vitebsk, Smolensk, Moscow, Vladimir, Kostroma, Viatka, and Perm; and is common in the Crimea, where it attains a large size. It is widely spread in the Caucasus, north Persia, and Asia Minor; and occurs in Siberia as far east as Lake Baikal; but it is only cultivated² in the northern Himalayas and in western Tibet.

It is doubtfully wild in northern Germany, where it is, however, planted to a considerable extent. Farther south, it is undoubtedly indigenous in southern Germany, Austria, the Balkan peninsula, Italy, Spain, and the greater part of France.³ In central and southern Europe, it is often the dominant tree in the forests of the alluvial plains and in the woods on the banks of rivers, as on the Danube and its great tributaries, where it either forms pure stands or grows in mixture with *Quercus pedunculata*, *Populus nigra*, and *Salix fragilis*. It grows in similar situations to the last species, but thrives in lighter and more sandy soils. It ascends the river valleys in the mountains to 1400 ft. in the Bavarian Forest, to 2700 ft. in the Bavarian Alps, to 2900 ft. in Transylvania, to 3200 ft. in the Caucasus, and to 5400 ft. in the Sierra Nevada. The comparatively low altitude

¹ Köppen, *Holzgew. Europ. Russlands*, ii. 259 (1889).

² J. D. Hooker, *Flora Brit. India*, v. 629 (1888).

³ It is common on the banks of all the large rivers of western France from the Seine to the Adour; and appears to be the sole native large willow in these situations where I saw no *S. fragilis* in 1912.

which it attains in the mountains is not due to the fall in temperature, as it ripens seed and grows to be a fine tree in Livonia.

The white willow is supposed to be indigenous in Britain in marshy ground from Sutherland southwards; and is considered by Praeger¹ to be probably in Ireland an original tree of river banks, but now generally planted.

Witches' brooms² on this species are apparently formed by the irritation set up by a mite (*Eriophyes salicis*), which causes a shoot to branch repeatedly and produce small narrow soft leaves, the whole mass often measuring a foot in diameter, and turning bright red in autumn.

The white willow was early introduced into North America, where it is now planted both in Canada and the United States. Together with *S. fragilis*, it has proved very useful as a windbreak in the prairie regions, and where timber is scarce is valuable for fuel. It is also a useful tree for reclaiming and holding the soil along streams. The wood is fairly durable in contact with the soil, and has been employed for fence-posts in the north-western plains of the United States. Pinchot³ recommends that it should be grown as coppice, when required for posts or fuel; and says that plantations should be tilled frequently till they are well shaded. This cultivation destroys weeds, and prevents excessive evaporation of moisture from the soil.

(A. H.)

REMARKABLE TREES

A tree at Bury St. Edmunds, figured by Strutt, *Sylva Britannica*, plate xxiii, as the Abbot's Willow, is one of the largest white willows of which we have record. It was measured by a surveyor, named Lenny, in 1822, when it was 72 ft. high by $18\frac{1}{2}$ feet in girth, and was estimated to contain 440 feet of timber. Loudon was informed that it was almost dead in 1836.

The largest white willow known to us is at Haverholme, near Sleaford, in the park east of the priory, and measured⁴ in 1907 about 80 ft. high by $25\frac{1}{2}$ ft. in girth, with a spread of branches about 80 ft. in diameter. A photograph, for which I am indebted to Miss F. H. Woolward (Plate 380) shows it to be past its prime; but though partly decayed, it is said to be still increasing in girth.

At Water Hall farm, Bayfordbury, Herts, there is a tree, about seventy years old, which Mr. H. Clinton-Baker measured in 1912. It is about 65 ft. high; and has a short bole, 27 ft. in girth at one foot from the ground, and divided at four and a half feet up into two stems, the larger of which is 17 ft. in girth at six feet from the ground.

At Compton Wynyates, Kington, a beautiful old mansion belonging to the Marquess of Northampton, there is a group of sound healthy trees from 80 to 90 ft. high, one of which girthed 10 ft. 4 in. in 1905.

At Highclere, there is a fine tree, a picture of which by Alfred Parsons, now in the possession of Lady Carnarvon, was reproduced by Robinson, *Wild Garden*, 258 (1895). It formerly had three stems, but the two largest were blown down some

¹ *Proc. Roy. Irish Acad.* vii. 283 (1901).

² *Proc. Roy. Hort. Soc.* xxxvi. pt. ii. p. cxvii. (1910).

³ *U. S. Dept. Agric. Forest Circ.* No. 87 (1907).

⁴ Measured by Mr. J. Cowanec. In *Woods and Forests*, 1884, p. 642, this tree was said to have been, in 1881, 27 ft. 4 in. in girth at one foot from the ground, 20 ft. 5 in. at four feet, and 28 ft. at seven feet. The branches spread 40 ft. on one side, and 28 ft. on the other. Cf. *Gard. Chron.* xiv. 362 (1893).

years ago. Mr. Storie informs us that the stem remaining, which leans to one side, is over 50 ft. in height and girths 13 ft. at five feet from the ground.

At Fawsley Park, Daventry, a tree, of which a photograph was reproduced in the *Journal of the Northampton Natural History Society* for 1882, was said to have been no less than 102 ft. high and 9 ft. 2 in. in girth. This tree was blown down in February 1882; and apparently all that now survives is a small tree, grown from a cutting, specimens of which were kindly sent us by Lady Knightley of Fawsley.

In Scotland, Henry measured in 1904 two trees at Palnure, Kirkcudbright, which were 86 ft. by 10 ft. 8 in., and 82 ft. by 12 ft. 9 in.

At Coodham House, Kilmarnock, there are two great trees, the largest of which was 17 ft. 1 in. in girth in 1904, when it was measured by Mr. Renwick. Mr. J. M'Gran, the gardener, informs us that in 1910 it was about 60 ft. high, and girthed 17 ft. 8 in. at three feet from the ground, 19 ft. 8 in. at five feet, and 21 ft. at six feet.

At Moncreiffe I saw in 1907 a remarkable old willow, of which the original trunk, now broken, measured 19 ft. 4 in. in girth. The branches had become rooted in several places; and one of these, now severed from the trunk, is over 6 ft. in girth. The total circumference of the branches is 106 paces. The foliage of this tree, of which we have not seen flowers, is not so white as usual; and it may be a form of *S. viridis*.

In Ireland we have no records of any very large trees; but in Mucksna Wood, a mile from Kenmare, I saw by the road-side in 1910 some very fine willows, which the Marquess of Lansdowne believes to have been planted eighty or ninety years ago. I measured one of these 85 ft. by 9 ft. 10 in.

The white willow attains a large size in Germany. T. Schube¹ gives reproductions from photographs of two enormous trees which are growing in Silesia, one at the Primkenauer factory, 20 ft. in girth, and the other, with a taller stem not quite so thick on the road between Stronn and Korschlitz. The largest willow² in Berlin, which grew beside a canal and had a girth of 23 ft., fell to the ground in 1894. Beissner reports³ a tree, 92 ft. high and 9 ft. in girth in 1907, which is growing in a park at Hohenmistorf in Mecklenburg. As the park was laid out in 1854, this willow probably dates from that year.

TIMBER

The wood of this species is used for making cricket-bats of an inferior kind, those of the best class being mainly obtained from *S. cœrulea*. Apart from this special use, the wood of the white willow is of considerable value, though it is not so much esteemed now as formerly. It is tough, and indents without splintering from blows or hard usage, and is used on that account for brakes on railway waggons, and for the sides and bottoms of carts; it is also used for the rims of riddles and milk-pails, and by turners for making toys. It is also valuable for hurdle-making. G. W. Newton states⁴ that George Stephenson had a high opinion of willow, as forming durable blocks for paving. Gorrie states⁵ that "in roofing it has been known to stand one hundred years as couples, and with the exception of about $\frac{1}{2}$ in. on the

¹ *Mitt. Deut. Dend. Ges.* 1910, p. 52, figs. 8 and 9.

² *Ibid.* 1894, p. 29.

³ *Ibid.* 1907, p. 56.

⁴ *Timber Trees*, 34 (1859).

⁵ Loudon, *Gard. Mag.* i. 45 (1826).

outside, the wood has been found so fresh at the end of that period as to be fit for boat-building." Boards of willow were laid for floors in 1700.¹ (H. J. E.)

SALIX CÆRULEA, CRICKET-BAT WILLOW

Salix cœrulea, Smith, *Eng. Bot.* t. 2431 (1812), and in Rees, *Cycl.* xxxi. 141 (1819); Aiton, *Hort. Kew.* v. 365 (1813) (not Forbes).

Salix alba, var. *cœrulea*, Smith, *Eng. Flora*, iv. 231, 232 (1828); Loudon, *Arb. et Frut. Brit.* iii. 1523 (1838); Bean, in *Kew Bulletin*, 1907, p. 312, plate, and 1912, p. 205.

Salix viridis, Pratt,² in *Journ. Roy. Agric. Soc.* lxxvi. 22 (1905), and *Quart. Journ. Forestry*, i. 325, fig. No. 02 (1907) (not Fries).

A tree, attaining 100 ft. in height, with ascending branches, making a narrow angle with the stem, and forming a pyramidal crown.³ Terminal branchlets erect, not spreading or drooping. Bark smoother than in *S. alba*. Young branchlets appressed pubescent, becoming reddish brown in winter and the following year. Leaves similar to those of *S. alba*, but thinner in texture, more translucent, and less densely pubescent; lower surface not white, but bluish grey; margin ciliate, with minute glandular serrations.

Pistillate catkins, differing from those of *S. alba* as follows: ovary⁴ slightly stalked, more tapering at the apex, about $\frac{1}{6}$ in. in length; each of the two style-arms distinctly bilobed; scale more concave, about two-thirds the length of the ovary. Fruiting capsule, nearly $\frac{1}{4}$ in. long, on a distinct short pedicel.

This remarkable tree, which is best distinguished by its pyramidal habit, with stiff ascending branches and branchlets, is *par excellence* the true cricket-bat willow, as it exceeds the other kinds in rapidity of growth. Bean calls it the "best close-bark willow." In addition to its different habit, the leaves are readily distinguishable from those of *S. alba* by their different colour, and also by their translucency, as when viewed against the light with a lens, the tertiary venation is always plainly visible. In the forms⁵ of *S. viridis*, which approach *S. alba* in foliage, the leaves simulate those of *S. cœrulea* in colour and translucency, but are considerably larger and are also more coarsely serrate in margin; and no form of *S. viridis*, known to me, has either the peculiar habit or rapid growth of *S. cœrulea*.

S. cœrulea is considered by most botanists to be a variety of *S. alba*; but it differs from the latter in the flowers, which approximate in their size and shape and stalked ovaries to those of *S. fragilis*; and it is possible that *S. cœrulea* may be the first cross between these two species, most of the characters of *S. alba*, if this hypothesis is correct, being dominant.

S. cœrulea was first distinguished by Smith, who was unable to find any botanical

¹ Ellis, *White Woods*, quoted by Mitchell, *Dendrologia*, 56 (1827).

² Mr. E. R. Pratt at first accepted, on Mr. Linton's identification of certain specimens, the name *S. viridis* for the true cricket-bat willow, though in *Journ. Roy. Agric. Soc.* lxxvi. 22 (1905), he agrees that the East Anglia cricket-bat willow has leaves indistinguishable from those of *S. cœrulea*.

³ Owing to the fastness of growth of *S. cœrulea*, the nodes are at greater intervals, and the crown of foliage in consequence is remarkably sparse. The bark is darker in colour than that of *S. alba*.

⁴ Bean, *Kew Bull.* 1907, p. 313, states that the ovaries of *S. cœrulea* are identical with those of *S. alba*. A careful examination shows that the pyramidal tree with bluish foliage has always the distinct flowers described above.

⁵ These forms of *S. viridis* are often referred to *S. alba*, var. *cœrulea*, especially on the Continent; but I restrict the name *S. cœrulea* to the pistillate pyramidal tree here described.

character to separate it from *S. alba*, except "that the under side of the leaves loses at an early period most of the silky hairs." However, he went on to say: "Its qualities are of the highest importance. The superior value of the wood and bark, the rapid growth as well as handsome aspect of the tree, its silvery blue colour, its easy propagation and culture, in dry as well as wet situations, all render it so superior to our common white willow, that a cultivator might justly think lightly of any one who should tell him that there was no difference between them." He states that a cutting planted in Norfolk "became in ten years a tree 35 ft. high and 5 ft. 2 in. in girth, which is a rapidity of growth beyond all comparison with the common white willow." Succeeding botanists have applied the name *cœrulea* to pendulous slow-growing trees, of which the foliage is bluish white beneath; but I consider that Smith distinctly described the quick-growing pyramidal tree which is now recognised by cultivators as the true cricket-bat willow; and his specimen of *S. cœrulea* in the herbarium of the Linnean Society, London, is undoubtedly this tree.

Apparently no staminate tree¹ of *S. cœrulea* exists; and Smith knew it only as a female tree.

The origin of *S. cœrulea* is obscure; but it appears to be confined to the eastern counties of England, where it has been known² since 1804 at least. Bean,³ relying upon Shaw, states that it is only found at the present time in Essex, Hertford, and Suffolk; but it undoubtedly occurs also in Norfolk and Cambridgeshire; and is said to have been formerly a rare tree in Kent and Surrey. Dealers restrict their purchases to the eastern counties, and have not yet ever found any suitable willow for making bats in other parts of Britain or on the Continent. It is probable, however, that *S. cœrulea*, when planted in other parts of the British Isles, will prove satisfactory, as there is no reason for believing that the peculiar qualities of the wood of this tree are dependent upon the climatic conditions of the eastern counties.

Mr. J. A. Campbell, who planted in 1904 about 150 trees of *S. cœrulea* at Arduaine, Lochgilhead, Argyllshire, has received a favourable report⁴ from Mr. D. J. Carter, willow-dealer at Waltham Cross. One of these trees, which was cut down in 1912, when it was 6 in. in diameter, would, if it had been large enough for making bats, have fetched the normal price. This tree was too small to give a certain result; but judging from Mr. Carter's report, *S. cœrulea*, grown in the west of Scotland, where the rainfall is 60 inches annually, apparently retains the qualities which render its timber so valuable in East Anglia, where the climate is dry and sunny, and the mean summer temperature much higher than in the west.⁵

Loudon identified *S. cœrulea* with the upland or red-twigged willow of Pontey⁶;

¹ Forbes, *Sal. Woburn*, 273, t. 137 (1829), describes as *S. cœrulea*, a male tree, which is doubtless a form of *S. viridis*.

² Smith, *Fl. Brit.* iii. 1072 (1804), refers to it as a bluish, quick-growing variety of *S. alba*.

³ *Kew Bulletin*, 1907, p. 313.

⁴ Cf. Bean, in *Kew Bulletin*, 1912, p. 205.

⁵ Notwithstanding the above statement, I should hesitate to advise the planting of this willow in any part of Scotland or the west of England, until it has been proved by actual sale that the timber is of equal value to that grown in the eastern counties. Even supposing that it should prove to have the same qualities when large enough, it is not easy to convince leading manufacturers that their reputation is worth risking; and though eminent cricketers whom I have consulted do not seem to judge bats so much by the appearance of their wood, as by their balance, handle, and weight, they would rather pay a high price for a bat which is guaranteed by the maker than use a substitute whose durability and driving powers are more or less uncertain.—H. J. E.

⁶ *Profitable Planter*, 72 (1814). Sang, Nicol's *Planter's Kalendar*, 68 (1812), says that the red-twigged willow "forms a large tree and has a fine silvery foliage; it is probably the same as the upland willow of Mr. Pontey."

but the latter's description is vague and uncertain; and I have been unable to find any accounts of this remarkable tree as early as the eighteenth century.

S. cœrulea is much faster in growth than either *S. alba* or any of the varieties of *S. viridis*. It is true that well-shaped trees of the latter kinds, grown with clean stems on proper soil, are frequently purchased at a fair price¹ by bat-makers; yet *S. cœrulea* should always be preferred for planting. It comes to market earlier, on account of its rapid growth; and produces a wood light in weight,² very elastic and tough, which is found to be the most suitable for making the best kinds of cricket bats.³

CULTIVATION

The best account of the cultivation of this tree is given by Mr. E. R. Pratt, from whose article⁴ I shall quote largely.

The choice of soil is most important, as many failures are due to the prevalent idea that willows will thrive in any wet or marshy situation. This is erroneous, and soils sodden with stagnant water or of a peaty nature should be avoided. The best ground is undoubtedly rich light alluvial land by the side of a running stream; but good willows are also seen growing in fertile loam, where there is a good supply of moisture. Clay and gravel soils are usually quite unsuitable. If willows are planted in grass land beside a stream, they must be protected against cattle, during the whole period of their growth; and, in all cases, rabbits must be excluded.

In peaty soil, except in very rare cases where the drainage is good and the properties of the peat modified in consequence, willows never thrive, and after a few years often die. In such cases the soil, when examined, proves to be very acid in reaction; and the willows are frequently attacked by a fungus, *Physalospora gregaria*, Saccardo, which produces cankerous spots on the young stems. The epidermis at first looks as if scorched, then dries up, turns brown, and becomes cracked by the protrusion of very small black spots (the fruit of the fungus); it ultimately peels off, exposing the inner part of the stem. Dr. T. Johnson, who has given a good account,⁵ with figures, of this fungus, believes that its ravages are much favoured by raw peaty soil; and certainly, in some cases, it is the cause of extensive failures in willow plantations. In wet or marshy situations, where there is great growth of grass, the willow seems more liable also to the attacks of the beetle, *Saperda carcharias*, Linn.

Though rooted cuttings are frequently advertised by nurserymen, there seems to be no doubt that it is much more advantageous to plant large sets. Scaling,⁶ who had great experience, says: "All varieties of tree willows grow better and more

¹ Two trees in Suffolk, growing in good soil, which I examined before they were cut down—both *S. alba*, but one male, and the other female—were sold at 6s. 8d. per cubic foot in 1910; but these trees, twenty years after planting, had only attained 14 in. in diameter, and had short stems which made only four bat lengths.

² Mr. L. Fosbrooke, Ravenstone Hall, Leicester, states in *Gard. Chron.* xxxix. 46 (1906), "The close-barked white willow is *Salix cœrulea*. It is the quickest grower of all the tree willows in a moist soil, reaching 18 in. in diameter in as many years. The quicker the growth, the lighter the timber, and the better the price."

³ Mr. E. R. Pratt, in *Quart. Journ. Forestry*, i. 336 (1907), shows that the specific gravity of the wood of *S. alba* (male trees) exceeds that of *S. cœrulea* (female trees) by 14½ per cent.

⁴ *Journ. Roy. Agric. Soc.* lxi. 19-34 (1905).

⁵ *Proc. Roy. Dublin Soc.* x. pt. ii. 153-166, plates 13-15 (1904).

⁶ *Salix or Willow*, i. Cat. p. 8 (1871).

vigorously from cuttings than from rooted plants." Gorrie¹ found that shoots of the white willow "6 to 8 ft. long and about 2 in. in diameter succeed better than rooted plants; they require to be put from 18 in. to 2 ft. deep, in marshy soil, which should be drained." At the present time, it is the invariable custom amongst expert growers of cricket-bat willow to use large sets, up to 20 ft. long and 3 in. in diameter, and scarcely smaller than 6 to 10 ft. long by 2 in. in diameter. The sets are best obtained from young trees that have either been felled for sale or that have been specially pollarded for the purpose; and should never be taken from the tops of old trees, as these are seldom straight, and require much trimming. A young tree, about ten years old, gives the best sets when pollarded, and can be again pollarded every five years for six or seven times till decay sets in. The sets should be cut in early spring. Mr. Pratt, after trimming them for four-fifths of their length, has them tied up in bundles of ten, and kept in water for a month, after which they are planted out.

As the willow is a light-demanding tree, and the grower's object is to produce, as quickly as possible, a short stem clean of branches for about 12 to 15 ft., a good crown of foliage must be preserved from the start, and the trees should be planted so wide apart that they do not interfere with each other by lateral shade. If closely planted, they grow more slowly, and often develop an elliptical instead of a circular stem. The distance apart along the side of a stream should not be less than 10 yards. Close planting to kill undergrowth or grass is a mistake, as the latter, if necessary, can be removed by cultivation, though this is seldom done.

Holes may be made for the sets by driving in a stake two or three feet deep, which can afterwards be levered out. The sharpened end of the set is then dropped into the hole, and tightly rammed in position. It is very important to insert the set deeply and firmly, so that it may not be shaken by the wind. The after care consists in rubbing off in the first three years, with the gloved hand, as high up as possible, the buds which appear on the stem, so as to prevent the development of side shoots. Mr. Pratt advocates the pruning of the stem afterwards to a height of 25 ft., but this is seldom if ever done in Herts or Essex, where growers are content with a stem clear of branches to 12 or 15 ft.

Willow trees become saleable to bat-makers, when they are about 15 in. in diameter at six feet from the ground, or about 13 in. at twelve or fifteen feet up. The original set remains as a useless core in the centre of the stem. As the width of a bat is about $5\frac{1}{2}$ in. and the clefts are taken radially, the minimum diameter should be $5\frac{1}{2}$ in. + $5\frac{1}{2}$ in. + 2 or 3 in. (the diameter of the set) = 13 or 14 in. The trees may of course be allowed to grow for another period of years, until a second ring of clefts is formed around the first ring, or even for a further period; but it is usually most profitable to dispose of the trees when they are young.

The trees are generally sold standing, and are deemed of first quality when the stem is straight, clear of knots or branches, and covered with a smooth scaly bark, which is indicative of rapid growth. As the length of a bat is about 28 in., the trees

¹ Loudon, *Gard. Mag.* i. 46 (1826). J. Harrison, *New Method*, 20-24 (1766) recommended, in planting willows, the use of sets 16 ft. long, with all the side branches pruned off; to be preserved from cattle by three stakes two feet from the set, tied up with thorns; and an after treatment of disbudding.

as soon as felled, which is done in winter, are cross-cut into lengths of 28 to 30 in., and these in turn are split into clefts. The clefts are split up along the radii so that the annual rings run from the front to the back of the bat. The best clefts come from the lower part of the tree, which is far tougher than the upper portion. In the best bats I have counted from seven to nine annual growths.

The clefts are ultimately fashioned into blades, which are subjected to hydraulic pressure; and it is here that the value of *S. caerulea* shows itself, as blades made of *S. fragilis* are unable to stand the requisite amount of pressure. The further process of manufacture is detailed in a pamphlet¹ written by W. E. Bussey, which should be consulted by those interested in the growth of willow.

The extraordinary value of the true cricket-bat willow is not exaggerated in the following statement,² made by Mr. John Barker of Pishiobury, Sawbridgeworth: "A good set costs 1s. to 1s. 6d., and, if planted in a suitable soil and does well, is worth from £5 to £8 in fifteen years." He instances a case where a piece of land was bought for £50, and planted with willows, which were sold, when sixteen years old, for £2000 in 1905.

The following figures have been given to us by a reliable grower of willows in Herts. In December 1910 he sold twenty-four trees which grew on the bank of a stream, and had been thirteen years planted, for an average of £5 per tree. In January 1912 he sold eleven willows, which had been planted fourteen years previously, for £81. These trees averaged 55 to 60 ft. in height, and were clear of branches for about 18 ft., their stems ranging from 42 to 46 in. in girth at five feet from the ground. The best tree contained 12 cubic feet of timber, available for making bats, and as it sold for £8, the price per cubic foot came to 13s. 4d. In 1906 fifty-three trees growing on the same property were sold for £190. These had short stems, averaging 13 in. in diameter, and yielding only three bat lengths.

Many trees of remarkable size, but comparatively young, have been felled for conversion into cricket bats. One of the largest on record³ was a tree at Boreham, Essex, which was planted in 1835, and felled in 1888, when it was 101 ft. high and 5 ft. 9 in. in diameter. It weighed upwards of eleven tons, and was perfectly sound. It was felled by B. Warsop and Sons, who made from it no less than 1179 bats.⁴

Mr. H. Clinton-Baker tells us of another willow which grew in a field at Aspenden, near Buntingford, and was purchased by the same firm. It was 6 ft. in diameter, at three feet from the ground, and divided at five feet up into two stems, which were clear to a height of 50 ft., where they still measured 2 ft. in diameter.

Mr. Stuart Surridge purchased for £25 in 1910 a tree near St. Albans, which was about 80 ft. high and measured 5 ft. in diameter at three feet from the ground. Judging from a photograph, it had a clean stem of about 16 feet. He states that the largest tree known to him grew at Robertsbridge, in Sussex, and measured 21 ft. in girth. This was felled in 1902, and produced over 1000 cricket bats.

Sir Thomas B. Bevor made the following note in his copy of Evelyn's *Sylva* :

¹ Published in 1910 by Geo. G. Bussey and Co., Queen Victoria St., London, E.C.

² *Gard. Chron.* xxxix. 62 (1906).

³ *Trans. Eng. Arbor. Soc.* iv. 122 (1899).

⁴ Mr. Edwin Savill informs us that he sold a tree in 1911 for £70, but he has no measurements. The dealer told him that the number of feet utilized worked out at £1 per cubic foot.

"Mar. 12, 1808. Willow tree, planted about eighteen years in a meadow at Wortham, in Suffolk, in length about 22 ft., and measured, at four feet from the ground, 7 ft. 10 in., and in its bark appearing as green as when young. This willow is now found to be the cœrulean willow, and was taken down in 1816, and cut into boards which measured 22 in. broad; and increased (in the last) eight years in girth to 11 ft. 8 in."

There are many fine trees on the Copped Hall estate, near Epping, where the agent, Mr. P. W. Dashwood, informed me in 1907 that he had refused a short time previously an offer of £1500 for 100 trees to be selected by the purchaser. He sold one tree for £25 which was afterwards re-sold for £40 to another dealer. This tree had a stem $3\frac{1}{2}$ ft. in diameter, and was clean of branches for about 25 ft.; it yielded eleven lengths of bats, twenty-eight inches being allowed for a bat-length.

In 1910 I measured at Ryston, Downham, Norfolk, a true *S. cœrulea* which was twenty years old and growing in good soil—alluvial silt over clay. It was 80 ft. high by 5 ft. 4 in. in girth. A male *S. alba* of the same age growing beside it was 65 ft. high by 3 ft. 11 in. in girth. Mr. E. R. Pratt sent me a photograph of a tree, growing on the bank of the river Wissey at Hilgay, south of Downham, which, in October 1912, measured 84 ft. in height, and 6 ft. 5 in. in girth. This tree was planted in 1889; and is growing very rapidly, as it was only 5 ft. 6 in. in girth in February 1910.

Elwes saw in 1907 a fine tree growing in a meadow near Spains Hall, Braintree, Essex, which was considered by Mr. A. W. Ruggles-Brise, to be a true cricket-bat willow. It was quite sound and healthy, and measured 90 ft. by $12\frac{1}{2}$ ft.

The illustration (Plate 381) is reproduced from a negative for which we are indebted to Mr. M. C. Duchesne. It was taken from a tree in a meadow called Hartham, near Hertford, of which the grazing is annually let by the municipality. The soil and situation are considered ideal for growing willow. (A. H.)

SALIX VITELLINA, GOLDEN WILLOW

Salix vitellina, Linnæus, *Sp. Pl.* 1016 (1753); Smith, *Eng. Bot.* t. 1389 (1805), and *Eng. Flora*, iv. 182 (1828); Host, *Salix*, tt. 30, 31 (1828); Forbes, *Salic. Woburn.* 39, t. 20 (1829); Loudon, *Arb. et Frut. Brit.* iii. 1528 (1838).

Salix alba, Linnæus, var. *vitellina*, Stokes, *Bot. Mat. Med.* iv. 506 (1812); Seringe, *Ess. Saule Suisse*, 83 (1815); Andersson, in De Candolle, *Prod.* xvi. 1, p. 211 (1868); Buchanan White, in *Journ. Linn. Soc. (Bot.)* xxvii. 371 (1890); Camus, *Monog. Saules*, 75 (1904).

(?) *Salix basfordiana*,¹ Scaling, *Salix or Willow, Cat.* p. 8 (1871), and ii. 19 (1872).

A tree, attaining about 60 ft. in height, with spreading branches. Young branchlets, pubescent at the tips and near the nodes, becoming glabrous and bright yellow in winter, and in the following year. Leaves lanceolate, averaging $2\frac{1}{2}$ in. long and $\frac{3}{8}$ in. wide, gradually tapering to a slender acuminate caudate apex; shining green above, bluish white beneath, with scattered appressed silky hairs, usually slight

¹ Cf. page 1757, note 1.

on the upper surface, more abundant beneath; serrations minute with incurved glandular tips; margin either ciliate throughout the season, or with the cilia deciduous in summer; petiole slightly pubescent.

Catkins terminating short leafy branches and appearing with the leaves; axes white tomentose, densely flowered. Staminate catkins, 1 to $1\frac{3}{4}$ in. long, curved; stamens two, rarely three, base of filament slightly pilose; scales concave, ovate-lanceolate, almost glabrescent, slightly ciliate, nearly twice as long as the stamens; glands two, posterior quadrate and usually bilobed, anterior smaller and usually entire. Pistillate catkins, very slender, $1\frac{3}{4}$ in. long; ovary with a distinct pedicel, which is twice as long as the posterior bilobed quadrate gland, conic, glabrous, about $\frac{1}{8}$ in. long, ending in a short style; stylar arms spreading and bilobed; scale as long as the ovary, pubescent on both surfaces.

S. vitellina is related to *S. alba*, but is distinct in the flowers, and has narrower and less pubescent leaves. The flowers are occasionally unstable, three stylar arms and three stamens being present instead of two, and the ovary is often peculiarly inflated towards the apex. *S. vitellina* is variable as regards the amount of the pubescence; in one form the leaves are scarcely pubescent on the upper surface, and the margin becomes non-ciliate; while in another form there is appressed pubescence on both surfaces, often dense beneath, and the cilia are retained on the margin till late in the season. *S. vitellina* is possibly of hybrid origin, and though long known in cultivation and naturalised in many parts of Europe is very doubtfully wild. Smith states¹ that Crowe found it wild in pastures at Ovington, near Watton, Norfolk.

The following varieties are known:—

1. Var. *pendula*, Späth, *Cat.* No. 69, p. 110 (1888).

Branchlets pendulous. Leaves narrow, non-ciliate. This is a beautiful weeping tree,² which is often sold under the erroneous name of *S. babylonica*, var. *aurea*.

2. Var. *britzensis*, Späth, *Cat.* No. 57, p. 67 (1883).

Young branchlets bright red, pubescent. Leaves appressed-pubescent on both surfaces, ciliate till autumn. This is a staminate tree. It is the finest of all the coloured willows, the twigs assuming a beautiful red colour in winter. A thriving specimen at Glasnevin is about 40 ft. high, and is narrowly pyramidal in habit.

The golden willow is planted for ornament both in England and the Continent, and is occasionally cultivated in osier beds.³ It is very striking in winter, and seems to thrive in this country, though Smith states that the twigs are often killed by severe cold, like those of *S. babylonica*. We have seen no trees of great size, the finest being probably two trees at Glasnevin, which are about 65 ft. in height and 8 ft. in girth. These are probably of considerable age, and have rough bark like that of *S. fragilis*. It was early introduced into North America, where it is now very common in New England. (A. H.)

¹ *Fl. Brit.* iii. 1050 (1804).

² Dode, in *Bull. Soc. Bot. France*, lv. 655 (1910), considers this to be a hybrid between *S. vitellina* and *S. babylonica*, and names it *S. chrysocoma*, Dode.

³ Cf. Ellmore and Okey, in *Journ. Board. Agric.* xviii. 914 (1912), who say that it is one of the toughest willows grown, if used with the bark on in a green state. Hence it mostly produces rods, which are used for tying purposes.

POPULUS

Populus, Linnæus, *Gen. Pl.* 307 (1737) and 456 (1754), *Sp. Pl.* 1034 (1753); Wesmael, in De Candolle, *Prod.* xvi. 2, p. 323 (1868), in *Mém. Soc. Sci. Hainaut*, iii. 186-250 (1869), and in *Bull. Soc. Bot. Belg.* xxvi. pt. i. p. 371 (1887); Bentham et Hooker, *Gen. Pl.* iii. 412 (1880); Schneider, *Laubholzkunde*, i. 2-23 (1904), and ii. 869, 870 (1912); Dode, in *Mém. Soc. Hist. Nat. Autun.* xviii. 1-76 (1905); Ascherson and Graebner, *Syn. Mitteleurop. Flora*, iv. 14-54 (1908); Gombocz, in *Math. Termes. Közl.* xxx. 5-238, with two maps (1911).

DECIDUOUS trees, belonging to the natural order Salicaceæ. Terminal buds large, with one or two outer pairs of opposite scales at the base, and several imbricated scales above; axillary buds smaller, with fewer scales, the lowest of which is short, broad, and open next the stem; scales accrescent, marking when they fall the base of the branchlet with ring-like scars. Branchlets terete or angled, with five-angled pith, and showing, when the leaves have fallen, three-dotted leaf-scars, on the sides of which are visible two minute scars left by the early deciduous stipules. Leaves simple, alternate, penninerved, usually long-stalked; entire, dentate, or lobed; often different in shape, pubescence, and margin on the long and on the short shoots.

Flowers without honey, fertilised by the wind, appearing before the leaves in early spring; diœcious, in pendulous stalked catkins, which arise from buds in the axils of the leaf-scars of the previous year or at the ends of short shoots. Catkins bearing on a slender axis numerous flowers, each of which is subtended by a caducous stalked lobed, dentate, or lacinate scale (bract). Perianth absent, replaced by a stalked disc. Male flowers densely crowded; stamens four to twelve, or twenty to sixty, with short white filaments, and purple or red two-celled anthers, arising from the oblique, flat or concave disc. Pistillate flowers not so dense in the catkin as the male flowers; ovary sessile in the oblique cup-shaped disc, one-celled, with two, three, or four placentæ; style short or obsolete, with as many entire or bifid stigmas as there are placentæ. Fruiting catkins elongated, ripening early before the leaves are fully grown; capsule one-celled, separating when ripe into two to four recurved valves, girt at the base by the persistent disc.¹ Seeds numerous, minute, without albumen, elliptic, compressed, acuminate at the apex, surrounded by tufts of long white silky hairs, attached to their short stalks and deciduous with them. Seedling,² with two stalked suborbicular cotyledons, sagittate at the base, thick and succulent; primary leaves either in opposite pairs as in *P. canescens*, or alternate as in the black poplars.

¹ In section *Turanga* the disc is deciduous, and does not persist on the fruit.

² An account of the germination of poplars, with figures of the seedlings, is given by Miss F. II. Woolward, in *Journ. Bot.* xlv. 417, t. 487 (1907). Cf. also Hinkel, in *Bull. Soc. Dend. France*, No. 25, p. 88 (1912).

The poplars are typical light-demanding trees, incapable of bearing shade, their branchlets and leaves dying when not exposed to full light. This is well seen when two Lombardy poplars are planted close together, the shade of the taller of the two killing the branches on the adjacent side of the other. In connection with this demand for light, which necessitates sparse branches and foliage, the poplars normally shed many of their smaller branchlets in autumn. The process¹ by which this is effected is similar to that by which the leaves are cast off,—a zone of corky tissue being formed at the point where the rupture subsequently takes place,—the branchlet leaving when it falls a circular scar on the main branch to which it was attached.

The genus *Populus* comprises about twenty-five species, inhabiting the extra-tropical regions of the northern hemisphere from the Arctic Circle southwards; in North America extending to Lower California and northern Mexico; throughout Europe and northern Africa; and in Asia, extending as far south as Asia Minor, Syria, Mesopotamia, Persia, Afghanistan, the Himalayas, China, and Japan. Towards the extreme north certain species often form great forests; elsewhere poplars are most common in alluvial land bordering rivers, streams, and swamps; but occasionally they form a part of the deciduous forests.

The genus is divided into five sections; and the following key, based mainly on the characters of the leaves and buds, includes all the species in cultivation, with the more important hybrids; and in addition, three species, mainly of botanical interest, which we have not seen in England in the living state.

I. *TURANGA*, Bunge, *Beit. Kennt. Fl. Russ.* 498 (1848).

This section differs from the others in the remarkable polymorphic leaves, and in the deeply cleft disc of the flowers, which does not remain persistent at the base of the fruit.

1. *Populus euphratica*, Olivier.²

Northern and eastern Africa, Syria, Mesopotamia, Persia, Turkestan, Afghanistan, north-west India, Mongolia, north China.

A tree 50 ft. high. Leaves coriaceous, greyish green, of the same colour on both surfaces; on young trees, linear or oblong, entire, short-stalked, and willow-like; on old trees extremely diverse, ovate, oblong, rhombic, or orbicular, lobed or cut, long-stalked.

Not hardy in Great Britain.³ This poplar, and not a willow,⁴ is the '*arabim*' of the Psalms, cxxxvii. 2, the trees growing by the rivers of Babylon, on which the Jews in captivity hanged their harps.⁵

¹ This natural fall of branchlets, effected by a vital process, was termed *cladopsis* by Berkeley, in *Gard. Chron.* 1855, p. 596. It has been observed in oaks and willows, as well as in poplars, and Shattock gave a complete account of it in the case of the aspen in *Journ. Bot.* xxi. 306 (1883). This phenomenon appears to have been first noticed by J. Main, *Hort. Register*, iv. 193, fig. A (1835), where a fallen branch of the black poplar is figured.

² *Voy. Emp. Othom.* figs. 45, 46 (1807). This is a very variable species, which has been variously treated by botanists. Gombocz, in *Math. Termes. Közl.* xxx. 71, 72 (1911), recognises several varieties, and treats *P. pruinosa*, Schrenk, as a distinct species. *P. illicitana*, Dode, in *Bull. Soc. Dend. France*, 1908, p. 163, lately found near Elche in Spain, appears to be only naturalized there, and is identical with the ordinary form of the species in Morocco and Algeria.

³ Späth, *Catalogue*, No. 91, p. 51 (1893-1894), states that a plant sent to Lauche from Turkestan in 1881 soon died. It was reintroduced by General Korolkow, who sent it to Späth in 1892.

⁴ *Salix babylonica*, Linnæus, was so called, because it was erroneously supposed to be the tree of the Psalms. Cf. p. 1752.

⁵ Cf. Koch, *Dendrologie*, ii. pt. i. p. 507 (1872), and Ascherson, in *Sitzb. Ges. Nat. Fr. Berlin*, 1872, p. 92.

II. LEUCE, Duby, in De Candolle, *Syn. Pl. Fl. Gall.* i. 427 (1828).

White poplars and aspens.—Bark smooth on young stems, ultimately breaking on the surface into rough rhombic cavities. Buds variable, tomentose and dry, or glabrous and viscid. Leaves variable, tomentose or glabrous; lobed, dentate, or serrate. Flower scales fringed with long hairs; stamens few, about ten; capsules slender, oblong.

A. White poplars.—Leaves densely tomentose on the long shoots; less tomentose or glabrescent, and different in shape on the short shoots.

2. *Populus alba*, Linnæus. Europe, North Africa, Asia Minor, Caucasus, Central Asia, Himalayas. See p. 1777.

Leaves on the long shoots palmately lobed, snowy white beneath; on the short shoots oval, dentate, greyish beneath.

3. *Populus tomentosa*, Carrière. North China. See p. 1786.

Leaves on the long shoots triangular-ovate, without lobes, biserrate, grey tomentose beneath; on the short shoots, with a few sinuate teeth, glabrescent beneath.

4. *Populus canescens*, Smith. Western Europe. See p. 1780.

Leaves on the long shoots ovate-deltoid, greyish white beneath, with irregular triangular serrated teeth; on the short shoots suborbicular or broadly ovate, glabrescent beneath, with a few sinuate teeth.

B. Aspens.—Leaves on the long and short shoots not markedly different, glabrous or glabrescent beneath.

* *Branchlets glabrous.*

5. *Populus tremula*, Linnæus. Europe, North Africa, Asia Minor, Caucasus, Siberia. See p. 1787.

Leaves suborbicular, $1\frac{1}{2}$ to 2 in. in diameter, thin in texture, acute or rounded at the apex; margin with rounded or sinuate teeth.

6. *Populus tremuloides*, Michaux. North America. See p. 1791.

Leaves orbicular or ovate, $1\frac{1}{2}$ to 2 in. in diameter, thin in texture, cuspidate at the apex; margin ciliate, finely and regularly serrate.

** *Branchlets slightly tomentose.*

7. *Populus Sieboldii*, Miquel. Japan. See p. 1794.

Leaves ovate, 3 in. long, 2 in. wide, thick in texture, shortly acuminate at the apex; margin with minute sinuate teeth or glandular serrations.

8. *Populus grandidentata*, Michaux. North America. See p. 1792.

Leaves ovate-deltoid, 3 to 4 in. long, 2 to 3 in. wide, thin in texture, acuminate; margin with a few sinuate triangular large teeth.

III. AIGEIOS, Duby, in De Candolle, *Syn. Pl. Fl. Gall.* i. 427 (1828).

Black poplars.—Trees with furrowed bark. Buds viscid, but not very odorous. Leaves green on both surfaces, with a clearly defined translucent border.

A. *Leaves never ciliate in margin.*

9. *Populus nigra*, Linnæus. Europe, Caucasus, Siberia. See p. 1795.

Leaves rhomboid, about 3 in. long, 2 in. broad, cuneate at the base, gradually tapering above into a long acuminate apex; glands never present at the base. Stigmas always two. Stamens fifteen to thirty, purple.

Branchlets and petioles glabrous in var. *typica*, pubescent in var. *betulifolia*.

The Lombardy poplar (p. 1798) is the fastigate form of var. *typica*; and var. *plantierensis* (p. 1802) is the fastigate form of var. *betulifolia*.

B. *Leaves ciliate in margin.*

* *Glands absent at the base of the leaf.*

10. *Populus Fremontii*, Watson. North America. See p. 1794.

Leaves on young cultivated trees, reniform or rhombic, with a cuneate base; on old trees deltoid with a truncate base; about $2\frac{1}{2}$ in. wide; apex cuspidate; serrations few, coarse, and incurved. Stigmas three. Stamens about sixty, with dark red anthers.

** *Glands always present on the base of the leaf.*

11. *Populus monilifera*, Aiton. North America. See p. 1807.

Branchlets rounded. Leaves deltoid-ovate, about 3 in. wide, shallowly cordate or truncate at the base, cuspidate at the apex; serrations sinuate, with incurved tips, fewer and coarser than in the hybrids. Stigmas three or four. Stamens fifty to sixty.

12. *Populus angulata*, Aiton. North America. See p. 1810.

Branchlets angled. Leaves triangular-ovate, longer than broad, up to 7 in. long, and 5 in. broad, truncate or cordate at the base, acute or shortly acuminate at the apex. Stigmas four. Stamens fifty to sixty.

*** *Glands variable at the base of the leaf, absent or one or two in number.*

Hybrids between the European *P. nigra*, and one or other of the American *P. monilifera* and *P. angulata*. Leaves with irregular marginal cilia, which are often sparse, and usually deciduous in summer; serrations not coarse and sinuate.

* *Branchlets glabrous.*

13. *Populus serotina*, Hartig. See p. 1816.

Branches ascending, wide-spreading. Leaves unfolding latest of all the poplars and with a red tint, ovate-deltoid, about 3 in. wide, with a broad truncate base, and a short cuspidate or acuminate apex. A staminate tree; stamens twenty to twenty-five.

14. *Populus regenerata*, Schneider. See p. 1824.

Similar to *P. Eugenei* in habit, with foliage like that of *P. serotina*, but unfolding a fortnight earlier. A pistillate tree; stigmas usually only two.

15. *Populus Eugenei*, Simon-Louis. See p. 1826.

A narrow columnar tree, with ascending short branches. Leaves unfolding early with a reddish tint, smaller than those of *P. serotina*, broadly cuneate at the base, with a slender sharp-pointed non-serrated acuminate apex. A staminate tree; stamens about twenty.

16. *Populus marilandica*, Bosc. See p. 1828.

A tree with irregular branches. Leaves early in unfolding, rhomboid, cuneate at the base, tapering above into a long acuminate apex. A pistillate tree; stigmas variable, two, three, or four.

17. *Populus Henryana*, Dode. See p. 1829.

A tree with irregular branches. Leaves opening early, not tinged with red, ovate-triangular, cuneate at the broad base, and ending in a long acuminate apex. A staminate tree; stamens thirty to thirty-five. Flower buds pubescent.

** *Branchlets pubescent.*

18. *Populus robusta*, Schneider. See p. 1829.

Branchlets grey. Leaves unfolding early with a deep red tint, variable in shape, ovate-deltoid or rhomboid; cuneate, rounded, or truncate at the base; acuminate at the apex; petioles pubescent. A staminate tree; stamens twenty.

19. *Populus Lloydii*, Henry. See p. 1830.

Branchlets yellow. Leaves similar to those of *P. robusta*, but smaller; petioles pubescent. A pistillate tree; stigmas usually two.

IV. TACAMAHACA, Spach, in *Ann. Sci. Nat.* xv. 32 (1841).

Balsam poplars.—Trees with rough furrowed bark, and fragrant foliage. Buds very viscid, exhaling a strong balsamic odour. Leaves whitish beneath, without a clearly defined translucent cartilaginous border; petioles rounded or quadrangular, channelled on their upper side.

A. *Branchlets rounded, without projecting ribs, except occasionally on vigorous shoots of young trees.*

* *Branchlets and petioles pubescent.*

20. *Populus candicans*, Aiton. North America. See p. 1834.

Leaves broad, ovate-deltoid, palminerved and cordate at the base, 5 to 6 in. long, 4 in. wide, ciliate in margin.

21. *Populus tristis*, Fischer. Himalayas (?). See p. 1840.

Leaves narrow, ovate, palminerved and cordate or rounded at the base, 4 in. long, 2 in. wide, ciliate in margin.

22. *Populus Maximowiczii*, Henry. Japan, Amurland, Manchuria, Korea. See p. 1838.

Leaves nearly orbicular, oval, or elliptic; palminerved and subcordate at the rounded base; 4 in. long, 3 to 3½ in. wide; densely ciliate in margin, and pubescent on the midrib, nerves, and veinlets of both surfaces.

23. *Populus suaveolens*, Fischer. Siberia, Mongolia. See p. 1841.

Leaves ovate or ovate-lanceolate, palminerved and rounded at the base, abruptly contracted into an acuminate apex, 3 to 3½ in. long, 1¼ to 2 in. broad; margin ciliate; glabrous on both surfaces.

** *Branchlets and petioles glabrous.*

24. *Populus balsamifera*, Linnæus. North America. See p. 1832.

Leaves ovate, palminerved and rounded at the base, 4 to 5 in. long, 2 to 3 in. wide, sparsely and minutely ciliate in margin.

25. *Populus angustifolia*,¹ James. Rocky Mountains of North America. See p. 1831.

Leaves lanceolate, resembling those of *Salix fragilis* in shape, cuneate at the base, greenish beneath, 2 to 4 in. long, ¾ to 1 in. wide; lateral nerves, fifteen pairs, all pinnate.

B. *Branchlets with projecting linear ridges.*

* *Branchlets pubescent.*

26. *Populus laurifolia*, Ledebour. Altai Mountains. See p. 1842.

A wide-spreading tree. Leaves lanceolate, 3 to 5 in. long, 1 to 2 in. broad, rounded at the base, gradually tapering to an acuminate apex, finely and regularly serrate.

27. *Populus berolinensis*,² Dippel. A hybrid. See p. 1844.

A narrow columnar tree. Leaves ovate or ovate-rhombic, 3 in. long, 2 in. wide, rounded or cuneate at the base, contracted at the apex into an acuminate point, crenately and occasionally irregularly serrate.

** *Branchlets glabrous.*

28. *Populus Wobstii*, Schröder. A hybrid. See p. 1843.

Branchlets only slightly ribbed in the first year, the ribs more apparent in the second year. Leaves lanceolate, tapering to a narrow rounded base, 4 to 6 in. long, 2 in. broad; ciliate in margin; nerves all pinnate.

29. *Populus Simonii*, Carrière. North China. See p. 1839.

Leaves rhombic-elliptic, cuneate and pinnately nerved at the base, contracted at the apex into a short cuspidate point, 3 in. long, 1¼ in. broad.

30. *Populus trichocarpa*, Torrey and Gray. Western North America. See p. 1836.

Young stems with bark peeling off in papery shreds. Leaves ovate or ovate-deltoid, palminerved and rounded or subcordate at the base; 5 in. long, 3 in. broad; whitest beneath of all the balsam poplars.

V. LEUCOIDES, Spach, in *Ann. Sci. Nat.* xv. 30 (1841).

Trees with rough bark, breaking into loosely attached plates. Leaves very large, cordate, simply serrate, covered when unfolding with greyish tomentum, which speedily disappears except on the nerves beneath; petioles rounded, much shorter than the blades, which do not flutter in the wind. Buds pubescent, viscid. These poplars are not easily propagated by cuttings.

31. *Populus lasiocarpa*, Oliver. Central China. See p. 1846.

Leaves ovate-cordate, longer than wide, about 9 in. long, and 6 in. broad; green beneath, with uniform serrations, extending regularly to the sinus at the base.

32. *Populus heterophylla*, Linnæus. United States, from the Mississippi valley eastwards to the Atlantic coast. See p. 1846, note 2.

¹ This species is very distinct from the other balsam poplars, in the willow-like leaves, which are not whitish beneath.

² This hybrid differs from the balsam poplars in the very narrow translucent border on the leaves, which are less fragrant and greenish, or only slightly whitish beneath. *P. rasumowskyana* and *P. petrowskyana* are similar hybrids, of which I have not seen complete material. See pp. 1843, 1844.

Leaves ovate-cordate, nearly as broad as long, 4 to 7 in. long, 3 to 6 in. wide; pale beneath, with regular serrations except at the base, where they are few and wide apart. (A. H.)

THE RAISING OF POPLARS FROM SEED

No good description or illustration of the germination of poplars seems to have been published in England before that of Miss Florence Woolward¹ in 1907.

I have never found in England a poplar grown from seed either naturally or by nurserymen; and though Grigor² describes the process, it seems doubtful whether he ever practised it; and all my own attempts to raise poplars from seed were fruitless, until I followed nature as closely as possible. Having observed that poplars only germinated freely on the sandy banks of rivers, I sowed seed as soon as ripe on a pot of sand, and placed the pot in a pan of water in the full sun. Germination was then extremely rapid, according to Miss Woolward, in ten hours to two days. I found that after four days no more seeds came up, and that in all cases the proportion of germinating seed was quite small. In five or six days the cotyledons are well developed, but the growth of the young plants is very slow and does not exceed 2 to 5 inches in height in the first season. Some one-year seedlings of *P. nigra*, sent me from the banks of the Allier in central France, were only 3 to 4 inches above ground, though their thick rather fleshy root was 6 to 10 inches long. Some seedlings of *P. monilifera* from the banks of the St. Lawrence in Canada, collected by Mr. Jack, were equally small; as were some of *P. nigra* raised by Mr. Hankins from seed collected at Bury St. Edmunds.

Miss Woolward and I also raised *P. canescens* from seed collected at Upcot near Colesborne, where both sexes of this tree grow on my own property; and she raised *P. marilandica* from seed of a tree in Kew Gardens. In both cases the seedlings were much less vigorous than cuttings from the same trees.

I also raised seeds collected under a tree, which I believe to be *P. monilifera*, of American origin, in the botanic garden at Padua, which was perhaps fertilized by a *P. alba*, the only poplar growing near it; but none of those seedlings have shown the least sign of hybrid origin, and have grown slowly and seem tender as compared with poplars raised from cuttings.

I am therefore convinced that, though we may succeed, by crossing different species, in obtaining new races of superior vigour, like *P. Eugenei* and *P. robusta*, the raising of poplars from seed is not a practice which can be recommended for general purposes. Some species of poplar are said to be difficult or impossible to strike from cuttings, among which Grigor includes *P. alba* and *P. canescens*, but I have found no difficulty in the case of the latter. In the case of species which will not strike, recourse must be had to layers, root-suckers, or grafting. (H. J. E.)

¹ *Journal of Botany*, xlv. 417, t. 487 (1907).

² *Arboriculture*, 328 (1881). Hickel, in *Bull. Soc. Dend. France*, No. 25, p. 88 (1912), gives directions for raising poplars from seed, which he has followed with success at Versailles.

POPULUS ALBA, WHITE POPLAR

Populus alba, Linnæus, *Sp. Pl.* 1034 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1638 (1838) (in part); Willkomm, *Forstl. Fl.* 516 (1887); Mathieu, *Flore Forestière*, 483 (1897); Schneider, *Laubholzkunde*, i. 21 (1904); Ascherson and Graebner, *Syn. Mitteleurop. Fl.* iv. 17 (1908); Boissier, *Flora Orient.* iv. 1193 (1879); Hooker, *Fl. Brit. India*, v. 638 (1888); Aigret, in *Ann. Trav. Publ. Belg.* x. 1213 (1905); Gombocz, in *Math. Termes. Kozl.* xxx. 141 (1911).
Populus major, Miller, *Dict.* ed. viii. No. 4 (1768).
Populus nivea, Willdenow, *Berl. Baumz.* 227 (1796).

A tree, similar in size and bark to *P. canescens*. Young branchlets and buds densely white tomentose.¹ Leaves (Plate 408, Fig. 1), very variable in size and shape, dependent upon the position and vigour of the branchlets and on the age of the tree; on vigorous long shoots and suckers, large, up to 4 or 5 in. in diameter, ovate, palmately three- to five-lobed; lobes triangular, with deep sinuses; margin ciliate with minute glandular teeth; subcordate at the rounded or broad base, acute at the apex; dark green and slightly tomentose above; covered beneath with a dense snowy white tomentum; petiole rounded, tomentose. Leaves on short shoots (and occasionally at the base of the long shoots), elongated oval, rounded at the base, with a few sinuate teeth, usually covered beneath with a thin greyish tomentum; in some cases (var. *denudata*, Wesmael) glabrescent; in some forms, broad and suborbicular like the similarly placed leaves of *P. canescens*, but uniformly tomentose beneath, and with fewer teeth in the margin; petiole tomentose.

Pistillate catkins similar to those of *P. canescens*, but more silvery in colour; scales obovate to lanceolate, with minute teeth, and fringed with long hairs; stigmatic lobes four, green, erect, long and linear, each of the two pairs united at the base. Staminate catkins² (probably not perfectly developed), 1 inch long; axis tomentose; scales concave, spatulate, dentate, fringed with long hairs; disc pubescent; stamens six.

Spread over an immense area, *P. alba* is very variable in the form of the foliage, and might be divided into several distinct geographical races; but the wild specimens in herbaria are scanty and incomplete; and only a few important varieties will be here mentioned. *P. canescens*, a native English tree, and *P. tomentosa*, wild in North China, are easily distinguishable; and are treated here as distinct species.

1. Var. *nivea*, Aiton, *Hort. Kew.* iii. 405 (1789).

This is the typical form³ of the species described above. It has been long in cultivation in western Europe, where it is known in gardens as var. *argentea*, var. *acerifolia*, var. *arembergiana*, etc. It appears to be indigenous in eastern and south-eastern Europe, in the Caucasus, in Persia, Turkestan, Afghanistan, and the Altai Mountains, where specimens have been gathered by travellers. In Kashmir, according to Mr. Lovegrove, of the Forest Department, from whom I have received specimens, the typical form is fairly common in the wild state, attaining on an average 90 ft. in height and 8 ft. in girth.

In cultivated trees, the leaves are extraordinarily variable in size and shape, but it

¹ The suckers of *P. alba* are described by Dubard, in *Ann. Sci. Nat.* xvii. 163 (1903).

² The only male flowers of *P. alba* which I have been able to examine were produced by a small tree at Kew, labelled var. *nivea*, and did not seem to be properly developed. Most, if not all, of the white poplars in Britain are female trees.

³ Gombocz, *op. cit.* 148, 149, recognizes as forms of var. *nivea*, the slight variations, which are doubtfully constant, called by Dode, *op. cit.* 21, 22, *P. triloba*, *P. Treyviana*, *P. Paletskyana*, *P. heteroloba*, *P. Morisetiana*, and *P. palmata*.

is doubtful if these constitute distinct varieties; on one tree I have observed ordinary branches with small leaves, varying in shape from oval and slightly toothed to trilobed, and more vigorous shoots showing large palmately lobed leaves. Old trees put forth feeble long shoots, on which the terminal white leaves are often imperfectly developed.

2. Var. *subintegerrima*, Lange, in Willkomm and Lange, *Prod. Fl. Hisp.* i. 233 (1861).

Var. *integrifolia*, Ball, in *Journ. Linn. Soc. (Bot.)* xvi. 668 (1878).

Populus subintegerrima, Dode, *op. cit.* 20 (1905).

Populus monticola, Brandegee, in *Zoë*, i. 274 (1890); Sargent, in *Garden and Forest*, iv. 330, fig. 56 (1891), vi. 190 (1893), and vii. 313, fig. 51 (1894).

Populus Brandegeei, Schneider, *Laubholzkunde*, i. 23 note, and 803 (1906).

Leaves coriaceous, often sub-evergreen; on the long shoots ovate or orbicular, sub-cordate or cuneate at the base, sub-entire or irregularly and slightly toothed, white beneath; on the short shoots almost orbicular, slightly sinuate or quite entire, grey beneath.

A native of southern Spain, Algeria,¹ and Morocco, where it was gathered in the greater Atlas by Hooker. It occurs also in the Canaries and the Azores. It appears to have been introduced into Mexico by the Spaniards, and has been found, apparently naturalised, along streams in the high mountains of Lower California, where it is called *guerigo* by the inhabitants. According to Sargent,² who speaks of it as a distinct native American species, its wood in this locality is quite unlike that of the other poplars, being light red, satiny, and useful for making furniture.

Similar forms³ occur near Askabad, east of the Caspian Sea, and in Kashmir.

3. Var. *pyramidalis*,⁴ Bunge, in *Rel. Bot. Mém. Ac. St. Pétersb.* vii. 498 (1851).

Var. *Bolleana*, Lauche, *ex* Huttig, in *Deut. Gart.* 500 (1878); Masters, in *Gard. Chron.* x. 502 (1878) and xviii. 556 (1882).

Populus Bolleana, Carrière, in *Rev. Hort.* liii. 40, 123 (1881), and lxiii. 188, fig. 48 (1891); Masters, in *Gard. Chron.* xviii. fig. 96 (1882).

Resembling the Lombardy poplar in habit. Leaves on the long shoots palmately 3- to 5-lobed, very white tomentose beneath; on the short shoots orbicular, with coarse triangular teeth, green beneath with traces of tomentum.

The fastigate form of the white poplar was first described by Bunge from specimens found by Lehmann in 1841, apparently wild⁵ on the bank of a stream on the north side of the Karatau mountain, between Bokhara and Samarkand. It appears to have been introduced⁶ in 1872 into Hoser's nursery at Warsaw, from a cutting sent by Col. Korolkow.⁷ Lauche procured it for the Horticultural Society of Potsdam from the same source in 1875.

¹ Collected near Ronda in Spain, by M. P. Price, and near Affreville in Algeria by A. Henry. A specimen from Gibraltar, in the Cambridge Herbarium, has slender female catkins, 4 to 5 in. long, with a woolly axis and pedicellate flowers; scales long, concave, irregularly toothed or lacerate; styles 4, spreading.

² In *Garden and Forest*, vi. 190 (1893).

³ Specimens in the Kew Herbarium.

⁴ *P. alba*, var. *croatica*, Wesmael, in De Candolle, *Prod.* xvi. 2, p. 324 (1868) is an erroneous name founded on *P. croatica*, Waldstein and Kitaibel, in *Flora*, xv. 2 Beil. p. 14 (1832), which is a narrow form of *P. nigra*. Cf. Koch, *Dendrologie*, ii. pt. i. p. 489 (1872).

⁵ Lehmann also saw it planted at Bokhara, where he gathered a leafless branch bearing staminate flowers, on 5th March 1842.

⁶ Cf. *The Garden*, 10th Dec. 1887, p. 543.

⁷ According to Carrière, *Rev. Hort.* lxiii. 188 (1891), it was introduced by Col. Korolkow, under the name of *P. alba pyramidalis* into various places in France in 1878, as Orleans, Segrez, Angers; and was first sold by Simon-Louis in 1879-1880. E. Morren, in *Belg. Hort.* 1879, p. 269, says that it was sent to Späth from Tiflis by Scharrer in 1879.

The oldest tree in England is probably a fine specimen at Kew, growing near the large Ginkgo tree, which measured 67 ft. by 4 ft. 8 in. in 1910. Another at Terling Place, Essex, planted in 1886, measured, in 1910, 60 ft. high by 3 ft. 3 in. in girth. A good specimen at Over Bridge, near Gloucester, was 55 ft. high in 1911. The largest tree we know of in Germany is one at Späth's nursery, which in 1908 was 66 ft. by 4 ft. It was first sent out from here in 1879.

4. Var. *globosa*, Späth, *Cat.*, No. 66, p. 3 (1886); Dippel, *Laubholz.* ii. 191 (1892).

A small tree or shrub, of dense habit, oval in outline, with small slightly lobed deltoid cordate leaves, grayish beneath, and said to be pink in the young state. This has been propagated by Späth of Berlin, since 1886, when it originated in their nursery from a cutting of *P. alba*; but is little known in England.

5. Var. *Richardi*. Leaves yellow on the upper surface, the colour lasting throughout the season. This was shown at the International Horticultural Exhibition of 1912 by Richard, nurseryman at Naarden-bussum, near Amsterdam.

6. Var. *pendula*, Loudon, *Arb. et Frut. Brit.* iii. 1640 (1838). Branchlets pendulous. This is mentioned by Loudon as a continental variety not introduced in 1838. It has lately been noticed¹ at Breslau; but we have seen no specimens.

DISTRIBUTION

Both the grey and the white poplars have been so widely planted in Europe that their exact distribution in the wild state is very uncertain. According to Willkomm, *P. alba* is certainly not a native of northern Germany, or of Scandinavia, though it thrives as a planted tree in Norway as far north as lat. 68°. Apparently *P. canescens* is a native of the British Isles, central and northern France, and of the Rhine valley in Baden and Alsace; while typical *P. alba* is more southerly and easterly in its distribution, occurring throughout the Mediterranean region in Spain and Portugal, Italy, the Balkan States, Greece, Algeria, Morocco, Syria, and Asia Minor, and extending northwards into the Alps and Carpathian ranges, being a characteristic tree of the alluvial flats of the Danube and all its tributaries from Bavaria, throughout Austria and Hungary, to its mouth in the Black Sea. Farther east, *P. alba* occurs in Russia, the Caucasus, western Siberia, the north-western Himalayas, and western Tibet. It is usually a native of low-lying moist woods, especially those fringing the banks of rivers; but it ascends in the valleys of the Alps, and in Spain and Italy to about 2000 feet elevation.

The white poplar is certainly not indigenous in England, and records of it as a wild tree all probably refer to *P. canescens*, which often shows a considerable amount of white foliage on the long shoots on young and vigorous trees. Turner,² in 1568, says, "As touching the whyte aspe, I remember not that I ever saw it in any place in England," and he appears to have known the tree, as he says it was plentiful in Germany and Italy. The date of the introduction of *P. alba* is uncertain.³ The

¹ Behnsch, in *Mitt. Deut. Dend. Ges.* 1906, p. 212.

² *Herball*, 99 (1568).

³ Hartlib, *Complete Husbandman* (1659), *ex* Loudon, *op. cit.* 1641, states that some years before the time of his writing, 10,000 aables were sent into England from Flanders, and transplanted into many counties. These trees were probably *P. canescens*.

white poplar is often called *abele* in England, but this is the Dutch name, *abeel*,¹ of *P. canescens*. The white poplar is known in Dutch and Belgian nurseries as *peuplier blanc de Hollande*.

The true white poplar has never become a common tree in England. Most of the large trees known as white poplars that we have seen are *P. canescens*, and it is impossible to separate the two species in Loudon's account of them. There are three good trees of *P. alba* at Bayfordbury, Hertford, the largest of which was 95 ft. by 10 ft. 4 in. in 1911. Mr. J. E. Little of Crofton, Hitchin, who has kindly sent specimens, tells me that between Norton Mill and Radwell Mill, near Baldock, Herts, on the bank of the river Ivel, there are four large white poplars, about 80 feet in height and 12 to 13 feet in girth. At Syston Park, Grantham, Miss F. H. Woolward, in 1905, measured a tree 105 ft. by 10 ft. 10 in. In Ireland the finest are at Adare Manor, where Mr. R. A. Phillips measured a tree 80 ft. by 9 ft. in 1910. Another at Nenagh was 60 ft. by 5 ft. in 1911. All these trees bear female flowers.

Pynaert² saw in 1882, at Troyes in France, a true white poplar which measured 140 ft. in height and 21 ft. 3 in. in girth, at six and a half feet above the ground. It divided at thirty-one feet up into three main stems, the largest of which girthed 14 ft. 9 in.; while the total spread of branches was 260 ft. in circumference. This magnificent tree, which was supposed to be about 400 years old, was destroyed³ by a storm on 1st February, 1902. I saw, in 1912, a fine tree in the botanic garden at Toulouse, 90 ft. high by 8 ft. in girth. (A. H.)

POPULUS CANESCENS, GREY POPLAR

Populus canescens, Smith, *Fl. Brit.* iii. 1080 (1805), and *Eng. Flora*, 245 (1828); Smith and Sowerby, *Eng. Bot.* xxiii. t. 1619 (1806), and vii. 114, t. 1392 (1840); Loudon, *Arb. et Frut. Brit.* iii. 1639 (1838); Bromfield, in *Phytologist*, iii. 841 (1850); Schneider, *Laubholzkunde*, i. 23 (1904); Dode, in *Mém. Soc. Hist. Nat. Autun*, xviii. 26 (1905); Aigret, in *Ann. Trav. Publ. Belg.* x. 1214 (1905).

Populus alba, Linnæus, var. *β*, *foliis minoribus*, Lamarck, *Fl. Franc.* ii. 235 (1778).

Populus alba, Linnæus, var. *canescens*, Aiton, *Hort. Kew.* iii. 405 (1789).

Populus alba, Willdenow, *Berl. Baumz.* 227 (1796) (not Linnæus); Hunter, in Evelyn, *Silva*, i. 208, plate (1801); Smith, *Eng. Bot.* t. 1618 (excl. description) (1806).

Populus alba, Linnæus, var. *genuina*, Wesmæel, in De Candolle, *Prod.* xvi. 2, p. 324 (1864).

Populus alba, Linnæus, var. *typica*, Gombocz, in *Math. Termes. Közl.* xxx. 151 (1911).

Populus megaleuce and *alba*, Dode, *op. cit.* 24, 25 (1905).

Populus hybrida, Reichenbach, *Icon. Fl. Germ.* xi. 29, t. 615 (1849) (not Bieberstein⁴).

Populus Steiniana, Bornmüller, in *Gartenfl.* xxxvii. 173, figs. 37, 38 (1888).

Populus Bachofenii, Reichenbach, *Icon. Fl. Germ.* xi. 29, t. 616 (1849) (not Wierzbicki⁵).

¹ Murray, *New Eng. Dict.* i. 15 (1888), says that the Dutch name corresponds to an old French word, *abel*, derived from late Latin, *abellus*, a name given to the white poplar in the twelfth century. Worlidge, *Syst. Agric.* 96 (1681), speaks of the *abele* tree as "a finer kind of white poplar."

² *Bull. Arbor. Belg.* 1882, p. 190.

³ *Ibid.* 1902, p. 72.

⁴ Bieberstein, *Fl. Taur. Cauc.* ii. 422 (1808), describes *P. hybrida*, a doubtful plant which, *op. cit.* iii. 633 (1819), he abandons, as not being different from *P. alba*. A specimen, however, in the Cambridge Herbarium, labelled "*P. hybrida*, M. B., Caucasus," is quite distinct from *P. alba*, and appears to be a form of *P. canescens* with orbicular leaves, sinuately toothed, and glabrous beneath. It bears fruiting catkins 4 in. long.

⁵ *P. Bachofenii*, Wierzbicki, in Rochel, *Banat. Reise*, 77 (1838), is said by Gombocz, *op. cit.* 148, to be a form of *P. alba*, var. *nivea*, and identical with *P. heteroloba*, Dode, authentic specimens of which I cannot distinguish from typical *P. alba*, var. *nivea*.

A large tree, attaining 100 ft. or more in height and 15 ft. in girth. Bark on young stems thin, smooth, grey or whitish; on older stems breaking on the surface into small roughened dark-coloured rhombic cavities, which ultimately unite together, making the bark towards the base of old trunks deep and longitudinally furrowed. Young branchlets, towards the top of the long shoots, covered with a dense whitish tomentum, which towards their base and on the short shoots diminishes in quantity, the twigs becoming dull grey or shining and glabrescent. Buds ovoid, more or less tomentose, according to their position on the branchlet. Leaves (Plate 408, Fig. 3) of two kinds—on long shoots and on suckers ovate-deltoid, cordate, acute, dark shining green and slightly tomentose above, covered beneath with a thick greyish tomentum; margin ciliate, with a few triangular teeth, variable in size, and like the rest of the margin irregularly glandular-serrate; petiole rounded, tomentose. Leaves on the short shoots, suborbicular or broadly ovate, subcordate, obtuse; margin non-ciliate, with a narrow translucent border, and a few sinuate non-serrate teeth; dark green, shining and glabrescent above; lower surface light green, with traces of scattered grey tomentum; petiole laterally compressed, glabrescent or slightly tomentose.

Staminate catkins,¹ 2½ to 4 in. long; axis tomentose; scales obovate, toothed, yellowish brown, fringed with hairs at the apex; pedicels pilose; disc oblique, entire in margin, glabrous; stamens eight to fifteen. Pistillate catkins about 1 in. long; with similar scales; disc pubescent; ovary glabrous, with four spreading sub-sessile yellowish simple stigmatic lobes.² Fruiting catkins, 3 to 4 in. long; capsules glabrous, two-valved. The stigmatic lobes like those of *P. alba*, are simple and undivided; whereas in *P. tremula*, each lobe is deeply scalloped and waved.

Populus Bogueana, Dode, *op. cit.* 24 (1905), is a vigorous form of *P. canescens*, in which the leaves on the long shoots are very large, 5 in. or more in length and breadth; and appears to be now sold by some nurserymen as *P. tomentosa*, the white poplar from Peking. A tree of this at Kew, obtained from Simon-Louis in 1904, is now about 25 ft. high. Another at Grayswood, obtained from Barbier in 1906, is 15 ft. high and very thriving. There are also small trees with similar large foliage in the Botanic Gardens at Edinburgh and Glasnevin. I found this form wild in the forest of Orleans, where it was growing evidently from vigorous suckers of the typical grey poplar beside it.

By *P. canescens*,³ Smith meant the common grey poplar in England, which I have described above. It differs mainly from typical *P. alba* in the lesser amount of

¹ A tree in the Cambridge Botanic Garden bore monocious catkins in 1907, the staminate flowers at the base, the pistillate towards the apex. Similar cases are recorded by Penzig, *Pfl. Teratologie*, ii. 321 (1894), and by Baillon, in *Bull. Soc. Linn. Paris*, 1897, p. 658.

² The eight stigmas, figured by Smith, *Eng. Bot.* xxiii. t. 1619 (1806), have not been observed by any other botanist, and were probably abnormal. In *Eng. Bot.* vii. 114, t. 1392 (1840), the number of stigmas is said to be inconstant, but I have found them invariably four.

³ The grey and white poplars were first distinguished by Lobelius, *Icon. Pl. seu Stirp.* ii. 193 (1591). Their synonymy is much involved, but has been clearly elucidated in an interesting article by Tidestrom, in the *American Midland Naturalist*, i. 113 (1909), to which the reader interested in such matters is referred. I am not at all certain that Smith clearly understood the distinctions between the two species, as Sowerby's plate of *P. alba*, t. 1618 (1806), is the leaf of a vigorous shoot of *P. canescens*; and Smith's statement that *P. alba* is not uncommon in moist woods (in England) is erroneous, as the latter is never seen in England, except as a planted tree. Most of his description refers to *P. alba*; and his specimen in the herbarium of the Linnean Society, London, certainly belongs to this species.

the tomentum on the branchlets and leaves, the latter having a different shape. It is adapted to the humid and mild climate of western Europe; while *P. alba*, with its dense protective covering against evaporation of water, is a native of drier and more continental regions.

In the grey poplar, as in the white poplar, the leaves are fundamentally of two kinds, different in shape, margin, tomentum, and petiole; but conveniently distinguished as "white leaves" and "green leaves." Some shoots bear only white leaves, some only green leaves; whilst others have green leaves towards the base and white leaves towards the tip. The green leaves may be greyish beneath or nearly devoid of tomentum. The size of the white leaves is inconstant, and depends on the vigour of the branchlets. In old trees the green leaves are preponderant, especially on the lower branches; and such trees are popularly known as *P. canescens*. In younger trees, and on the upper branches of older trees, the white leaves are conspicuous; and such trees are often erroneously called *P. alba*. In addition to this variation, occurring on the same tree in its different stages of growth, there are differences in the foliage of different trees, which require further study.

A peculiar form, in which the leaves are thinner in texture, orbicular and not deltoid in outline, and nearly glabrous beneath, is considered by Dr. C. E. Moss to be possibly the hybrid *P. canescens* × *P. tremula*. Two pistillate trees¹ with this foliage, one at Hitchin, and another growing beside a stream between Caverham and Icklingham, Suffolk, have pink stigmas, the colour of which suggests the influence of *P. tremula*. These two trees flower a fortnight earlier than ordinary *P. canescens*. Staminate trees with similar foliage have been found both in England and Ireland. Mr. R. A. Phillips, who sends specimens² from Lorrha, Tipperary, points out that the catkins are shorter than in the typical grey poplar, about 1½ in. long, with fewer (4 to 7) stamens, and narrower scales. There is also a difference in habit, the round-leaved trees have thick stiff ascending branches and short erect twigs; while the ordinary form has spreading branches and pendulous twigs.

In *P. tremula*³ the foliage is all of one kind, similar in form to the green leaves of *P. canescens*, but devoid of any trace of tomentum. The theory that typical *P. canescens* is a hybrid⁴ between *P. alba* and *P. tremula* rests on this apparent similarity of foliage, and is not supported by evidence from the floral organs. Female trees of the grey poplar are, however, rare, and the pistillate flowers have only been examined in a few cases. So far as I can judge, *P. canescens* is a good species, being the

¹ The pistillate tree with pink stigmas is *P. canescens*, Dode, in *Mém. Soc. Hist. Nat. Autun*. xviii. 26 (1908) (not Smith).

² Mr. Phillips recently sent me another form with leaves intermediate in shape and with flowers having eight stamens.

³ The suckers of *P. tremula* bear leaves which, in their shape and in the presence of a slight tomentum, simulate the white leaves of *P. canescens*.

⁴ The older continental botanists, as Reichenbach, *Icon. Fl. Germ.* xi. 30, t. 617 (1849), and Hartig, *Naturgesch. Forst. Culturpfl.* 434 (1851), considered *P. canescens*, Smith, to be identical with the pubescent form of the aspen, *P. tremula*, var. *villosa*. This has silky hairs on the leaves and branchlets, very different from the tomentum of *P. canescens*. The occurrence of true hybrids between *P. tremula* and *P. alba* is possible on the Continent. Radde, *Pflanzenverb. Kaukas.* 153 (1899), saw a group of trees near Sotschi on the eastern shore of the Black Sea, which he considered to be of this origin, as the trees strongly resembled *P. tremula*. Reehinger, in *Verh. Zool. Bot. Ges. Wien*, xlix. 284 (1899), discusses the hybrids in Austria. Adamovic, *Veg. Balkanlând.* 145 (1909), reports similar hybrids in eastern Roumelia. Cf. also *P. albo-tremula*, Krause, in *Jahrb. Schles. Ges.* 1848, p. 130.

western representative in Europe of the white poplar. It appears to be common in France, extending eastward to the Rhine valley; and is known in Belgium and France as *franc-picard* or *grisard*. It often attains an immense size in France, the finest that I have seen being one in the Botanic Garden at Toulouse, which was 100 ft. in height and 12 ft. in girth in 1912. In Holland, where it is wild on the dunes near Haarlem,¹ it is always called *abeel*, a name which is often erroneously applied to the white poplar by English writers. The grey poplar is undoubtedly a native² of England, and is the tree referred to by old authors as the white poplar; but has been probably always better known to woodmen and peasants as the aspe.

(A. H.)

Both the grey and white poplars were known to Evelyn,³ who spoke of the first as the white "to be raised in abundance by every set or slip. Fence the ground as far as any old poplar roots extend and they will furnish you with suckers innumerable, to be slipped from their mothers and transplanted the very first year, but if you cut down an old tree you shall need no other nursery." Later on, he says: "There is something a finer sort of white poplar, which the Dutch call abele, and we have late much of it transported out of Holland. They are also best propagated of slips from the roots, the least of which will take, and may in March, at three or four years' growth, be transplanted." The latter was still an uncommon tree in Plot's time, for he says:⁴ "Of unusual trees now cultivated in Oxfordshire is the abele tree, advantageously propagated by Sir J. Croke of Waterstock, by cutting stakes out of the more substantial parts of the wood; which put into moist ground grew more freely than willows, coming in three or four years' time to an incredible height."

French and English authors agree that the white poplar will not bear lopping like the black poplars; and though I have no experience in this matter, yet as I have never seen a pollarded tree I presume that the grey poplar is equally liable to injury when large branches are cut. It seems able to attain its largest dimensions in poor stiff soil, and in cold situations, provided that there is sufficient moisture in summer; and though I cannot say that the tree is equal to the black Italian poplar from an economic point of view, or equal to *P. alba* as an ornamental tree, yet as the illustration shows, it is a stately tree when well grown.

The range of this tree in Great Britain is obscure, because it has been planted for a long period.⁵ Watson⁶ says, "It is given as an unquestioned native in the floras of Surrey, Essex, Herts, Suffolk, Norfolk, Cambridge. In the floras of Tyne and North Yorkshire it is reduced to the grade of denizen. And if I rightly know the distinction between *alba* and *canescens*, I should now deem the latter native, and the former planted, as seen in Surrey and elsewhere."

Though the male tree is found of large size in many counties, the female is in

¹ Mr. L. Springer, a distinguished landscape gardener of Haarlem, says that the true white poplar will not endure the sea wind on the coast of Holland.

² Clement Reid, *Origin of Brit. Flora*, 150 (1899), states that leaves collected by Prestwich in interglacial beds at Greys, Essex, suggest *P. canescens*, though they may belong to *P. tremula*. The latter species is only recorded from one locality, Caerwys, Flintshire, in neolithic deposits; so that the geological evidence as to the existence of poplars in England is very scanty.

³ *Sylva*, 78 (1679).

⁴ *Natural History of Oxfordshire*, 175 (1705).

⁵ Loudon quotes M'Culloch, that it is the only tree found in the island of Lewis, but probably he mistook the aspen for it.

⁶ *Topographical Botany*, i. p. 357 (1873).

my experience very rare, the only ones I have seen being two rather stunted specimens of considerable age, which grow on my land by the side of a watercourse in a meadow on Upcot Farm, near Withington, Gloucestershire. There are male specimens close to them, and in some seasons fertile seed is produced, from which, in 1907, a few seedlings¹ were raised by Miss F. Woolward. Two of these were planted at Colesborne, but one was weakly from the first and the other was killed by a fungoid disease soon after I planted it out. I have never seen a natural seedling of this or of the white poplar in England.

REMARKABLE TREES

The finest grey poplars that we have seen are in a group called the Grove in the park at Longleat. Mitchell,² writing in 1827, mentions these as being then 100 ft. high, with trunks 3 to 4 ft. in diameter, and 40 to 60 ft. of clear bole. In *Trans. Eng. Arbor. Soc.* v. 391 (1903), an illustration of one of these trees from a photograph by A. C. Forbes was given. He calls it an abele poplar, and gives the measurement of the largest as 120 ft. by 15 ft. 3 in., and the cubic contents 450 ft. Ten trees in this grove, all with straight clean boles of 50 to 80 ft., then averaged 115 ft. by 13 ft., with an average cubic content of 240 ft. When I last visited Longleat in 1909 I found the majority of them still healthy, and measured one which was 125 ft. by 11 ft.

There are several very fine trees at Colesborne, one of which (Plate 382) has two stems rising from the base, and measuring 115 ft. by 10 ft. and 10 ft. 3 in. respectively. These trees sucker freely, and some young trees grown from the suckers, which have been pruned but not transplanted, are growing very fast—about 40 ft. in ten years.

In a field about a mile from Overbury Court, near Tewkesbury, Mr. F. R. S. Balfour discovered a tree 86 ft. high, with a trunk 18 ft. long by 18 ft. 10 in. in girth and with very large spreading branches. At Kingston Lacy, Dorsetshire, a tree with many suckers round it measured, in 1906, 118 ft. by 13 ft. 9 in. At Strathfieldsaye I measured in 1905 a tree 108 ft. by 16 ft., which had a sucker coming up 80 yards from its base. In the park at Syon House there is a well-shaped tree 101 ft. by 12 ft. 5 in.³ In the home park of Windsor Castle there is a short avenue of grey poplars close to the bank of the Thames, below Victoria Bridge. Mr. Mackellar informs us that these were planted between 1840 and 1850, and measured in January, 1913, 90 to 100 ft. in height and 9 to 12 ft. in girth. At Gilbert White's old home at Selborne, the tallest tree is a grey poplar, which Mr. H. B. Watt⁴ measured in 1912 as 109 ft. high by 9 ft. 5 in. in girth. At Youngsbury, Ware, Hertford, a tree measured 95 ft. by 10 ft. 4 in. in 1911.

In Wales I have seen none of any great size; and I have not heard of any remarkable ones in the eastern or northern counties.

In Scotland, where the tree is common, Mr. J. Renwick⁵ tells us of two very

¹ *Journ. Bot.* xlv. 417, t. 487 (1907). ² *Dendrologia*, 51 (1827). ³ A. B. Jackson, *Cat. Trees Syon*, 22 (1910).
⁴ *Selborne Magazine*, xxiii. 122 (1912). ⁵ *Glasgow Naturalist*, iii. 119, pl. ii. (1911).

large trees at Mauldslie Castle, Lanarkshire, the seat of Lord Newlands, which in 1911 measured 100 ft. by 21 ft. 3 in. at two feet from the ground, and 117 ft. by 16 ft. 5 in. at two feet nine inches from the ground. Both these trees suffered severely in the great gale of October 5, 1911, the larger tree losing one of its heavy limbs. Walker, *Essays of Natural History*, 49 (1812), states: "In the year 1769 there was a row of abeles at Stevenston, East Lothian, which was soon after cut down. It contained 122 trees, all about 80 ft. high and from 20 to 30 ft. of clear trunk, without a branch. The trunks were 5 to 7 ft. in circumference, and yet they stood only 7 ft. distant from each other. They were planted in a deep moist soil, were then eighty years old, and afforded a great quantity of timber. It is doubted whether or not the abele is a native of England. It certainly has the appearance of being an indigenous tree in several parts of Scotland. It was planted in many places about the end of the last and in the beginning of the present century, but it has since been neglected." The tallest recorded in the *Old and Remarkable Trees of Scotland* was at Glenarbuch in Dumbartonshire, and was said to be 110 ft. by 12 ft. in 1867.

In Ireland the grey poplar is found on the banks of the Suir, Nore, Barrow, and other rivers in the south, where it may very possibly be wild; and Mr. R. A. Phillips has sent us specimens of several trees, one of which, growing near Birr, was 90 ft. by 12 ft. in 1910. I measured a tree at Markree Castle, Sligo, which in 1909 was 120 ft. by 13 ft. There are two fine trees at Abbeyleix, one of which was 100 ft. by 13 ft. 4 in. in 1910.

In Belgium and France this tree is known as *grisard*, and is often mistaken for the white poplar. I have not noticed any of remarkable size.¹

TIMBER

I am inclined to think that the timber is of superior quality to that of the black Italian poplar; and from what I heard in Belgium and France,² that opinion is also held there. But this may depend on the age of the trees and the rate of growth, which, according to Crowe,³ who paid much attention to this tree in Norfolk, is slower than that of any other British poplar. It is rarely distinguished by the timber merchants in England. Messrs. Howes and Sons, Norwich, however, inform me that "it is the only poplar found to be of any service in the coach-building trade. It is light in weight, exceedingly strong, and can be cleaned up into a nice finish to receive the paint." They pay for the best quality of the wood of this tree, which they know under the name of abele, about 2s. 6d. per foot, as compared with about 1s. 3d. for the wood of the black Italian poplar, which is much less durable and not so firm in texture. I prefer to use it at home for cart bottoms and linings, and for flooring cottage bedrooms, for which its toughness and non-inflammable nature make it valuable.

(H. J. E.)

¹ In *Mitt. D. Dendr. Ges.* 1904, p. 18, a tree was recorded at Schloss Dyck, near Dusseldorf, which, at about 95 years old, was 48 metres high by 3½ metres in girth. The height is evidently much exaggerated.

² Mouillefert, *Essences Forestières*, 301 (1903), says that its fine-grained wood is one of the best of the poplars.

³ Smith, *Eng. Flora*, iv. 244 (1828), who obtained his information from Crowe, states that "the wood is much finer than that of any other British poplar, making as good floors as the best Norway fir in appearance, and having moreover the valuable property, that it will not, like any resinous wood, readily take fire." Cf. *Gard. Chron.* 1848, p. 172.

POPULUS TOMENTOSA

Populus tomentosa, Carrière, in *Rev. Hort.* x. 340 (1867); Wesmael, in De Candolle, *Prod.* xvi. 2, p. 325 (1868), and *Mém. Soc. Sc. Hainaut*, 228, t. 17 (1869); Schneider, *Laubholzkunde*, i. 21 (1904); Dode, in *Mém. Soc. Hist. Nat. Autun*, xviii. 25 (1905); Gombocz, in *Math. Term. Közl.* 140 (1911).

Populus alba, Burkill, in *Journ. Linn. Soc. (Bot.)* xxvi. 535 (1899) (not Linnæus).

Populus alba, Linnæus, var. *tomentosa*, Wesmael, in *Bull. Soc. Roy. Bot. Belg.* xxvi. 373 (1887); Burkill, in *Journ. Linn. Soc. (Bot.)* xxvi. 535 (1899).

Populus alba demodata, Maximowicz, in *Bull. Soc. Nat. Mosc.* i. 49 (1879) (not Hartig).

Populus pekinensis, L. Henry, in *Rev. Hort.* lxxv. 355, fig. 142 (1903).

A large tree, similar in size and bark to *P. alba*. Branchlets grey tomentose. Buds ovoid, slightly tomentose, chestnut brown. Leaves (Plate 408, Fig. 2) on the long shoots of old trees, 4 to 6 in. long, 3 to 5 in. broad, triangular-ovate, without lobes or lobules, subcordate or truncate at the broad base, acuminate at the apex; margin with a few (not exceeding ten on each side) sinuate teeth; dark shining green above, glabrescent beneath with traces of grey tomentum. Leaves on the long shoots of vigorous young trees, similar in shape, but the margin biserrate with acute glandular teeth, and the lower surface covered with a grey tomentum. Leaves on the short shoots, small, ovate or triangular, cuneate at the base, sinuately toothed, glabrous beneath. Flowers not seen.

This fine poplar, which attains an enormous size in north China,¹ was discovered by Simon at Siwan, north-west of Peking. His specimen, described by Carrière, is identical with those in the Kew Herbarium, collected near Peking by Sir Rutherford Alcock and by Prof. Sargent, and with another gathered in Shantung by the Rev. A. Williamson, which is preserved in the Edinburgh Herbarium. Gombocz records it also for the mountains of Shensi, and Kiaochow in Shantung. Elwes, in 1912, saw old trees in the grounds of the Summer Palace, Peking, which were about 75 ft. high and 10 ft. in girth. This poplar is called *pai-yang* by the Chinese.²

A young living plant sent from Peking in 1897 by Père Provost to the Museum at Paris, where it was propagated, has grown vigorously, and was in 1912 about 35 ft. high by 2 ft. 3 in. in girth. We have seen no trees in England of this species.³ Jack⁴ introduced in 1905 into the Arnold Arboretum cuttings from Peking, which have produced thriving and hardy young trees. He states, however, that it is more readily propagated by grafting.

(A. H.)

¹ According to Schneider, it was collected also by Père Giraldi, farther south in Shensi; but the latter's specimen is identified by Diels, *Flora von Central China*, 274 (1901), with *P. tremula*, and is possibly *P. wutaica*, Mayr, *Fremdländ. Wald- u. Parkbäume*, 494, fig. 215 (1906).

² Cf. Bretschneider, *Bot. Sinic.*, ii. 359 (1892), who refers to this tree as *P. alba*.

³ The trees often sold by French nurserymen as *P. tomentosa* appear to be *P. Bogueana*, Dode. Cf. *ante*, p. 1781.

⁴ *Mitt. Dent. Dent. Ges.* 1909, p. 281.

POPULUS TREMULA, ASPEN

Populus tremula, Linnæus, *Sp. Pl.* 1043 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1645 (1838); Wesmael, in *Mém. Soc. Sc. Hainaut*, iii. 229 (1869), and De Candolle, *Prod.* xvi. 2, p. 325 (1864); Willkomm, *Forstl. Flora*, 521 (1887); Mathieu, *Flore Forestière*, 486 (1897); Schneider, *Laubholzkunde*, i. 19 (1904); Dode, in *Mém. Soc. Hist. Nat. Autun*, xviii. 30 (1905); Ascherson and Graebner, *Syn. Mitteleurop. Flora*, iv. 24 (1908); Gombocz, in *Math. Termes. Közl.* xxx. 123 (1911).

Populus australis, Tenore, *Ind. Sem. Hort. Neap.* 1830, p. 15.

Populus græca, Grisebach, *Spic. Fl. Rum.* ii. 345 (1844) (not Aiton, *Hort. Kew.*).

A tree, occasionally attaining in Scandinavia, Russia, France, and Germany 100 ft. in height and 6 to 8 ft. in girth, but usually much smaller, especially in the British Isles. Bark of young trees smooth, thin, greenish or whitish; on old trunks thick, with small rhomboidal fissures, as in *P. alba*, and ultimately deeply furrowed. Young branchlets glabrous, rounded, shining, with orange lenticels. Buds ovoid, acute, shining brown, slightly viscid, with ciliate scales, the uppermost of which are slightly pubescent. Leaves (Plate 408, Fig. 4) suborbicular, variable in size, averaging 2 in. in diameter, thin in texture, truncate or subcordate at the base, rounded or acute at the apex; margin with a narrow translucent border, and a few rounded or sinuate small teeth; tomentose when young, speedily becoming glabrous on both surfaces, pale or glaucous beneath; venation pseudo-five-palmate; glands¹ at the base two, cup-shaped, well-developed on the terminal leaves of long vigorous shoots, absent on the basal leaves and on those of the short shoots; petioles slender, glabrous, laterally compressed, often as long as the blade. Leaves on young plants and on sucker shoots, and in rare cases on sporadic branches of adult trees, different in shape and much larger, 4 to 5 in. long, 3 to 4 in. broad; ovate, acuminate at the apex, truncate or cordate at the base, greyish and slightly woolly beneath, glandular-serrate, with short pubescent terete petioles.

Catkins sub-sessile, densely and greyish tomentose; axis pubescent; scales long persistent, obovate, deeply lobed and fringed with long white hairs; flowers dense, numerous, on very short pilose pedicels. Stamens about 10, with short filaments and purple anthers, on an oblique disc with an entire and incurved margin. Ovary glabrous; stigmas two, reddish, each divided, forming four widely dilated curving arms; disc funnel-shaped, oblique, glabrous; capsule two-valved.

This species in the wild state displays a considerable amount of variation in the shape, size, and colour of the leaf, and in the amount of pubescence on the branchlets and leaves. The most noteworthy² are:—

1. Var. *Freynei*, Hervier, in *Bull. Herb. Boiss.* iv. app. i. 18 (1896), and *Rev. Gen. Bot.* viii. 177 (1896). Leaves rhombic, cuneate at the base, ciliate, pubescent beneath when young. Central France and Prussia.

¹ According to Kerner, *Nat. Hist. Plants*, Eng. Trans. i. 238, fig. 55 (1898), these glands exude resin and serve for absorbing water in rainy weather; but Trelease, in *Bot. Gaz.* vi. 284 (1881), states that they contain honey at the beginning of the season, and are visited by bees and other insects.

² Var. *purpurea*, Simon-Louis, ex Späth, *Cat. No.* 102, p. 108 (1898-1899), with purplish young leaves, does not seem to differ from the type, as seen in cultivation at Kew.

2. Var. *villosa*, Wesmael, in De Candolle, *Prod.* xvi. 2, p. 325 (1868).

Populus villosa, Lange, *Syll. Soc. Ratisb.* i. 185 (1824), and ex Reichenbach, *Fl. Germ. Excur.* 173 (1830).

Populus canescens, Reichenbach, *Icon. Fl. Germ.* xi. 30 t. 617 (1849) (not Smith); Hartig, *Forstl. Kulturpfl.* 434 (1851).

Branchlets and leaves at first densely pubescent with long silky hairs, more or less persistent in summer. This variety¹ appears to be quite as common in the wild state as the typical glabrous form.

The origin of the following cultivated form is unknown:—

3. Var. *pendula*, Loudon, *Arb. et Frut. Brit.* iii. 1646 (1838).

Populus pendula, Burgsdorf, *Anl. Anpfl. Holzart.* ii. 175 (1787).

Branchlets pendulous. Usually seen as a small grafted tree.

The common aspen is widely spread through Europe, northern Africa, Asia Minor, the Caucasus, and Siberia, being replaced by closely allied species in China, Japan, and the Himalayas. It occurs in every European country; but is absent from the south of Spain, Sicily, and the islands in the western Mediterranean. It is much more common in the north, where it reaches the Arctic Circle both in Europe and Asia; and either in pure woods or mixed with birch covers extensive tracts in Scandinavia, Russia, and Siberia. Towards the south, it only occurs as a scattered tree in mixed woods; and ascends in the Pyrenees to 6000 ft., and in the Alps to 4000 ft. In England it is not uncommon in coppiced woods; but it is of more frequent occurrence in the Highlands of Scotland, ascending to tree limit.

The aspen is a short-lived tree, rarely attaining an age of over 100 years. When cut down, it produces coppice shoots of no great vigour, and usually reproduces itself in such cases by abundant suckers,² which are given off to a considerable distance by its widely-spreading superficial roots. (A. H.)

As an ornamental tree the aspen is in northern countries one of the most beautiful, on account of the splendid red and yellow tints which the leaves assume in autumn; but in England these colours are seldom seen in the same degree, and though the bright pale green of its trembling leaves gives it a certain beauty, it is hardly worth growing in any quantity. It is not particular about soil, and may serve to clothe waste places such as old pit banks. It is one of the latest trees to come into leaf in spring.

The largest trees I have noticed in England are two at Little Sodbury Manor, in Gloucestershire, which do not much exceed 60 ft. in height. Sir Hugh Beever tells me that he has seen none larger in the eastern counties. There are four trees forming a handsome group near the river Gade at The Grove, Watford, the largest being 54 feet by 3 ft. 3 in. in 1904. These were photographed³ by Mr. Henry Irving.

In Wales the tree does not seem common, but apparently attains a greater size than it usually does in England. In May 1911 I saw some large trees at an

¹ M. Dode informed me that in the Forêt de Bondy this variety attains 35 metres in height.—H. J. E.

² The suckers of *P. tremula* are described by Dubard, in *Ann. Sc. Nat.* xvii. 160 (1903).

³ Reproduced by Groom, *Trees and their Life Histories*, figs. 192, 193 (1907).

elevation of about 800 ft. at Abergwessin in North Breconshire. The Welsh name for it in this district is *aethnen*; but at Hafodunos, in North Wales, W. Jones, the head gardener, told me that the local name was *tafoden merched*, which means "women's tongues." In the Isle of Man a name of the same meaning, *chengey-ny-mraane*, was used.

In the Highlands, where it ascends to the upper limit of trees—in Braemar up to at least 1600 ft.¹—it seems commoner, and attains larger dimensions. I have never seen any, however, which in size equal those in the north of Norway, the largest I know of being a tree on the shores of Loch Garry, which Captain Ellice of Invergarry found in 1910 to be about 60 ft. by 7 ft.² In the birch woods of Strathglass, Glenaffric, and Guisachan the aspen occurs in clumps which appear to have grown from suckers, but old trees are scarce. The largest I saw was a fallen tree above the falls in Glenaffric, which, when standing, was about 50 ft. high, with a trunk 7 ft. in girth. The belief³ of the Highlanders, who call the aspen *crithean* or *critheac*, that the Cross of Christ was made of this tree still exists both among Catholics and Protestants in this district. I was assured by reliable persons that it is looked on as an accursed tree, and that no Highlander will use the wood for any purpose, even for fuel.⁴ Notwithstanding this belief, I saw on the croft of Peter Macdonald at Balnath, near the head of Glen Urquhart, a group of well-shaped aspen about 40 ft. high, which, as he told me, he had trained up from suckers, and were about forty years old.

In Ireland, the aspen is recorded from almost every county, but is by no means a common tree. Mr. R. A. Phillips informs us that it is native on mountain cliffs, rocky lake shores, the banks of rivers, and in old hedgerows in uncultivated bogland districts, and also on the islands off the west coast. In the mountains of Kerry and Antrim it is a mere bush, but in the lowlands is a small tree, rarely over 40 ft. in height. The finest which he has seen grows on the edge of the river Nore near Durrow, and measured 65 ft. by 5 ft. in 1908.

According to Schübeler it extends in Scandinavia as far north as Alten (lat. 70°), where it attains 60 ft. in height, and in the south ascends to 3500 ft. The tallest aspens that he mentions in Norway grew some miles east of the farm of Viken, in Nidervan, and were 90 to 100 ft. high; whilst at Femrade, in Sogndal (lat. 61°), there was a very old aspen 58 ft. high, with a girth of 16 ft. at four feet from the ground. I saw myself in Junkersdal, in lat. 67°, trees of 80 feet high and 6 to 7 ft. in girth, which were finer than any I know in Great Britain.

In France, Mouillefert says, that though common in the damper parts of the forest on sandy or gravelly soils, it is rare on dry or calcareous formations, and that owing to the freedom with which it produces suckers it tends to supersede other trees in suitable places.

¹ White, *Flora of Perthshire*, p. 268, says that it ascends to 2100 ft. in Athole, and 1400 ft. in Rannoch; and that both the forms—*villosa*, Lange, and *glabra*, Syme,—occur in the county.

² Loudon mentions trees of much greater size at various places in England and Scotland, but there is little doubt that they were *P. canescens*.

³ Cf. Loudon, *op. cit.* 1648, and Cameron, *Gaelic Names of Plants*, 70 (1883).

⁴ Cf. Carmichael, *Carmina Gadelica*, 104 (1900), who states that in Uist the hateful aspen is banned. If it still exists in Uist, it is now an uncommon tree, as I saw none in North or South Uist in 1910.

Though usually looked on as a forest weed, it is possible that when grown naturally from suckers thickly enough to clean the stems from branches, it may have some value for making matches. In Sweden it is largely employed for this purpose, and according to Schübeler 1,400,000 cubic ft. were thus used in 1882, and valued at 70 ore (about 8d.) per cubic foot. Cargoes of poplar timber, which I believe to be mainly aspen, are now imported from the Baltic for making matches, and cost delivered in Gloucester from 38s. to 48s. per load of 50 cubic ft. caliper measure.

It is also largely used for pulp-making, for which it is very suitable; but it could scarcely be produced here in sufficient quantities at a price that would compete with the produce of northern Europe and America.

On this subject, however, a valuable paper¹ by Weigle and Frothingham on the American aspens should be consulted, as these species resemble our native aspen in life-history, characteristics, and uses. The conclusions of these authors may be summarised as follows:

1. No other trees have so wide a distribution in Europe and Asia as the aspens, *P. tremula* covering 140° of longitude and 35° of latitude, whilst *P. tremuloides* ranges over 112° and 41° respectively.

2. They are both pre-eminently cold- and moisture-loving trees, requiring a very short season of growth and thriving—as *P. tremula* does at Colesborne—where frosts may occur during every month of the year.

3. For their best growth they require deep fresh or moist, porous and well-drained soils; but they will grow on thin dry soil and in poorly drained situations.

4. They are strikingly intolerant of shade; and this applies even more strongly to the suckers by which they are commonly reproduced, and which are often mistaken for seedlings. The latter are rarely seen in England.

5. Their growth is rapid during the first twenty to thirty years, and though they may attain considerable size, yet they are short-lived, usually decaying before 100 years of age, and often much sooner; and root-suckers do not produce such large or well-shaped trees as seedlings.

6. They are best managed as a pure crop under a short rotation; and on account of their extreme light-demanding character require timely thinning.

7. The wood produces the best and whitest pulp, which can be produced and manufactured, more cheaply than other species, into paper which is peculiarly suitable for books and magazines. As the fibre is too short to make good paper alone, it is mixed with a proportion (usually about 40 per cent) of sulphite spruce pulp which adds strength. The finished paper is tough, white, and easily sized, and though inferior to rag paper for the finest uses, is much cheaper.

Waste land suitable for profitable planting of *P. tremula* (and possibly also *P. canescens*) might be found in some parts of Scotland and Ireland; and experiments in this direction are advisable.

In France, according to Mouillefert, the wood is valued for charcoal, but as firewood it burns out very quickly.

(H. J. E.)

¹ U.S. Forest Service, Bull. No. 93, *The Aspens: their Growth and Management* (1911).

POPULUS TREMULOIDES, AMERICAN ASPEN

Populus tremuloides, Michaux, *Fl. Bor. Amer.* ii. 243 (1803); Sargent, *Silva N. Amer.* ix. 158, t. 487 (1896), and *Trees N. Amer.* 154 (1905); Schneider, *Laubholzkunde*, i. 19 (1904); Dode, in *Mém. Soc. Hist. Nat. Autun*, xviii. 33 (1905).

Populus trepida, Willdenow, *Sp. Pl.* ii. 803 (1805); Loudon, *Arb. et Frut. Brit.* iii. 1649 (1838).

Populus tremuliformis, Emerson, *Trees Massachusetts*, 243 (1846).

Populus atheniensis,¹ Ludwig, *Neue Wilde Baumz.* 35 (1783), ex Koch, *Dendrologie*, ii. 486 (1872); Koehne, *Deut. Dend.* 80 (1893).

Populus græca,¹ Loudon, *Arb. et Frut. Brit.* iii. 1651 (1838) (not Aiton); Lauche, *Deut. Dend.* 316 (1883).

A tree, attaining in America 100 ft. in height and 9 ft. in girth. Bark like that of *P. tremula*. Young branchlets slender, glabrous, shining reddish brown, with orange lenticels. Buds ovoid, sharp-pointed, shining brownish, slightly viscid, with glabrous scales. Leaves (Plate 408, Fig. 5) ovate to nearly orbicular, 1½ to 2 in. in diameter, thin in texture; truncate, rounded or cuneate at the base; shortly cuspidate at the apex; glabrous on both surfaces, pale beneath; margin with a narrow translucent border, ciliate especially on the leaves of the short shoots, finely glandular-serrate; pseudo-three- to five-palminerved at the base, where the glands in occurrence and appearance are like those of *P. tremula*; petiole slender, glabrous, laterally compressed, variable in length, often as long as the blade. Leaves on sucker shoots, similar to those of *P. tremula*, but glabrous on both surfaces, with ciliated margins.

Flowers scarcely distinguishable from those of *P. tremula*, but with more slender catkins, smaller in all the parts of the flowers; disc of the pistillate flower crenate.

1. Var. *pendula*. A weeping form, with pendulous branches, always grafted.

This is generally known as the *Parasol de St. Julien*, which is said² to have been first propagated by Messrs. Baltet, who found in 1865, on the bank of a canal at St. Julien, near Troyes, a tree with weeping branches, which they crown-grafted on the white poplar, and considered to be a weeping form of *P. tremula*.

It is said by Koch³ to have been much more common in commerce in 1872 than the weeping variety of the common aspen, and it is possible that the preceding history is applicable rather to a weeping variety of *P. tremula*.

2. *P. cercidiphylla*, Britton, *N. Amer. Trees*, 180 (1908), seems to be a form with small entire or undulate leaves, which was found in Wyoming by Dr. C. C. Curtis in 1900. (A. H.)

¹ Loudon describes this poplar under both the names *P. trepida* and *P. græca*, and states in *Gard. Mag.* 1840, p. 231, and *Trees and Shrubs*, 823 (1842), that *P. græca* was "named after the village called Athens, on the banks of the Mississippi, where the tree grows abundantly." *P. atheniensis* is said by Koehne to derive its name from the town of Athens in New York State, whence it was introduced. *P. græca*, Aiton, *Hort. Kew.* iii. 407 (1789), was insufficiently described, and said to be a native of the Greek archipelago.

² Cayeux, in *The Garden*, 1886, p. 2. The pendulous variety of *P. tremuloides* is called *Parasol de St. Julien*, in Simon-Louis's catalogue, 1899-1900, and appears to be now always sold in France under this name. Späth, *Catalogue*, No. 57, p. 61 (1883), identifies the *Parasol de St. Julien* with *P. canescens pendula*; and the latter name, now no longer employed, would seem to show that Späth's tree was rather a weeping *P. tremula* than a pendulous form of *P. tremuloides*.

³ *Dendrologie*, ii. pt. i. 487 (1872).

The American aspen is similar in its habits to the common species, and is widely spread throughout North America, from southern Labrador, the eastern shores of Hudson's Bay, the mouth of the Mackenzie river, and the Yukon valley in Alaska, southwards to Pennsylvania and Nebraska, and through all the mountain regions of the west to central California, the San Pedro mountain in Lower California, northern Arizona, New Mexico, and the state of Chihuahua in Mexico. It is common in the east on moist sandy soil, and often borders the western prairies with a wide belt; and to the northward is often mixed with spruce and birch. In the mountain regions of the western and Pacific states, it ascends to 10,000 ft. above the sea. Sargent says that on account of its remarkable power of germinating on burnt soil, and rapidly covering mountain sides which have been devastated by fire, it has had a greater influence than any other tree on the composition and distribution of the subalpine and boreal forests of North America. Macoun says that in the Northwest, Athabasca, and Mackenzie districts it is everywhere common on dry soil, but not on alluvial flats, and that it reproduces freely after a forest fire by root-suckers, but not from seed.

It is said to have been introduced¹ in 1779 by Hugh, Duke of Northumberland; but we have seen no trees of considerable size, and the weeping variety appears to be now the only kind usually cultivated.

Loudon says that a tree in the Chiswick Garden was 12 ft. high eight years after planting; and on account probably of its northern habitat it produced leaves so early that on the 20th April 1835 they were cut by frost. It is so like the aspen of the old world in appearance that even if it would grow, it is hardly worth cultivation except in botanic gardens. (H. J. E.)

POPULUS GRANDIDENTATA

Populus grandidentata, Michaux, *Fl. Bor. Am.* ii. 243 (1803); Loudon, *Arb. et Frut. Brit.* iii. 1650 (1838); Sargent, *Silva N. Amer.* ix. 161, t. 488 (1896), and *Trees N. Amer.* 155 (1905); Schneider, *Laubholzkunde*, i. 17 (1904); Dode, in *Mém. Soc. Hist. Nat. Autun*, xviii. 28 (1905). Gombocz, in *Math. Termes. Közl.* xxx. 138 (1911).

A tree, attaining in America 70 ft. in height and 6 ft. in girth; bark like that of the common aspen. Young branchlets covered at first with a greyish tomentum, persistent more or less during summer. Buds ovoid, acute, grey tomentose. Leaves (Plate 408, Fig. 7) on the long shoots, 3 to 4 in. long, 2 to 3 in. broad, ovate-deltoid; truncate, rounded, or cuneate at the base; acuminate at the apex; glabrescent and dark green above; lower surface pale or glaucous green, glabrescent or with traces of the grey tomentum, which is dense at the time of unfolding of the leaves; margin with a narrow translucent border, and with a few sinuate triangular teeth, but entire near the base; petioles slender, laterally compressed, glabrescent. Leaves on the short shoots, oval, with sharper teeth, and often with two glands at the summit of the petiole.

¹ Loudon, under *P. græca*, p. 1651.

Catkins with deep narrowly lobed scales, fringed with long hairs; differing chiefly from the other aspens in the pubescent disc and ovary; stamens six to twelve; style divided into four long filiform lobes; capsule two-valved.

This species is much less widely spread in North America than the other aspen (*P. tremuloides*), apparently requiring a moister soil, and mainly growing in deep sand on the banks of rivers and swamps. It occurs in Ontario, southern Quebec, Nova Scotia, and New Brunswick, extending southward in the United States to north Delaware on the coast, and along the Alleghany Mountains to North Carolina, and westwards to Minnesota, Wisconsin, Illinois, Indiana, Kentucky, and Tennessee.

According to Dame and Brooks,¹ it is best distinguished from *P. tremuloides* in early spring, by the colour of the unfolding leaves, which are cottony white, whilst those of *P. tremuloides* appear yellowish green. The leaves when open are much larger and more coarsely toothed, and the buds divergent, dull, and dusty-looking; whilst those of *P. tremuloides* are mostly appressed and highly polished with a resinous lustre. In Canada it generally grows on sandy soil, mixed with pines, and is often mistaken for aspen. It is never a large tree, though usually larger than *P. tremuloides*, and as Elwes saw it, near Ottawa, is a straggling, ill-shaped tree of 40 to 50 ft. high, liable to be broken by the wind, and of little or no value either for use or ornament.

Though introduced, according to Loudon,² in 1772, it has always been a scarce tree in England, and the only specimen at Kew died about a year ago. At Grayswood, Haslemere, a tree obtained from Meehan in 1887 is only 16 ft. high, and apparently this species does not thrive in our climate.

The weeping grafted tree, commonly cultivated under the name *P. grandidentata*, var. *pendula*, differs from that species in flowers and other characters,³ and may be distinguished as follows:—

Populus pseudo-grandidentata, Dode, in *Mém. Soc. Hist. Nat. Autun*, xviii. 31 (1905).

Populus tremula, Linnæus, var. *pseudo-grandidentata*, Ascherson and Graebner, *Syn. Mitteleurop. Flora*, iv. 26 (1908).

Young branchlets stout, dark reddish, with orange lenticels, covered with whitish tomentum in spring, which persists in summer at the base of the shoots. Buds viscid, tomentose near the top of the branchlet, glabrescent elsewhere. Leaves (Plate 408, Fig. 8) similar in shape and dentation to *P. tremula*, but larger, 3 to 4 in. in diameter, and thicker in texture; margin with a translucent border, ciliate in spring. Staminate catkins, 2 in. long, with a slender pubescent axis; pedicels glabrous; stamens five, on an oblique glabrous shallow spatulate disc, which is entire in margin; filaments slender, white; anthers red.

The origin of this plant is unknown, but it is probably a hybrid; and if it came

¹ *Trees of New England*, 32 (1902).

² *Trees and Shrubs*, 823 (1842). It was introduced earlier into France, as it is well figured as *P. tremula, ampliori folio*, by Duhamel, *Traité des Arbres*, ii. 178, pl. 38, fig. 8 (1755).

³ In *P. grandidentata* the leaves are ovate, long acuminate, with fewer and larger teeth than in the weeping tree; stamens more numerous, with short filaments; pedicels and disc pubescent.

from America may be a cross between *P. tremuloides* and *P. grandidentata*.¹ It appears to have been first mentioned by Simon-Louis² in 1869. Koch³ speaks of it as a pendulous tree existing in England in 1872. There are good specimens at Abbotsbury and at Glasnevin. (A. H.)

POPULUS SIEBOLDII

Populus Sieboldii, Miquel, in *Ann. Mus. Bot. Lugd. Bat. (excl. pl. masc.)* iii. 29 (1867); Wesmael, in De Candolle, *Prod.* xvi. 2, p. 327 (in part) (1864); Schneider, *Laubholzkunde*, i. 17 (1904); Dode, in *Mém. Soc. Hist. Nat. Autun*, xviii. 32 (1905); Gombocz, in *Math. Termes. Közl.* xxx. 131 (1911).

Populus tremula, Linnæus, var. *villosa*, Franchet and Savatier, *Enum. Pl. Jap.* i. 465 (1875) (not Wesmael); Maximowicz,⁴ in *Bull. Soc. Nat. Mosc.* liv. 49 (1879); Shirasawa, *Icon. Ess. For Japon*, i. text 37, t. 18, figs. 1-10 (1900).

Populus rotundifolia, Simon-Louis, ex Dippel, *Laubholzkunde*, ii. 192 (1892).

A tree, attaining in Japan 60 ft. in height. Young branchlets stout, covered in spring with a dense white tomentum, persistent in part during summer. Buds more or less tomentose, not viscid. Leaves (Plate 408, Fig. 6) thicker in texture than those of *P. tremula*, densely tomentose and ciliate when young, glabrescent in summer, dark shining green above and yellowish or pale beneath, about 3 in. long and 2 in. broad, ovate, rounded or cuneate at the base, abruptly contracted into a glandular short acuminate apex; margin with a translucent border, minutely (varying even on the same leaf) sinuately toothed or glandular serrate; basal glands usually well developed; petiole slender, pubescent, laterally compressed. Flowers similar to those of *P. tremula*, but with the disc slightly pubescent.

This species, which is very distinct in appearance from the common aspen, appears to be confined to Japan, where it was collected at Aomori by Elwes.

It appears to have been introduced by Simon-Louis about 1887, but the only tree which I have seen is a grafted one at Glasnevin, planted in that year, which has only attained a height of 15 ft. and is not very thriving. (A. H.)

POPULUS FREMONTII

Populus Fremontii, Watson, in *Proc. Am. Acad.* x. 350 (1875); Sargent, *Silva N. Amer.* ix. 183, t. 496 (1896), and *Trees N. Amer.* 164 (1905); Dode, in *Mém. Soc. Hist. Nat. Autun*, xviii. 40 (1905); Gombocz, in *Math. Termes. Közl.* xxx. 76 (1911).

Populus monilifera, Torrey, in *Sitgreave's Rep.* 172 (1853) (not Aiton).

A tree, attaining 100 ft. in height and 15 ft. in girth; bark at first smooth and thin, ultimately becoming on old trunks deeply fissured into broad rounded scaly

¹ Nuttall, *Gen. Pl.* ii. 239 (1818), describes as *P. grandidentata*, var. *pendula*, a tree "with pendulous branches, as in the weeping ash, on the Alleghany Ridge, Pennsylvania, rare." Loudon, *op. cit.* 1651, states that there was a tree bearing this name in the Horticultural Society's garden in 1838; but that its branchlets were not pendulous. There is, therefore, no evidence that Nuttall's tree, seen only in the wild state, was ever introduced into cultivation.

² *Cat. Général*, 1869, p. 73, where it is called *P. grandidentata*, var. *pendula*, and is described as a weeping form with large teeth to the leaves.

³ *Dendrologie*, ii. pt. i. 488 (1872).

⁴ The staminate specimen described by Miquel, which is preserved in the Leyden Herbarium, is a species of *Carpinus*, according to Maximowicz.

ridges. Young branchlets glabrous. Buds small, viscid. Leaves on old trees deltoid, about 2½ in. broad, truncate at the base, and abruptly contracted at the apex into broad short entire points: on young cultivated trees (Plate 409, Fig. 13), reniform or rhombic, with a cuneate base and a similar apex; serrations few, coarse, with incurved points; margin with dense minute cilia, discernible with a good lens; glands absent at the base; petiole glabrous.

Staminate catkins, 2 in. long; axis glabrous; disc broad, oblique, entire in margin; stamens sixty, with dark red anthers. Pistillate catkins, 2 in. long; pedicels short; disc crenate, cup-shaped; stigmas three, irregularly and crenately lobed. Fruiting catkins, 4 to 5 in. long; capsule thick-walled, three- to four-valved.

This species grows on the banks of streams in California, Lower California, Nevada, southern Utah, southern Colorado, and western Texas.

It¹ has only lately been introduced into cultivation, and small specimens may be seen at Kew and Glasnevin.

Var. *Wislizeni*, Watson, in *Amer. Journ. Sci.* xv. 136 (1878).

Populus Wislizeni, Sargent, *Silva N. Amer.* xiv. 71, t. 732 (1902), and *Trees N. Amer.* 165 (1905); Dode, in *Mém. Soc. Hist. Nat. Autun*, xviii. 39 (1905); Gombocz, in *Math. Termes. Közl.* xxx. 78 (1911).

This appears to have similar foliage, and is mainly distinguishable by the long pedicels of the flowers. It is the common poplar in the Rio Grande valley of western Texas and New Mexico, and the adjacent parts of Mexico. (A. H.)

POPULUS NIGRA, BLACK POPLAR

Populus nigra, Linnæus,² *Sp. Pl.* 1034 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1652 (1838); Wesmael, in De Candolle, *Prod.* xvi. 2, p. 327 (1868), and in *Mém. Soc. Sc. Hainaut*, iii. 258 (1869); Willkomm, *Forstliche Flora*, 527 (1887); Mathieu, *Flore Forestière*, 491 (1897); Schneider, *Laubholzkunde*, i. 5 (1904); Dode, in *Mém. Soc. Hist. Nat. Autun*, xviii. ("groupe nigra") 37 (1905); Ascherson and Graebner, *Syn. Mitteleurop. Fl.* iv. 36 (1908); Gombocz, in *Math. Termes. Közl.* xxx. 85 (1911).

A tree, attaining above 100 ft. in height and 20 ft. in girth, usually with a straight and single stem, but occasionally dividing near the base into several limbs; with wide-spreading stout and irregular branches, not slender and regularly ascending as in many of the hybrids. Bark deeply furrowed on old trunks, and often covered with large burrs. In all its forms this species is readily distinguishable from the American species and the hybrids by the leaves, non-ciliate on the margin, without glands at the base, and when well-developed gradually tapering from the middle of the blade to a long acuminate apex.

The black poplar, and apparently all the poplars of the same section, rarely if ever produce suckers while the trees are living, but if one is cut down suckers are

¹ According to Dode, the trees introduced are var. *Wislizeni*; but until they flower their identification is uncertain. However, Späth, *Cat. No.* 95, p. 89 (1895-1896), states that the young plants first introduced in 1894 were obtained from Colorado, where only the typical form of the species exists.

² By this name Linnæus meant the black poplar inhabiting temperate Europe; though he quotes a Virginian poplar *ex Herb. Gronov.* It is most convenient to assume, as the typical form of the species, the tree planted by Linnæus at Upsala, which is still living, and from which I gathered specimens in 1908.

produced abundantly from the roots. Root cuttings are as readily propagated as ordinary cuttings. Dubard, in *Ann. Sc. Nat.* xvii. 147 (1903), gives an elaborate account of the peculiarities of the suckers of this tree.

This species comprises two distinct forms, one glabrous in all its parts, the other more or less pubescent, described in detail as follows:—

1. Var. *typica*, Schneider, *op. cit.* 5; Ascherson and Graebner, *op. cit.* 39. Continental Black Poplar.

Young branchlets rounded, glabrous, ashy grey in the second year. Buds reddish, viscid, glabrous, closely appressed to the twig at their base, with a sharp apex curving outwards. Leaves on the long shoots (Plate 409, Fig. 11), about 3 in. long, and 2 in. broad, cuneate at the base, gradually tapering from about the lower third, where they are widest, towards the long acuminate apex; glabrous; dark green above, light green below; margin with a narrow translucent border, non-ciliate, finely and crenately glandular-serrate; petiole glabrous, laterally compressed. On the short shoots the leaves are smaller, broader at the base, which is often less cuneate, and truncate or rounded; and similar leaves often occur on old trees even on the long shoots.

Catkins about 1½ in. long, with early deciduous scales, which are broadly obovate, and divided into numerous irregular, linear entire or lanceolate toothed lobes; axis glabrous. Staminate flowers sub-sessile; stamens twenty to thirty on an oblique concave non-ciliate glabrous disc, which is slightly waved and upturned in margin; filaments white, thread-like, as long as the deep red anthers. Pistillate flowers shortly stalked; ovary glabrous, globose, in a cup-like glabrous disc; stigmas two, dilated, crenate in margin, closely appressed at first to the sides of the upper part of the ovary. Capsules two-valved, glabrous, on long pedicels.

2. Var. *betulifolia*, Torrey, *Fl. New York*, ii. 216 (1843); Skan, in *Bot. Mag.* t. 8298 (in part¹) (1910); Schneider, *Laubholzkunde*, ii. 870 (1912). English Black Poplar.

Var. *viridis*,² Lindley, *ex Loudon, Arb. et Frut. Brit.* iii. 1652 (1838).

Var. *betulaefolia*, Wesmael, in De Candolle, *Prod.* xvi. 2, p. 328 (1868).

Var. *hudsonica*, Schneider, *Laubholzkunde*, i. 5 (1904); Ascherson and Graebner, *Syn. Mitteleurop.* Fl. iv. 39 (1908).

Populus nigra, Michaux, *Fl. Bor. Am.* ii. 244 (1803) (not Linnæus).

Populus hudsonica, Michaux f., *Hist. Arb. Amer.* iii. 293, t. 10, fig. 1 (1813), and *N. Amer. Sylva*, ii. 114, t. 96, fig. 1 (1819).

Populus betulifolia, Pursh, *Fl. Amer. Sept.* ii. 619 (1814); Loudon, *Arb. et Frut. Brit.* iii. 1656 (1838); Dode, in *Mém. Soc. Hist. Nat. Autun*, xviii. 48 (1905).

Populus nigra, Vaillantiana, and *Muelleriana*, Dode, in *Mém. Soc. Hist. Nat. Autun*, xviii. 48 (1905).

Young branchlets rounded, covered with a dense short pubescence, orange or yellow in the second year. Buds greenish, tinged with brown, viscid, otherwise as

¹ The female catkins figured show ovaries with three stigmas, and were taken from a hybrid tree (*P. Lloydii*) growing near Turnham Green station. Cf. p. 1831, note 1.

² Lindley's specimen in the Cambridge Herbarium is a vigorous branch from a young tree of *P. nigra*, var. *betulifolia*. This is confirmed by a tree labelled var. *viridis* in the Cambridge Botanic Garden. Loudon's description of this variety, "leaves of a brighter green than the species," is inadequate; and the name var. *viridis*, though older than that of var. *betulifolia*, cannot be used. Mackie, in Loudon, *Gard. Mag.* xiii. 230 (1837), says that var. *viridis* was discovered at Bealings, near Woodbridge, and had been grown in his nursery at Norwich for twenty years.

in var. *typica*. Leaves¹ (Plate 409, Fig. 12) similar in shape, colour, size, and margin to those of var. *typica*, but slightly pubescent when young; petioles pubescent.

Catkins 1½ to 2 in. long, as in the typical variety, but with a pubescent axis; stamens in the specimens examined, fewer, about twelve to fifteen; scales, ovary, and stigmas, identical. Fruiting catkins—on the Bury St. Edmunds tree, which was probably fertilised by staminate trees of the same variety close beside it—about 4 in. long, with ovoid capsules about ¼ in. in length, glabrous and tuberculate on the outer surface; seed oblanceolate, yellowish, about ⅓ in. long, covered with dense cottony hairs enveloping the whole catkin after the dehiscence of the capsules.

Forms, in which glabrous catkins are associated with pubescent leaves and branchlets, occur; and on this account I have refrained from making var. *betulifolia* a distinct species.²

The pubescent variety of the black poplar is the only form occurring in England in the wild state; and it is also a native of the greater part of France, from Normandy and Picardy to the foot of the Pyrenees. In 1912 I saw it apparently wild in many places, as in hedges on hills not far from Argentan, where it grows in a small and stunted form. It is most common, however, as a fine tree, often with a burry trunk, along the banks of the great rivers, as on the Seine at Mantes, on the Loire near Tours, on the Garonne in the vicinity both of Bordeaux and of Toulouse, on the Adour between Bayonne and Dax, and on the Gave de Pau, where there are two good trees in a meadow opposite the shrine at Lourdes. This poplar is also frequently planted in botanic gardens, as at Le Mans, Tours, and Montauban, a fine tree in the latter place measuring 90 ft. by 13 ft. There is a specimen in the Montpellier Herbarium, gathered at Ganges on an island in the river Herault; but I have seen no specimens from Provence.³ It is remarkable how this variety has escaped the notice of British botanists, though it has been collected from early times, as there are specimens in the British Museum⁴ gathered by Plukenet and Buddle towards the end of the seventeenth century.

This tree was first distinguished by the younger Michaux, who found it growing on the banks of the Hudson river above Albany, and mentions large specimens planted in New York city; but adds that he never saw it in the forest. Sargent⁵ in 1896 stated that it was growing then on an island in the Delaware river near Easton, Pennsylvania; but in a letter to Kew, dated 31st July 1902, he mentions only a single specimen known to him, an old tree near Boston;⁶ and adds that it is

¹ On very old trees the leaves are smaller, truncate or occasionally subcordate at the base, and with a shorter acumen at the apex. These appear to be *P. Muelleriana*, Dode.

² *P. nigra*, var. *pubescens*, Parlatores, *Fl. Ital.* iv. 289 (1867), was described from trees growing in moist valleys at S. Martino, Palermo; and is recorded in Thessaly by Halacsy, *Consp. Fl. Græc.* iii. 136 (1904). A specimen in the Cambridge Herbarium has branchlets, leaves, petioles, and female catkins covered with long white hairs; and is much more pubescent than trees growing in England. *P. hispida*, Haussknecht, which I have not seen, is probably the same as var. *pubescens*.

³ Pardé, in *Bull. Soc. Dend. France*, 1911, p. 255, states that *P. nigra* is pretty common in Provence; but this is probably var. *typica*.

⁴ *Herb. Sloan*, 83, fol. 8, and 126, fol. 6.

⁵ *Silva N. Amer.* ix. 153, note (1896). In the Montpellier Herbarium there is a specimen of this tree labelled "*Populus*, New York, growing planted opposite Dr. Hosack's door in Broadway, May 7, 1807." Another specimen named *P. hudsonica*, Michaux, was taken from a tree growing at Versailles in 1808.

⁶ This is no doubt the tree which I saw growing on the shore of Jamaica Pond, when staying with Prof. Sargent in 1904, and recognised at once as the English black poplar by its burry trunk and foliage.—H. J. E.

sold in the United States by Ellwanger and Barry of Rochester under the name of *P. elegans*.¹ There is little doubt that this poplar was introduced into the United States in the eighteenth century from England.

3. Var. *italica*, Du Roi, *Harbk. Baumz.* ii. 141 (1772). Lombardy Poplar.

Var. *pyramidalis*, Spach, in *Ann. Sc. Nat.* xv. 31 (1841).

Populus italica, Moench, *Bäume Weissenstein*, 79 (1785).

Populus dilatata, Aiton, *Hort. Kew.* iii. 406 (1789).

Populus pyramidata, Moench, *Meth.* 339 (1794).

Populus pyramidalis, Borkhausen, *Forstbot.* i. 541 (1800).

Populus fastigiata, Poirét, in Lamarck, *Encycl.* v. 235 (1804); Loudon, *Arb. et Frut. Brit.* iii. 1660 (1838).

Branches directed nearly vertically upwards, forming a narrow fastigiata tree. A sport of the typical glabrous variety of *P. nigra*, differing in no respect except in habit.² The leaves are variable, many being the same as those of the ordinary form; but others are often broader than long, truncate or subcordate at the base, with a short acuminate apex, due to increased vigour, as is usual in this species.

The common Lombardy poplar is a staminate tree, always reproduced by cuttings; and for aught we know, all the numerous individuals planted throughout the world may have originated from a single tree, as happened, without any doubt, in the case of the upright form of the common yew. No instances of a second origin have been recorded.

A few trees³ of similar habit, though with branches not quite so vertically inclined, have been observed bearing pistillate flowers.⁴ Plate 383, reproduced from a photograph sent to us by the late Prof. W. Blasius, shows a remarkable female tree at the village of Greene, near Kreiensen, in the Duchy of Brunswick, which has ascending and not erect branches, and differs considerably in habit from the ordinary Lombardy poplar. There is a good specimen at Kew with nearly erect branches, about 50 feet high, which was covered with woolly catkins in 1908. It produced flowers in the spring of 1910, which did not, however, ripen into fruit

¹ This is referred to as a variety of *P. nigra*, commonly sold by nurserymen in the United States, by L. H. Bailey, in *Cornell Univ. Bull. Agric.* No. 68, p. 227 (1894).

² I carefully compared in 1908, in Serbia, the branchlets, foliage, and buds of a Lombardy poplar with those of some wild common black poplars growing near it, and did not detect the slightest difference. The bark of some trees in this region, and also in Algeria, is remarkably whitish; while the colour of their third year and older twigs is peculiarly greyish. This form has been named *P. thevestina*, Dode, in *Mém. Soc. Hist. Nat. Autun*, xviii. 52 (1905). Siehe, in *Mitt. Deut. Dend. Ges.* 1912, p. 123, describes the remarkable pale bark of the Lombardy poplar in Asia Minor. Cuttings were obtained in Algeria by Mr. A. W. Hill in 1910, which are now growing in the nursery at Kew. Vigorous shoots from near the base of old Lombardy poplars at Cambridge show the same coloration.

³ Spenner, *Fl. Friburg*, i. 274 (1825), mentions a female tree near the Carthusian monastery at Friburg in Germany. Another was reported to have been noticed in the University Botanic Garden at Göttingen in 1828 (cf. Denson, in Loudon, *Gard. Mag.* vi. 419 (1830)). Loudon, *Derby Arboretum*, 57 (1840), states that the female tree was introduced in 1840 into the Horticultural Society's garden from Monza near Milan. There is a specimen in the Kew Herbarium, sent from Karlsruhe by A. Braun in 1845, and others undated, which are labelled Frankfort-on-Oder and Switzerland. Mr. W. L. Wood also noticed, in 1910, two smaller trees with pistillate catkins growing in the Walpole Road, Twickenham.

⁴ *P. pannonica*, Kitaibel, *ex Besser, Pl. Enum. Volhynia*, 38 (1822), and Reichenbach, *Icon. Fl. Germ.* xi. 30, t. 619 (1845) (figured with rhombic acuminate leaves), is possibly the correct name of the female Lombardy poplar. Besser, in *Flora*, 1832, ii. Suppl. 14, states that *P. croatica*, which was published at the same time as *P. pannonica*, is the name that should be applied to the supposed cross between typical *P. nigra* and the Lombardy poplar, which grew in the Theresa garden at Vienna, the sex of which is not mentioned. It was supposed to occur wild on the Dnieper. Zawadzki, *Enum. Pl. Galic.* 117 (1835), saw fine specimens of this on the Dniester in Podolia. Petzold and Kirchner, *Arb. Musc.* 593 (1864), state that they received *P. fastigiata*, var. *pannonica*, from many sources, but never were able to discover any distinguishing characters. Cf. also *P. nigra*, var. *pannonica*, Dippel, *Laubholzkunde*, ii. 198 (1892).

in this season, though there are staminate trees at no great distance. It opens its flowers at the same time as the Lombardy poplar. The latter is about three weeks earlier than the native black poplar, an indication of its southern origin.¹ The history of these pistillate trees is quite unknown; but they may have arisen as the result of hybridisation between the staminate Lombardy and the ordinary poplars.

The staminate Lombardy poplar appears to have originated on the banks of the river Po in northern Italy, probably in the beginning of the eighteenth century, as it was unknown to classical writers² and is not mentioned by mediæval Italian authors.³ Moreover, it was not noticed by Ray and other English travellers in Italy in the seventeenth century. Séguier,⁴ an old writer, states that it was known anciently in Lombardy, and mentions a superb avenue, which he saw in 1763 at Colorno, the residence of the Duke of Parma. It was apparently carried⁵ by the Genoese to the Levant; and there are no grounds for supposing that it originated in Asia Minor or Afghanistan, as Royle,⁶ who first made this statement, simply relied on the fact that it bore a native Persian name.⁷ W. G. Browne,⁸ who travelled in Asia Minor in 1798, makes the first reference to its occurrence in western Asia, where he states that it abounds all over the plain of Damascus, and when old becomes rugged and uncouth, as usual in other regions.

It was introduced from Lombardy into France in 1749; and is usually stated to have been brought into England and planted at St. Osyth's in Essex, in 1758, by the Earl of Rochford, who was ambassador in Turin at the time. It was possibly, however, first planted at Whitton some years earlier by Archibald, Duke of Argyll, who died in 1761, as the tree still growing there in 1838 was much larger than any of the others recorded by Loudon, being 115 ft. high and 19 ft. 8 in. in girth at 2 feet from the ground.⁹

¹ Sargent, *Silva N. Amer.* ix. 154, note (1896), says that the fact that the Lombardy poplar does not suffer in the cold of the Canadian winter, shows that it originated in a climate much more severe than that of northern Italy. (The winter in the plain of the Po, it may be stated, is very cold, the mean temperature being below 35° Fahr.; and in Milan the thermometer sometimes sinks below zero.) Prof. Budd, quoted by L. H. Bailey, *Cornell Univ. Bull. Agric.* No. 68, p. 228 (1894), however, explains that the Lombardy poplar, grown in Canada, was imported from Voronej in central Russia, where it has become acclimatised, and is perfectly hardy. The Russian hotanists assured him that its hardiness depended on the region from whence it was obtained. Bailey, *Survival of the Unlike*, 297 (1896), in an interesting chapter on acclimatisation of trees, states that cuttings of the white poplar, taken from trees at Montpellier and at Geneva, which were planted at the latter place, differed as much as twenty-five days in their time of coming into leaf; and similar results were obtained at Ithaca (New York) with cuttings of the Lombardy poplar.

² The often quoted lines of Ovid, *Met.* ii. 345-360, and of Virgil, *Æneid*, x. 190, do not refer to this tree, as has been supposed. The poplars depicted by Perugino (1446-1524), as in a picture in the London National Gallery, are slender, but not with vertical branches, and are probably *Populus alba*. Cf. Rosen, *Die Natur in der Kunst*, 293 (1903).

³ Rostafinski, in *Verhandl. K. K. Zool. Bot. Gesell. Wien*, xxii. 170 (1872), states that it was introduced from Italy into Poland by King Sobieski, who reigned from 1624 to 1696, and that the original trees are still standing in the garden of the Wilanow Castle, near Warsaw. Miss Ivanovska, at my request, examined the old poplars there, which proved to be all of the ordinary wide-spreading form; and Prof. Rostafinski in a letter acknowledges that he made a mistake.

⁴ *Hist. Plant. Nat. Envir. Verone*, ii. 267 (1745).

⁵ Fougeroux de Bondaroy, in *Mém. d'Agric., Paris*, 1786, p. 84.

⁶ *Illust. Bot. Him.* i. 344 (1839). Griffith's statement that it is wild near Kabul, at 7000 ft. altitude, is not confirmed. Aitchison, in *Trans. Bot. Soc. Edin.* xviii. 162 (1891), says: "I only met with this tree cultivated in orchards or near houses in Afghanistan and north-east Persia."

⁷ Boissier, *Fl. Orient.* iv. 1194 (1879), doubts its existence in the wild state in western Asia; and his reference to it being perhaps wild in the Karatau mountain in Turkestan is an error, as the wild fastigiata poplar in this locality is *P. alba*, var. *pyramidalis*. Cf. p. 1778.

⁸ *Travels in Africa, Egypt, and Syria*, 397, 408 (1799). Siehe, in *Mitt. Deut. Dend. Ges.* 1912, p. 123, states that in Asia Minor the Lombardy poplar is extensively cultivated and is a most useful tree, producing after twenty or thirty years' growth, long slender but tough beams, which are much used in house-building.

⁹ Loudon, *Arb. et Frut. Brit.* i. 58 (1838).

According to Sargent,¹ it was brought to America in 1784 by W. Hamilton, who planted it in his garden at Woodlands near Philadelphia.

The Lombardy poplar appears to be a short-lived tree, and is said to be dying out in Germany. As it does not now apparently attain the immense size recorded in former years, there may be some truth in the opinion advanced by Focke² that as all the trees have been raised by cuttings since the origin of the first sport, they may now be dying of old age. (A. H.)

The most reliable account we have of the introduction of this tree is that given by Aiton, *Hortus Kewensis*, iii. 406 (1789), who states that it was brought by Lord Rochford from Turin, where he was ambassador about 1758. He planted cuttings at St. Osyth's Priory in Essex, where two trees now much decayed still survive. I am indebted to Mr. J. Edge, the gardener there, for photographs and measurements of the larger of these trees, which show a large hollow stump divided into two trunks about 20 feet high and measuring 18 ft. in girth at 3 feet from the ground. Living branches have sprung from different places in the trunk, two of which attain a height of about 50 feet.

Loudon records a large tree of the same age as the last, which was blown down at Canterbury in 1836; but the tallest tree mentioned by him was at Great Tew in Oxfordshire, said to have been 125 feet high when only fifty years old. A tree was recorded by Thomas Hogg, forester at Hampton Court, Herefordshire,³ as growing at Wharton Court farm near that place, which in 1879 was said to measure no less than 160 feet. I visited this place in 1905 and found no trace of its remains; but if the height was correct, which from the other measurements given of trees on the estate seems probable, it was much taller than any that I have measured in England or France.

Sir Hugh Beevor tells me of a tree at Pitchford, Shropshire, which in 1907 was 120 ft. by 14 ft. 8 in.; and I have measured many of 100 to 115 feet, but none which can be said to stand out from the average of mature trees. Henry measured a tree at Shiplake House, near Henley, which was 105 ft. by 10 ft. 10 in. in 1905; and another at Alderbourn Manor, Gerard's Cross, which was 100 ft. by 12 ft. in 1912, and visible for many miles around. An old tree in Lensfield Road, Cambridge, 90 ft. high in 1904, of which a photograph was sent me by Mr. Lynch, was removed in 1912.

J. Smith⁴ recorded a tree growing at Fox Mills near Romsey as 125 ft. by 13 ft. 2 in., but when I was there in 1900 I could not find it; and another at Greatbridge House, near Romsey, which was 130 ft. by 13 ft. 9 in. These died in 1881, no doubt from the effects of the inclemency of the weather in 1879-80.

The seasons of 1879-81 appear to have killed a very large number of Lombardy poplars in the eastern and midland counties, not perhaps so much by their excessive

¹ Sargent, *op. cit.* 154, note (1896).

² In *Gart. Zeit.* September 1883, quoted in *Gard. Chron.* xx. 571 (1883). Cf. also *Rev. des Eaux et Forêts*, xxiv. 277 (1885). Manetti's letter quoted by Loudon, *Gard. Mag.* xii. 450 (1836), is rather obscure, and his statement that plants were raised in Italy from seed, which preserved the characters of their parents, is extremely doubtful. In the Cambridge Herbarium, however, there is a specimen, with female flowers and fruit, of a poplar sent by Manetti, which he considered to be the female Lombardy poplar.

³ *Trans. Scot. Arb. Soc.* ix. 151 (1879).

⁴ *Ibid.* xi. 534 (1887).

cold, as because of the two unusually cold and wet summers. A paper on the subject by Mr. H. D. Geldart¹ gives many interesting particulars; and all his correspondents seem to agree that the damage was much greater than in the colder winter of 1860-61, when the thermometer at Audley End near Saffron Walden went down on Christmas morning to -11° . Mr. Geldart quotes the replies received by Mr. Southwell to his inquiries as to the death of Lombardy poplars in other parts of England as follows. Twenty miles round York, death or severe injury was almost universal; in Wilts, they had suffered very much; in west Dorset, most of them were killed or seriously injured; near Doncaster, all were more or less killed; but at Oxford among the College gardens it was the exception to find a damaged tree; and Mr. C. B. Plowright wrote that in the west of England the Lombardy poplars did not seem to be injured at all.

In Scotland it was, according to Dr. Walker, introduced at New Posso in Tweeddale as early as 1765 from cuttings sent by the Earl of Hertford, and was extensively distributed some years later by Lord Gardenstone; but the climate of most parts of Scotland is evidently too cold or too wet to suit this tree, as none of those mentioned by Loudon are still alive so far as I can learn, except one at Brahan Castle, Ross-shire, that was 70 ft. by 6 ft. in 1838. When I visited this place in 1907 I found a fine tree 98 ft. by about 9 ft., which may be the same. Six miles north of Inverness, on the high-road to Beauly, I also saw four well-shaped trees, of which the largest was 90 ft. by 11½ ft., showing the excellent climate of that district. Mr. Renwick tells us of one near Braidwood, Lanarkshire, which was 93 ft. by 10½ ft. in 1910; this was blown down on 5th November 1911.

In France the Lombardy poplar is common, though now on account of its inferior growth often replaced by the hybrid poplars. It commonly attains 110 ft. to 120 ft. in height, but I have seen none approaching the trees near Rouen mentioned by Loudon² which, according to M. Dubreuil, were then 150 ft. high. A tree³ at the Trianon, Versailles, was 17½ ft. in girth at four feet from the ground in 1888.

The Lombardy poplar has been planted largely in the irrigated districts of Utah, and, according to F. C. Sears,⁴ rows of tall Lombardy poplars, marking the irrigation canals, are a feature in the landscape. (H. J. E.)

In Chile,⁵ especially about Valparaiso, the Lombardy poplar is largely planted, both in gardens and on the margins of the irrigation canals, where it grows so rapidly as to be ready for felling in fifteen years. Its timber is used for indoor work in houses. Dode states⁶ that in Chile and Argentina there is a form of the Lombardy poplar which keeps its leaves evergreen.

Mr. Lovegrove has sent us specimens of the Lombardy poplar from Kashmir, where it is planted along roads, and often attains 100 ft. in height and 7 ft. in girth.

¹ *Trans. Norf. and Norw. Nat. Soc.* iii. 354-366 (1880-1884). Cf. *Gard. Chron.* xv. 764, 798, and xvi. 246 (1881), where instances are given of the death of many trees also in the north of France and in Belgium.

² *Arb. et Frut. Brit.* iii. 1670 (1838).

³ *Garden and Forest*, i. 174 (1888).

⁴ *Ibid.* x. 357 (1897).

⁵ Dr. W. Balfour Gourlay, in *Trans. Bot. Soc. Edin.* xxiv. 74, plate 7 (1910). It is much attacked in Chile by the quintral, *Loranthus tetrandus*.

⁶ *Bull. Soc. Dend. France*, 1908, p. 29, and 1909, p. 152, where this form is named *P. pyramidalis*, var. *Thaystiana*, Dode.

Its timber is used in house-building, and lasts well when protected from rain. A tree 5 ft. in girth sells for 12 to 26 shillings.

4. Var. *plantierensis*, Schneider, *Laubholzkunde*, i. 803 (1906).

Populus fastigiata plantierensis, Simon-Louis, *Cat.* 1884-1885, p. 51.

Populus plantierensis, Dode, in *Mém. Soc. Hist. Nat. Autun*, xviii. 43 (1905).

A fastigate form of var. *betulifolia*, similar to the Lombardy poplar in habit and foliage, but with reddish pubescent petioles, and shortly pubescent branchlets. It originated in Simon-Louis's nursery at Plantières, near Metz, whence it derives its name, and is said to occur in both sexes, and to be the result of a cross between the Lombardy poplar and var. *betulifolia*; but this origin is unlikely. The original tree is a male, and when measured by Elwes in 1908 was 74 ft. by 5 ft. It is claimed for it that it is more vigorous than the ordinary fastigate poplar, and not liable to die off at the top, as is frequent in the latter. There are specimens at Kew about 25 ft. high.

5. Var. *viadri*, Ascherson and Graebner, *Syn. Mitteleurop. Flora*, iv. 40 (1908).

Populus viadri, Rüdiger, in *Abhand. Naturw. Ver. Reg. Bez. Frankfurt*, viii. *Mon. Mitt.* 12 (1891); Koehne, in *Verh. Bot. Ver. Brandenb.* xxxvii. p. xxviii (1895), and in *Gartenflora*, xxxix. 447 (1890).

A narrow pyramidal tree, with ascending branches, which in branchlets, buds, and foliage resembles the typical glabrous form of the species.¹ It occurs along the banks of the Oder, near Frankfort, whence it derives its name (*Viadrus* being the Latin name for this river). It is said to produce pistillate flowers identical with those of *P. nigra*; but a tree² at Kew, about 25 ft. high, produced staminate flowers in 1910. These differ slightly from the type in occasionally having peculiar scales deeply bilobed at the summit. (A. H.)

DISTRIBUTION

The distribution of the black poplar is very wide in Europe, but difficult to define accurately, as it has been much planted in former times. In Norway and Sweden, Schübeler only knew it as a planted tree, and figured a very large one, which from its burry trunk has the appearance of the English tree. This grew on the banks of a river at Ronneby in Sweden; and when measured in 1882 by Prof. Wittrock, was, at four feet from the base, 34 ft. 8 in. in girth, dividing into two main trunks a little higher up; and this is the largest girth of which I have any record.

In the Botanic Garden at St. Petersburg a tree, supposed to have been planted by Peter the Great, measured in 1908 about 90 ft. high by 17 ft. in girth, forking low down, and with a large burr on its trunk.

In north Russia it extends to 57° N., according to Von Herder; but in the St. Petersburg Herbarium I found a note by Kusnetsov stating that it was found at

¹ Koehne, who mentions trees of both sexes in *Deut. Dend.* 84 (1893), describes this peculiar poplar as a hybrid, *P. candicans* × *nigra*, but he afterwards withdrew this very unlikely hypothesis. The leaves are more cuspidate at the apex than in ordinary *P. nigra*, and it is possible that *P. viadri* is a hybrid, but I have seen no pistillate flowers. *P. viadri* appears to have been introduced into cultivation by Späth, as it is mentioned as a novelty in his *Catalogue*, No. 91, p. 96 (1893-1894).

² Another tree at Kew, labelled *P. viadri*, also obtained from Rüdiger, is different in habit, having spreading and not ascending branches. It is pistillate, and appears to differ in no respect from *P. nigra*, var. *typica*.

Emetskoie on the Dwina in lat. 63° 30'. It is found on the Volga¹ as far south as Astrachan, and on the Ufa river, where, according to Loffiewsky, it attains 100 ft. high. I also found specimens in the herbarium under the name of *P. nigra* from Zlataoust on the southern Ural, from Tobolsk and Barnaoul, and from the Yenesei river in lat. 66° N., collected by Brenner, with very small leaves. In France I saw a large female tree at Chenonceaux, near Tours, which measured 100 ft. by 10 ft. 10 in. in 1908. At Dijon there is in the Botanic Garden a very large tree² of this species, probably the oldest in Europe. It is said from historical documents to be over five centuries old, and bears an inscription to the effect that in 1866 it was at the ground 12 metres, and at two metres high 8 metres in girth, and contained about 40 cubic metres—about 1400 cubic feet of timber. It is quite hollow at the base, the shell being only a foot or so in thickness, and has deeply ridged bark, 4 to 6 in. in thickness. As nearly as I could estimate, its present height is about 125 ft., but having lost several branches has probably been taller. Its girth at 5 ft. is 26 ft. 7 in. The leaves though small are typical in shape, but the trunk is not as burry as in English trees. I could not learn whether it is male or female. M. Mathey, inspector of forests, told me that the black poplar which was formerly common around Dijon is now growing scarce, being superseded, as in England, by *P. serotina*.

In Spain and Portugal I only saw small and stunted trees; and in Italy I have seen none which looked like true *P. nigra*. In Austria it is common in the valley of the Danube; and in the Prater at Vienna there are many good-sized trees. In Greece, Heldreich records it from Mt. Pelion. In Morocco, Maw and Ball collected specimens in the Atlas at 3000 to 4000 feet.

In Great Britain it has been occasionally confused by local botanists with *P. serotina*; and I can find nothing in the older works, such as those of Evelyn, Miller, and Boutcher, to show that these authors knew the tree from personal observation. Though rare in most parts of England it seems to be a native of the counties on the Welsh border, where it is still fairly common; and it is probably indigenous in Norfolk, Suffolk, Cambridgeshire, and Essex. It is so very distinct in trunk, foliage, and time of leafing from *P. serotina*, that it is extraordinary that so little notice has been taken of it either by botanists or foresters, and as the trees given below have in almost every case been visited and identified by ourselves, it is very likely that it will be found in other districts now that attention has been called to it.

The English tree may be recognised in mature specimens by its trunk being usually covered more or less with large burry excrescences, which are formed by a mass of abortive buds, and which do not seem to be found to the same extent in Continental specimens; secondly, by its flowering later and leafing earlier than the much commoner black Italian poplar; and, thirdly, by the shape of the leaves, and also by the green and not reddish tint of the young foliage. As this tree does not seem to have been propagated by nurserymen for many years past, young trees

¹ Loudon, *Trees and Shrubs*, 824 (1842), states that it abounds on the banks of the Vistula, whence the mottled wood of knotty trunks was brought to Berlin and made into ladies' workboxes. Concerning *P. vistulensis*, Hort., see Jacquin, *Ann. de Flor.* ii. 96 (1833), and *Rev. Hort.* 1865, pp. 305, 346, and 405.

² Figured in *Gard. Chron.* xxi. 641, fig. 123 (1884), and in *Rev. Hort.* iii. 184, fig. 11 (1854).

are rarely seen, and the species appears to be dying out in all parts of England, except on the Welsh borders and in East Anglia. The glabrous Continental form is very rarely planted in Britain.

REMARKABLE TREES

In the south-western counties I have seen none except at Dunster in Somerset, where, in a meadow below the castle there is an old hollow stump 24 feet in girth, from which a large limb has extended and taken root some way off, and thrown up two stems 5 and $5\frac{1}{2}$ ft. in girth, but only about 40 ft. high. There are three other large trees near the park gate south-east of the castle, the first 92 ft. by 17 ft measured over a large burr, the second about 90 ft. by $16\frac{1}{2}$ ft., also very burry.

In Hants I have seen none, but am told by Mr. J. Smith of Romsey that an old pollard exists near that town 15 ft. by 7 ft. 9 in. In Sussex there is a tree in the park at Beauport about 100 ft. by 8 ft. In Kent in Penshurst Park there are some small, old, and very stunted trees.

In Middlesex by far the finest are two at Syon. These are rather shut in by other trees, and in 1905 were¹ about 110 ft. by 17 ft. 8 in. In the MS. catalogue at Syon a tree of this species was recorded as 120 ft. by 15 ft. in 1849. There are two trees on Wandsworth Common, and Miss Woolward tells me of a young female tree near the Serpentine Bridge. In the Green Park there are three trees in a group about 100 yards from Piccadilly opposite Down Street.

In Suffolk on the banks of the Larke in the Abbey grounds at Bury St. Edmunds there are several old trees, one of which was figured by Strutt,² and was said by him to be 90 ft. by 15 ft., and to contain 551 cubic ft. of timber. I could not identify this particular tree in 1907, when on 7th April I found them covered with bright red male flowers, which gave a beautiful effect in the sun. A female tree here was only just showing flower at the same date, but produced fertile seeds later, from which Mr. Hankins, forester at Culford Park, raised numerous seedlings, thirty of which planted out in a plot measured 5 to 7 ft. high in November 1911.

A tree at West Stow, near Bury St. Edmunds, which measured 92 ft. high by 19 ft. in girth, was felled in March 1912. It had immense spreading superficial roots; and the original set, about 4 in. in diameter, was recognisable in the centre of the butt, being separated from the older wood by a ring-shake. Near the base of the trunk Mr. Hankins counted 225 annual rings. The timber was quite sound, the first length measuring 39 ft. by $42\frac{1}{2}$ in. quarter-girth or 489 cubic ft., the total contents being 748 cubic ft.; a plank of it is now in the Cambridge Forestry Museum.

At Islington Hall, King's Lynn, there is a magnificent tree, which was measured by Mr. A. P. Long in October 1912, as follows: total height, 108 ft.; girth at five feet from the ground, 17 ft. 3 in.; volume of the bole (36 ft. in length to the point where the first branch is given off), 361 cubic feet; total volume, 620 cubic feet.

¹ A. B. Jackson, *Cat. Trees Syon*, 22 (1910), gives the height of these trees as 128 ft.

² *Sylva Britannica*, t. 24.

At Weeting Park near Thetford there are two large trees in the park about 90 ft. high and 17 ft. 4 in. in girth, whose trunks are covered with large burrs. Mr. Howell, the gardener here, told me that a much larger one had been blown down some time before my visit, the trunk of which was no less than 20 ft. in girth at eight feet from the ground. The rings in the wood showed this tree to be over 200 years old. At St. Helens, Norwich, in Mr. Skelton's garden on the banks of the Wensum, there are two fine trees, one of which in 1908 was 95 ft. by $15\frac{1}{2}$ ft.

In Essex it is rare, but at Audley End, in a withy bed below the park, there are three trees, one of which measured 115 ft. by 15 ft. on 18th March, 1907, when it was not yet in flower. At Stanstead Bury, Hertford, Mr. H. Clinton Baker found a tree bearing pistillate catkins, and 85 ft. by 12 ft. 9 in., in April 1911. At Bishop Stortford Henry has seen a large female tree.

In Gloucestershire the tree is quite rare, the only ones I know of being a small tree by the roadside on Crickley Hill, and another on the banks of an old canal at Coombe Hill, half a mile west of the Gloucester and Tewkesbury Road. Miss F. Woolward discovered a female tree about 60 ft. high, near Bourton on the Water; and at Forthampton Court, near Tewkesbury, there are four trees about 90 ft. by 15 to 16 ft., by a pond north of Mr. Yorke's house. In Herefordshire the tree, I am told by Mr. T. E. Groom of Hereford, is not uncommon in the Wye valley, while Mr. Openshaw of Wofferton Court farm informs me that it was more abundant fifty years ago. In Worcestershire, Lees,¹ who seems to have known the tree better than recent botanists of the county, says, "A few scraggy native black poplars appear in various localities by brooksides, but this tree appears to be dying out." At Arley Castle there is a fine tree planted in the park, which is about 100 ft. by 15 ft.

In Shropshire I have seen more than in any other county, the finest being a tree at Oakley Park, Ludlow, which in 1908 was about 100 ft. by 15 ft. 10 in. Between Craven Arms and Lydbury North there are several comparatively young trees planted by the roadside about 90 ft. by 6 to 7 ft. In a meadow near Walcot Park a line of trees in which *P. nigra* and *P. serotina* are mixed, shows the difference of size, habit, and period of shedding their leaves very plainly. On 28th October 1908, *P. nigra* had shed all its upper leaves, while those of *P. serotina* were still green. *P. nigra* here averaged about 70 ft. by 6 ft., whilst *P. serotina* were about 100 ft. by 9 ft., all being apparently planted at the same time. Between Oswestry and Whittington on the main road are several large but not very old trees. Strutt says that the black poplar is oftener found in Suffolk and in Cheshire than in any other counties, but I can hear of none in the latter county.

The largest I have seen in Wales are at Gwernyffed Park, Breconshire, where there is a tree in a belt west of the lodge gate, overgrown with ivy, which is about 90 ft. by 17 ft. At Maesllwyth Castle, Radnorshire, there are two fine trees in the park, with burry trunks, measuring about 85 ft. by $15\frac{1}{2}$ ft. in 1907.

In the north I have seen none except at Alnwick, where in a field by the road between the town and the castle there is an old tree. Mr. A. C. Forbes tells me of a female tree near Hexham.

¹ *Botany of Worcestershire*, xl. (1867).

In Scotland it seems quite rare, and whether it is truly native seems doubtful. The finest I have seen is in the park at Gordon Castle, which in 1908 was about 100 ft. by 15½ ft. At Smeaton Hepburn I measured in 1911 a tree 90 ft. by 8 ft. 7 in. Mr. Renwick tells me of two trees at Auchentorlie, Dumbartonshire, of which the best measured 94 ft. by 12 ft. 8 in. in 1909; and of two trees at The Ross, Lanarkshire, one of which, bearing pistillate flowers, and 87 ft. by 14½ ft., was greatly injured by the storm of 5th November, 1911; the other measured 80 ft. by 12 ft. 5 in. in 1912. At the foot of the former tree, *Lathraea squamaria*, a parasitic plant, is growing. Mr. Renwick measured, in 1909, a fine tree at Cambusnethan House, Lanarkshire, 102 ft. by 11 ft. 8 in.; four trees at Dalzell House in the same county, the largest of which was 99 ft. by 17 ft. 7 in.; and a tree at Kilkerran, Ayrshire, 88 ft. by 15 ft. 3 in.

Selby¹ mentions an immense tree growing at Maxwellheugh near Kelso, which had a trunk 16½ ft. high and 31 ft. at the base, 21 ft. at two feet and 18 ft. at ten feet, respectively in girth, which was computed to contain over 900 ft. of timber, and, supposing it to be the black Italian poplar, says that it could not be above sixty years old.² But Sir George Douglas of Springwood Park, Kelso, informs me that this tree, which had to be cut down in 1902 as it overhung the road, and was decaying and dangerous, was, according to reliable oral tradition, nearly as large one hundred and twenty years previously; and in any case must have been a great deal older than Selby supposed. It was 21 ft. in girth at five feet from the ground when felled, and was said to have been 92 ft. high in 1859. Sir George Douglas further tells me that Andrew Brotherstone, a botanist of Kelso, called it the black Italian poplar. Particulars of it were sent to the Edinburgh Botanical Society, but Professor Balfour informs me that no trace can now be found of this in the records of the Society. Mr. G. Leven, forester at Bowmont Forest, informs us that the gardener who cut it down and a local nurseryman state that it was a black Italian poplar.

In Ireland it seems to be doubtfully native. I have seen none in positions where they seem really wild. Stunted trees which look like *P. nigra* are common by the roadsides in several counties, but the only fine trees I have seen are as follows:—At New Ross, Wexford, by the road about 500 yards south of the town, an old tree with a hollow trunk about 90 ft. by 18 ft. This is a female, and produced good seed in 1907, from which Miss Woolward raised seedlings.³ At Mallow Park, close to the bridge out of the town, a very large tree⁴ with a burry trunk, which in 1909 measured 90 ft. by 19½ ft. At Muckross, on the green near the hotel, an old tree about 70 ft. by 13 ft., which Mr. Greany, resident agent for the Muckross estate, told me was the only one he knew in the district. (H. J. E.)

¹ *British Forest Trees*, 202 (1842).

² M'Kay and Renwick, in *Trans. Nat. Hist. Soc. Glasgow*, iv. pp. 251, 261 (1891), found this tree to be 19 ft. 9 in. in girth at six feet three inches above the ground, in 1893.

³ Cf. *Journ. Bot.* xlv. 417, t. 487 (1907).

⁴ There are two photographs of this tree in the Timber Museum at Kew, which were sent in 1878, with a note that the girth in that year was 17 ft. 2 in. at 4½ ft. and 18 ft. 1 in. at 6 ft. above the ground.

POPULUS MONILIFERA, CANADIAN BLACK POPLAR

Populus monilifera,¹ Aiton, *Hort. Kew.* iii. 406 (1789); Willdenow, *Sp. Pl.* iv. 805 (1805); Watson,² *Dendr. Brit.* ii. t. 102 (1825) (excl. the staminate flowers); Hartig, *Naturges. Forstlich. Culturpfl.* 436 (1851).³

Populus virginiana,⁴ Fougereux de Bondaroy, in *Mém. d'Agric. Paris*, 1786, i. p. 87 (1787).

Populus canadensis,⁵ Michaux, *Hist. Arb. Amer.* iii. 297, t. 11 (1813); Loudon, *Arb. et Frut. Brit.* iii. 1655 (1838) (not Moench, Hartig, or Koehne).

Populus deltoidea,⁶ Sudworth, in *Bull. Torrey Bot. Club*, xx. 44 (1893) (in part).

Populus deltoidea,⁶ Sargent, *Silva N. Amer.* ix. 179, t. 494 (1896), and *Trees N. Amer.* 163 (1905) (in part).

A tree, attaining in America 100 ft. in height and 20 ft. in girth. Bark deeply divided into broad rounded scaly ridges. It is readily distinguishable in cultivation from *P. angulata* by its different foliage and the less angular branchlets, which are rarely marked with projecting ribs, but are similar in their greenish colour, with white lenticels. Buds brownish, viscid. Leaves (Plate 409, Fig. 14) smaller than in *P. angulata*, and broader in proportion to their length, averaging 3 in. in width, deltoid-ovate, abruptly cuspidate-acuminate at the apex; base wide, shallowly cordate, occasionally truncate; glabrous, marked at the base of the blade by two glands; margin with a narrow translucent border, densely ciliate, with sinuate serrations fewer and coarser than in *P. angulata*, absent on the base and at the apex, their glandular tips being incurved; petiole laterally compressed.

Catkins about 3 in. long; axes and pedicels glabrous; scales large, dilated at their apex, and irregularly divided into filiform lobes. Stamens 40 to 60; disc broad, orbicular or quadrate, oblique. Pistillate flowers; disc broad, cup-shaped; ovary sub-globose, 3- or 4-celled with 3 or 4 stalked dilated lobed stigmas.

¹ This is the oldest certain name for the northern form of the American black poplar, which is represented in the British Museum by a specimen from Fothergill's garden bearing staminate flowers, labelled *P. monilifera* in Solander's hand-writing. Fothergill lived 1712-1780, and his garden was at Upton, Westham.

² Watson figures a pistillate tree, growing at Kew in 1822, which was certainly the American species; but is no longer living, most of the poplars planted at Kew in early days having died or been removed. Watson mentions also a pistillate tree at Cottingham, near Hull, the only other specimen which he had seen. The staminate trees which he refers to as being plentiful were *P. serotina*.

³ Cf. *P. carolinensis*, Moench, p. 1810, note.

⁴ *Populus virginiana*, according to Fougereux, was a pistillate tree, usually named in collections "Peuplier de Canada," and very sensitive to frost when young. He probably meant the true northern species. Usually in France, the "Peuplier de Virginie" was a synonym of the "Peuplier Suisse," the hybrid *P. serotina*. Fougereux's name is wrongly used in *Journ. Bot.* l. 132 (1912).

⁵ Michaux's name, *P. canadensis*, is accompanied by an accurate description. *P. canadensis*, Moench, *Bäume Weiss.* 81 (1785), identical with *P. latifolia*, Moench, *Meth.* 338 (1794), is possibly one of the female hybrids, *P. regenerata* or *P. marilandica*, but must remain a doubtful name. These names of Moench are supposed by Dode, *op. cit.* 65 (1905), to indicate *P. canadensis*, but this is improbable, as Moench clearly describes the latter species as a variety of *P. balsamifera* with cordate leaves. *P. canadensis* is usually erroneously applied by Continental botanists to the various hybrid poplars which are commonly met with in cultivation. See pp. 1816, 1824, 1828. It is wrongly used for the Black Italian Poplar in *Journ. Bot.* l. 132 (1912).

⁶ Both these names, *deltoidea* and *deltoidea*, are modifications of *Populus deltoide*, Marshall, *Arb. Amer.* 106 (1785). This is an incomplete description of a poplar growing on the banks of large rivers in Carolina and Florida, and is perhaps meant for *P. angulata*. Dode, *op. cit.* 40 (1895), says: "Quant à la notation *deltoidea*, il semble absolument impossible de lui donner un sens quelconque, Marshall ne l'ayant fait suivre que de quelques mots équivoques."

Fruiting catkins, 6 to 8 in. long; capsules 3- to 4-valved; seed with long white hairs, enclosing the catkins, when the capsules dehisce, in a dense mass of cotton.

1. Var. *occidentalis*, Rydberg, in *Mem. New York Bot. Garden*, i. 115 (1900).

Populus occidentalis, Britton, ex Rydberg, *Fl. Colorado*, 91 (1906); Gombocz, in *Math. Termes. Közl.* xxx. 79 (1911).

Populus Sargentii, Dode, in *Mem. Soc. Hist. Nat. Autun*, xviii. 40 (1905); Britton, *N. Amer. Trees*, 178 (1908).

Leaves smaller, deltoid, truncate at the base, abruptly contracted at the apex into a long acuminate point, with few and coarse serrations.

This is the common black poplar in western North America, east¹ of the Rocky Mountains from Saskatchewan and Alberta southwards to New Mexico and western Texas; and is the characteristic tree on the river flats of the western prairies.

P. monilifera is distinguishable from all the hybrids by the dense persistent cilia on the margin of the leaf, the peculiar few hooked serrations, the abrupt cuspidate apex, and the constancy of the glands at the base; and when flowers are obtainable by the large number of stamens (about sixty), and the shape of the stigmas. It has been confused by most dendrologists with the hybrids, which both on the Continent and in England have entirely supplanted it in cultivation. It has become an extremely rare tree; and the only specimens which we know of in England are a tree apparently past its prime, though probably not over sixty years old, at Bradwell Grove, Burford (Oxon), the seat of W. H. Fox, Esq., which Elwes measured in 1910 and found to be 91 ft. by 9 ft. 3 in.; and another at Penrice Castle, Glamorgan-shire, about 80 ft. high and 13 ft. 9 in. in girth. The stem of the latter has deeply furrowed bark, and gives off the first branch at twenty-seven feet up; above are numerous wide-spreading branches.

An old tree in the Cambridge Botanic Garden was cut down two years ago, but a cutting from it is now making vigorous growth. Elwes has also obtained cuttings from America, which are thriving at Colesborne.

DISTRIBUTION OF *P. MONILIFERA* AND *P. ANGULATA*

P. monilifera and *P. angulata* are considered by modern American botanists and foresters to constitute a single species, which they term *P. deltoidea*, Marshall, with the following distribution, according to Sargent:—Province of Quebec and the shores of Lake Champlain, through western New England and New York, Pennsylvania west of the Alleghanies, and the Atlantic states south of the Potomac river to western Florida; and westwards as var. *occidentalis* to the base of the Rocky Mountains from southern Alberta to northern New Mexico; comparatively rare and of smaller size in the east and in the coast region of the south Atlantic states and east Gulf states; a large and abundant tree along the streams between the Alleghany range and the Rocky Mountains.

P. monilifera and *P. angulata* are undoubtedly connected by intermediate forms; and the view that they constitute one species is possibly true in a wide sense, but

¹ It is reported to occur in Idaho by M. E. Jones, *Montana Botany Notes*, 24 (1910).

they are very different in cultivation, and herbarium specimens justify them being kept separate. Var. *occidentalis*, Rydberg, more closely allied to *P. monilifera* than to *P. angulata*, may also rank, when further studied in the field, as a third species.

I am unable to limit correctly the distribution of the two species, but *P. monilifera*¹ is undoubtedly the poplar, wild in Ontario, Quebec, New England, New York, and Pennsylvania. *P. angulata*² appears to be that common in the basin of the Mississippi, and in the southern Atlantic states and the Gulf states.

Michaux states that *P. angulata* attains its most northerly point in lower Virginia, but is more common in the two Carolinas, Georgia, and Louisiana, growing in the marshy basins of the great rivers, ascending the Mississippi from its source to its junction with the Missouri, and continuing along the latter for a hundred miles. He had only seen *P. monilifera*³ along the river Genesee in New York, in some parts of Virginia, and on several islands of the Ohio river; but believed from reports that it occurred in the Mississippi valley as far south as the Arkansas river. (A. H.)

P. monilifera is not generally distributed or common either in Canada or New England so far as I saw. Macoun states⁴ that along the Grand Trunk Railway in Ontario there are many young trees which had grown from western seed carried by the railway cars, and he speaks of trees "over 50 ft. high, and some at least 2 ft. in diameter," at Big Stick Lake, north of the Cypress hills in Manitoba.

In New England it seems to be commonest in the Connecticut valley, where Dame and Brooks⁵ speak of it as a stately tree 70 to 100 ft. high; and Emerson mentions a tree which he found at New Ashford in 1838, not over sixty years old, which was 20 ft. 5 in. in girth. Mr. Foxworthy sent us a photograph of a tree with a wide-spreading crown growing near Ithaca, New York. This measured 80 ft. by 13 ft., with the trunk dividing into three main stems at about twenty feet from the ground. Self-sown seedlings found by Mr. Jack on the sandy shore of the St. Lawrence, near Chateaugay, on 15th August 1895, where the fruit was ripe on 30th May, were only 4 to 6 in. long, with 4 to 8 small crenate ovate-lanceolate leaves.

S. C. Mason, of the Agricultural College, Kansas, gives a good account of *P. angulata* in that state in *Garden and Forest*, iv. 182, and figures a large tree on the banks of the Kansas river which shows its habit in the west. This tree was 24 ft. in girth near the ground, and was 80 ft. high, with a spread of over 80 feet. Another was 104 ft. high, and as much in the spread of its branches. A tree cut on the Saline river had a stump 8 ft. across, and furnished ninety-six loads of wood. Though most of the large old trees have been cut by the early settlers to build their houses and stockades, the tree is now largely planted for fuel.

¹ Herbarium specimens from Ontario, Vermont, New York, and Ohio are *P. monilifera*.

² Herbarium specimens from the banks of the river Ohio, "near North Bend," collected by C. W. Short in 1833, and from Missouri and New Orleans, collected by Drummond, are *P. angulata*, var. *missouriensis*. Specimens gathered by Sargent at Augusta, Georgia, have pubescent leaves and petioles, and may be another variety.

³ Michaux describes this species under the name *P. canadensis*, and lays great stress on the difference in hardness between it and *P. angulata*. He considered the latter to be a native only of the southern states, as its shoots were always injured by a few degrees of frost.

⁴ *Cat. Canadian Plants*, i. 457 (1883).

⁵ *Trees of New England*, 34 (1902).

Ridgway, in *Proc. U.S. Museum*, 86 (1882), speaking of *P. angulata*, states that it is a very common tree on rich bottom lands and along alluvial banks of streams, where it occasionally attains immense size. Trunks of 5 to 6 ft. diameter are not uncommon, while trunks of 7 to 8 ft. are sometimes found, the stem being usually more than 50 feet clear. The largest measurements were as follows:—

	Girth.	Bole.	Height.	Measured by
In Posey Co., Ind.	18	70	165	C. Schneck.
In Wabash Co., Ill.	18 $\frac{3}{4}$	75	175	Dr. J. Schneck.
In Gibson Co., Ind.	24	—	—	R. Ridgway.

TIMBER

The timber varies very much in quality, a variety known as yellow cottonwood being much the best. Mason says that he has known strong and good houses built from it whose joists and sheathing boards were straight and sound thirty years after they were put up. But the timber of some trees is soft, spongy, and worthless. Sargent says that the wood is very difficult to season, and is apt to warp badly in drying, but of late years has been used in the Mississippi valley for packing-cases and other coarse work. (H. J. E.)

POPULUS ANGULATA, CAROLINA POPLAR

Populus angulata, Aiton, *Hort. Kew.* iii. 407 (1789); Michaux f., *Hist. Arb. Amer.* iii. 302, pl. 12 (1813); Loudon, *Arb. et Frut. Brit.* iii. 1670 (1838); Schneider, *Laubholzkunde*, i. 9 (1904); Dode, in *Mém. Soc. Hist. Nat. Autun*, xviii. 38 (1905); Gombocz, in *Math. Termes. Közl.* xxx. 81 (1911).

Populus carolinensis,¹ Fougereux de Bondaroy, in *Mem. d'Agric. Paris*, 1786, i. 90 (1787); Dode, *op. cit.* 37 (1905).

Populus heterophylla, Du Roi, *Harbk.* ii. 150 (1772) (not Linnæus).

Populus balsamifera, Miller, *Gard. Dict.* ed. 8, No. 5 (1759) (not Linnæus).

Populus angulosa, Michaux, *Fl. Bor. Amer.* ii. 243 (1803).

Populus macrophylla, Loddiges, *Cat.* (1836), ex Loudon, *op. cit.* 1671 (1838).

Populus Besseyana, Dode, *op. cit.* 38 (1905).

A tree, attaining over 100 ft. in height and 15 ft. in girth. Bark deeply and regularly furrowed on old stems. Young branchlets angled, glabrous, greenish with white lenticels; on vigorous shoots, with projecting ribs, persistent two or three years. Buds greenish, glabrous, only slightly viscid. Leaves (Plate 409, Fig. 15) always longer than broad, averaging, when well-developed, 7 in. long and 5 in. wide, triangular-ovate; base broad, truncate, subcordate or deeply and narrowly cordate; apex acute or shortly acuminate; glabrous and firm in texture when

¹ *P. carolinensis*, Moench, *Bäume Weissenstein*, 81 (1785), is said by Willdenow, *Sp. Pl.* iv. 805 (1805) and by Hartig, *Naturges. Forst. Culturpf.*, 436 (1851) to be identical with *P. monilifera*, Aiton; but this is uncertain, and Moench's plant may have been the female tree of *P. angulata*.

mature, slightly pubescent when young; with two to six glands at the base of the blade, irregular in shape and size, either on the petiole or on the adjoining margin; margin, with a narrow translucent border, ciliate, crenately glandular-serrate, the teeth close together, except near the apex, where they are wanting, and on the base, where they are coarser and wide apart; petiole laterally compressed, greenish, pubescent at first, glabrous later.

Catkins, about 2 to 3 in. long; scales small, cucullate or concave, dentate and without long linear lobes; axis and short pedicels glabrous. Stamens, thirty to forty, on an oblique glabrous disc; filaments slender, white; anthers red. Ovary sessile, globose, glabrous, in a deep five-lobed glabrous cup-shaped disc; stigmas three or four, yellowish, widely dilated, crenulate, often subdivided each into two lobes, spreading upwards or horizontally outwards from the apex of the ovary. Fruit not seen.

The female tree of typical *P. angulata*, which is in cultivation in Europe, has branchlets less winged than those of the staminate tree, and is often distinguished as *P. angulata cordata*, though its leaves are as often truncate as cordate. At Plantières, Metz, it is said¹ to be very hardy, as young trees bore without injury a temperature of -23° Cent. in December 1859; whereas the staminate tree is killed by a temperature of -12° to -15° Cent. The pistillate tree is represented at Kew by a specimen about 35 ft. high, which was obtained from Simon-Louis in 1885. A similar tree at Glasnevin regularly bears flowers, which have been drawn by Miss F. Woolward. There is an old tree of this at Plantières, which produced² fertile seed in 1860, and was 7 ft. in girth² in 1905.

1. Var. *missouriensis*, Henry. This variety has branchlets and leaves similar to those of typical *P. angulata*, but differs in the flowers, which are like those of *P. monilifera*. The scales of the flowers of both sexes are large, lacinate and fimbriate; while the stamens are 40 to 60, as in the latter species.

Var. *missouriensis*, judging from specimens in the Kew Herbarium, which agree with those sent to me by Rehder from North Bend on the Ohio river, appears to be the ordinary wild form of *P. angulata* in the Mississippi basin. This variety is in cultivation³ in the south of France and in Italy; but requires further study.

Typical *P. angulata* has not yet been identified, so far as I know, in the United States; and is possibly a form with peculiar flowers, in which the scales have become modified, that has arisen in cultivation in the cooler climate of western Europe. It may, however, yet be found wild in the Carolinas or in Virginia, whence *P. angulata* is reputed to have been originally introduced into Europe. (A. H.)

¹ Thomas, in *Rev. Hort.* 1861, p. 75. It is called *P. cordata*, by Simon-Louis, *Cat. Gen.* 1869, p. 72, where it is said to have been a long time in their nurseries, and to be of unknown origin.

² Letter to Kew from Jouin. Its leaves appear earlier than those of the European poplars, and were opening on 15th April 1911, and were fully out on 6th May 1911; whilst those of *P. serotina* do not come out at Metz till late in May, as M. Jouin told me.—H. J. E.

³ Specimens with staminate flowers collected by Elwes in the Borilly Park at Marseilles, and others of both sexes sent to me from Turin by Prof. Voglino, belong to var. *missouriensis*. Possibly all the trees in cultivation in the south of France and in Italy belong to this variety; but I see no means of distinction in the absence of flowers. The habit of these southern trees is scarcely distinct.

REMARKABLE TREES

The most remarkable tree in Europe is one at Danny Park, Sussex, the seat of W. H. Champion, Esq., of which Plate 384, reproduced from a photograph taken by Mrs. F. D. Godman in 1910, gives a good idea. When this wonderful tree was planted it is impossible to say, but Mr. Champion's grandfather told him that it was an old tree when he came to Danny about 1815; and judging from a drawing of the house made in 1787, in which a tulip-tree probably of the same age is shown as a small tree, it may have been planted about 1760. The branches extend over a space 150 yards round, as measured by Mr. Champion, and the spread on the longer axis is about 60 yards. The main stem was about 80 ft. in length and 12 ft. 10 in. in girth in 1909. It is a male tree, and flowers in April, holding its leaves till late in November. Cuttings have failed to root, but two trees were propagated by grafting on stocks of *P. serotina*, and these are growing at Conyboro, Lewes, the seat of Lord Monkbretton. An illustration of this tree was published in *The Garden*, xxv. 189 (1898), but the ground plan which I am able to give of it, from accurate measurements made by Mr. J. P. Williams, is the only way by which the extraordinary ramifications and rooting of its branches can be understood.

Another large male tree is at Syon Park, which in 1905 was 92 ft.¹ by 9 ft.; but this may not be the same as the one figured by Loudon, *Arb.* vii. 277, as 83 ft. high in 1838. I showed this tree to Prof. Sargent, who admitted it to be distinct from *P. monilifera*, but said that he had never seen any trees like it in America.

There are two male trees on the bank of the Thames in the playing fields at Eton, of considerable size, which keep their leaves till the end of November. Another at Beauport, in the lower part of the park, was 80 ft. by 6 ft. 4 in. in 1909, and, as Sir A. Lamb tells me, retains its leaves till the middle of December unless there has been a severe frost, which seems a good proof of its southern origin.

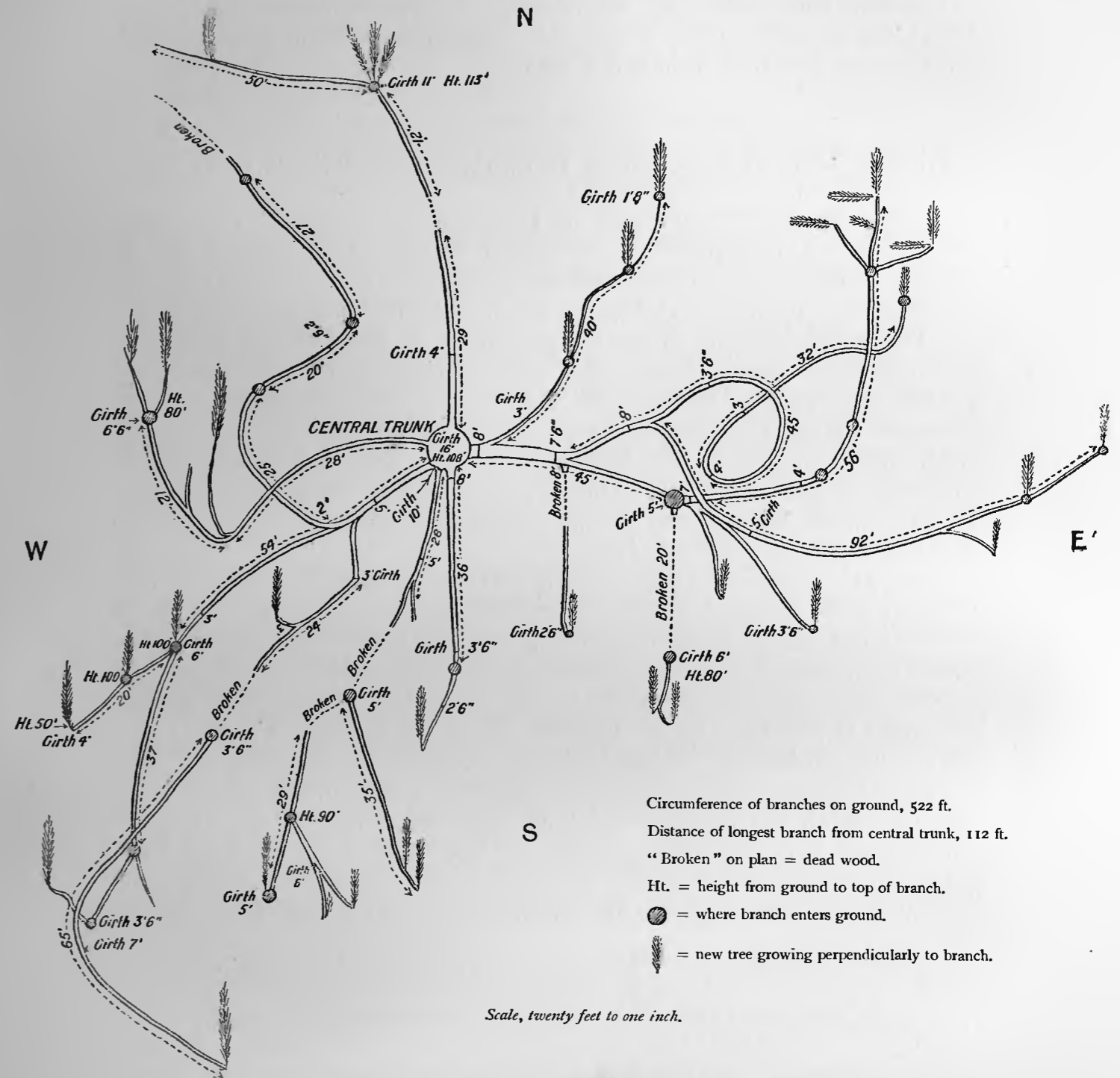
In Scotland I have seen none; but in Queen's County, Ireland, at Abbeyleix, the seat of Viscount de Vesci, there is a spreading tree of no great age, which in 1910 measured 63 ft. by 4 ft. It is a female tree and was obtained from Smith of Newry.

In France there are many old trees, especially around Paris. A large one at Baleine, near Moulins-sur-Allier, was blown down shortly before my visit in May 1909; and the log, which measured 14 metres long by 3.75 metres in girth, was sold for 140 francs. In the Parc Borilly at Marseilles there were a number of fine trees, all males, in full flower on 17th March 1910, whilst the trees which M. Coste, the head gardener, called *peuplier de Virginie* (*P. serotina*), growing close by, were not yet in bloom. (H. J. E.)

In the south of France in many places this species replaces the hybrid poplars, which are commonly planted farther north, as an avenue and roadside tree. There is a remarkable avenue, over a mile long, in the forest of Thétieu, near Dax, the trees averaging 90 to 110 ft. in height, and 7 to 9 ft. in girth, with stems clear of

¹ In Jackson's *Catalogue of Trees at Syon* the height is given as 111 ft.

branches to 30 or 40 ft. Near Puyoo I noticed, in 1912, some very large trees bearing mistletoe. In the park at Toulouse, this tree is largely planted in walks and



GROUND PLAN OF CAROLINA POPLAR AT DANNY PARK

avenues, and averages over 100 ft. in height, and 7 to 8 ft. in girth, much surpassing in size *P. nigra* which has been planted beside it. No tree in this region appears to have such a great demand for light; and in consequence it readily loses its lower

branches, and quickly produces clean stems with useful timber. Prof. Voglino,¹ who has made a careful study of the poplars in cultivation in the park of Santena, near Turin, states that this species grows more slowly, but attains a greater height than *P. serotina*. The wood, though slightly darker in colour, is much stronger, and is always very free from knots. Young trees, however, have brittle branches, which suffer severely even from slight falls of snow. (A. H.)

HISTORY OF THE AMERICAN BLACK POPLARS AND THEIR HYBRIDS IN EUROPE

P. angulata was early introduced into France, as it is mentioned as a well-known tree by Duhamel du Monceau,² who described it in 1755 as the "peuplier noir de Virginie à très grandes feuilles, et dont les jeunes pousses sont relevées d'arêtes qui les font paraître quarrées." This species was in cultivation³ in England in 1738.

The second American species of black poplar, *P. monilifera*, Aiton, appears also to have been early introduced into France, where, according to Michaux, it was probably imported from Canada. He accurately describes it under the name *P. canadensis*, and states that in cultivation it did not succeed in compact and clay soil and frequently branched into two near the base of the trunk. It was mentioned⁴ by Fougereux de Bondaroy in 1786 as the *Peuplier de Canada*, though he also called it *P. virginiana*, and states that he had only seen the pistillate tree. It is said⁵ to have been introduced into England in 1769.

Poplars hybridise very freely, especially in France, where seedlings are much more frequently found⁶ than in England; and probably the first hybrid to be selected was the tree now known as *P. serotina*, which, according to tradition, has been known in France as the *peuplier suisse* since the middle of the eighteenth century.⁷ Its botanical characters show that it is a cross between one of the two American black poplars, presumably *P. monilifera*, and the glabrous form of the European *P. nigra*. It is quite unknown in America.⁸ Michaux, who erroneously named it *P. monilifera* in 1813, is clear on the subject, as he states that "neither my father, myself, nor any of the educated English who traversed the Atlantic states, and a great part of the states of the West, ever found this species of poplar." He adds that it was commonly called *peuplier suisse* because it was more cultivated in Switzerland than elsewhere; and that only the male tree existed in France, which was always propagated by cuttings.

¹ *I Nemici del Pioppo Canadense di Santena*, 8 (1910). This valuable work, pp. 130, figs. 1-16, appeared in *Ann. R. Acad. Agric. Torino*, liii. (1910), and gives an account of the fungoid and insect enemies of the cultivated black poplars.

² *Traité des Arbres*, ii. 178, pl. 38, fig. 8 (1755). The figure represents exactly *P. angulata*.

³ A branch, gathered by Miller in the Chelsea garden in 1738, is preserved in the British Museum.

⁴ In *Mém. d'Agric. Paris*, 1786, p. 87.

⁵ Loudon, *Trees and Shrubs*, 825 (1842), under *P. canadensis*.

⁶ Loudon, *Trees and Shrubs*, 827 (1842), stated that many thousands of seedlings came up annually in the walks of Fontainebleau, most of which were destroyed, but some varieties had been selected from them.

⁷ It seems to have been the poplar described and figured by Duhamel, *Traité des Arbres*, ii. 178, pl. 39, fig. 5 (1755), as "*P. nigra, foliis acuminatis, dentatis, ad marginem undulatis, ou mal à propos osier blanc.*" It was supposed by Duhamel to be a variety of *P. nigra*, and was planted in vineyards, instead of willow, where it was treated as coppice, the shoots being cut annually. Fougereux, in *Mém. d'Agric. Paris*, 1786, i. 80, states that it grew with great vigour even in dry soils, and was called *osier blanc* in the districts south of Paris, and *alain* in other places.

⁸ Prof. Sargent assured us that he had seen no tree in America which resembled *P. serotina*.

He quotes from Foucault that its branches are less spreading than the Canadian poplar, and that on account of its more rapid growth and greater aptitude to thrive on dry soils, it had been very largely planted in all parts of France.

Poiret's account¹ of the black poplars existing in France in 1804 is instructive.

He enumerated five kinds:—

1. *P. nigra*, European species.
2. *P. angulata*, American species.
3. *P. monilifera*, American species, accurately described.
4. *Peuplier suisse*, which he regarded as of European origin, and therefore gave

it the botanical name of *P. nigra helvetica*; but he added that it resembled in many ways the next kind.

5. *P. canadensis*, apparently a hybrid from the description.

Mirbel,² also in 1804, distinguished five black poplars in cultivation:—

1. *P. nigra*.
2. *P. angulata*.
3. "*P. monilifera*, Aiton, with ciliate leaves," the true American species.
4. *Peuplier suisse*, also known as "*P. virginiana*, Hort. Paris."
5. "*P. monilifera*, Hort. Paris, with non-ciliate leaves," quite distinct from *P.*

monilifera, Aiton, and commonly known as *peuplier de Canada*.

I am unable to identify with certainty the second hybrid, *P. canadensis*, Poiret, or *P. monilifera*, Hort. Paris; but it was evidently distinct from the *peuplier suisse*, and was not the true American species; and possibly may have been identical with *P. regenerata*, which originated independently in 1814, near Paris.

Poiret,³ in 1816, added another poplar to his list of 1804, *P. marilandica*, Bosc, which on account of its rhombic leaves, with long points, similar to those of *P. nigra*, appears to be a second cross, probably the glabrous form of *P. nigra*, pollinated by *P. serotina*.

P. angulata, on account of its remarkable large leaves and conspicuously winged branchlets, was never confused with the other species and hybrids, and has continued to be cultivated both in England and on the Continent. The other American species, which was difficult to grow except in favourable moist soils, gradually ceased to be cultivated, and is now a rare tree in Europe. As the existence of hybrids was not suspected, both botanists and cultivators assumed the hybrids to be true species from America; and in course of time there were practically only four black poplars generally recognised in France:—

1. *P. nigra*.
2. *P. angulata*, known generally as *peuplier de Caroline*.
3. *P. serotina*, known either as *peuplier suisse* or *peuplier de Virginie*; always a staminate tree.
4. *P. marilandica* and *P. regenerata*, known commonly as *peuplier de Canada*, both pistillate trees.

The origin of the other hybrids is mentioned in their descriptions, which follow;

¹ In Lamarck, *Encycl. Meth.* v. 235-239 (1804).

² In *Nouveau Duhamel*, ii. 186 (1804).

³ In Lamarck, *Encycl. Meth. Suppl.* iv. 378 (1816).

and none appears to have arisen in England, except possibly *P. Lloydii*, one of the parents of which is the English or pubescent form of the black poplar.

P. serotina was first accurately and completely described by Hartig; and this name is preferable to *P. nigra helvetica* or *P. helvetica*. It has always been known in England as the black Italian poplar, and appears to have been imported from France, sometime before 1787, when Messrs. Dickson of Hassen-deanburn, Scotland, sold some stock to Pontey.¹ Mr. A. Dickson, much later, in 1813, informed Pontey¹ that this poplar was obtained by his firm from a gentleman in Scotland, who received it from his son in America; but this account is unreliable, as there is no evidence that this poplar originated in America, and it fails to explain the name "black Italian poplar," by which it was always sold. As *P. serotina* and the Lombardy poplar came into England about the same period, both poplars, arriving from the Continent, were supposed to be from Italy, and hence the name.

(A. H.)

POPULUS SEROTINA, BLACK ITALIAN POPLAR

Populus serotina, Hartig, *Naturges. Forst. Culturpf. Deutschl.* 437 (1851); Schneider, *Laubholzkunde*, i. 11 (1904); Dode, in *Mém. Soc. Hist. Nat. Autun*, xviii. 44 (1905); Ascherson and Graebner, *Syn. Mitteleurop. Fl.* iv. 44 (1908).

Populus helvetica, Poederlé, *Man. de l'Arbor*, ii. 148 (1792).

Populus monilifera, Michaux f., *Hist. Arb. Amer. Sept.* iii. 295, pl. 10, fig. 2 (1813) (not Aiton, *Hort. Kew.*); Loudon,² *Arb. et Frut. Brit.* iii. 1657 (1838) (excluding the pistillate tree).

Populus nigra helvetica, Poiret, in Lamarck, *Encycl. Méth.* v. 234 (1804).

Populus virginiana, Mirbel, in *Nouveau Duhamel*, ii. 186 (1804) (not Fougeroux).

Populus canadensis, Mathieu, *Flore Forestière*, 495 (excluding the pistillate tree) (1897) (not Michaux).

A large tree of hybrid origin (cf. p. 1814), attaining 130 ft. or more in height and 18 to 20 ft. in girth, with a single undivided straight stem, free from burrs, and slender wide-spreading ascending branches; bark regularly furrowed. Young branchlets at first green, turning brownish yellow in summer, glabrous, with white lenticels, slightly angled, becoming greyish and terete in the second year. Buds brownish, viscid. Leaves (Plate 409, Fig. 16), opening latest of all the poplars, with a reddish bronze tinge, glabrous, averaging on adult trees 3 in. in breadth and length, ovate-deltoid, with a broad truncate base and a short cuspidate or acuminate apex; margin crenate-serrate, with the serrations few and wide apart at the base of the blade; cilia short, at first continuous on the two sides of the blade and sparse on the base, deciduous in summer; glands near the insertion of the petiole, variable, one, two, or none being present; petiole reddish. On young plants and vigorous shoots, the branchlets have projecting ribs like those of *P. angulata*, and the leaves are much larger, up to 5 or 6 in. in length or more.

Staminate catkins about 3 in. long; axis glabrous; flowers on very short glabrous pedicels; scales early deciduous, obovate, with short irregular lobes

¹ *Profitable Planting*, 218 (1814).

² Loudon, in *Gard. Mag.* xiii. 536 (1837), says that this "is a very doubtful native of America, and much more likely, in our opinion, to be an improved European tree."

terminating in long filaments; stamens about twenty to twenty-five, with long slender white filaments and deep red anthers; disc oblique, shallow, concave, glabrous, crenate or slightly lobed in margin.

1. Var. *erecta*, Henry.

Populus monilifera erecta, Selys-Longchamps, in *Bull. Soc. Bot. Belg.* iii. 11, 13 (1864).

A fastigate form¹ of *P. serotina*, with which it agrees in sex, branchlets, buds, and leaves, the latter being late in unfolding.² (A. H.)

More remarkable for its habit than its size is this poplar, which was described by the late Baron de Selys-Longchamps, a distinguished Belgian naturalist. I visited the Château de Longchamps near Waremmé, about twenty miles west of Liège in 1908, on purpose to see these trees, and am indebted to the baron for a photograph (Plate 385), which shows their peculiar habit very well. The original tree was planted in a meadow close to the village of Willines in 1818, and was procured by chance from a neighbouring nursery. It is somewhat past its prime, and measures about 120 ft. by 8 ft. 8 in., having a somewhat less fastigate habit than Lombardy poplars growing in the same field. It is a male tree with reddish petioles. The trees shown in the photograph were grown from cuttings of it, which were planted in 1862. The tree which has been pruned measures 120 ft. by 7 ft. 4 in.; the unpruned one 120 ft. by 8 ft. 2 in. The Lombardy poplar planted next to it at the same time is only 100 ft. by 6 ft. 4 in. The earlier leafing of the Lombardy poplars is well brought out in the photograph. On the other side of the same meadow there is a line of poplars, which though they seemed identical in foliage with *P. serotina*, had whitish bark; and I was informed by M. Edmond de Selys, who has now succeeded his father, that these were liable to be injured by a canker in the branches, from which the dark-barked form planted in the same field was free.

I may add that as an ornamental tree, the fastigate form seems to be at least as good as the Lombardy poplar, whilst its timber is more valuable, its growth more rapid, and its hardiness superior. Cuttings from the fastigate variety were kindly sent me by the baron, and are growing vigorously at Colesborne. Henry saw in 1912 a specimen about 25 ft. high in the Calmpthout Nursery near Antwerp.

(H. J. E.)

2. Var. *aurea*,³ Henry.

Populus canadensis aurea van Geerti, André, in *Illust. Hort.* xxiii. 26, t. 232 (1876); Dippel, *Laubholzkunde*, ii. 200 (1892).

A sport, with yellow foliage, probably referable to *P. serotina*. This form was produced spontaneously on a single branch of a large tree in 1871; and was propagated by Ch. Van Geert in his nursery, which is now the Société Horticole de Calmpthout. We have seen no flowers or large trees of this variety; and the yellow colour of the foliage at Kew does not last throughout the season. (A. H.)

¹ This tree has been erroneously identified by Koch and other German dendrologists with the *peuplier régénéré* of Carrière, which is a pistillate tree, of quite independent origin. See p. 1824.

² Specimens obtained by Elwes from the trees planted in 1862. Baron Selys-Longchamps, in *Belg. Horticole*, 1864, p. 257, states that there were two original trees of the fastigate variety, which were planted in 1818 with 60 ordinary *peupliers suisses*. They resembled the latter in all respects, except in habit; but proved to be less vigorous, as they had not attained, 46 years after planting, as great a girth.

³ Simon-Louis, *Catalogue*, 1869, p. 73, mentions a variety with variegated leaves, which we have not seen.

CULTIVATION

Though no English writer has as yet fully realised the economic importance of the black Italian poplar, and though consumers have hardly recognised the value of its timber for many purposes; yet in France and Belgium it is more generally planted than any other tree, and, as I shall be able to show, will produce a quicker and larger return than any other, if properly grown and converted into timber. None of the poplars are particular as to soil, provided it is moist in summer; and though, like all other trees, they grow faster and larger on good than on bad soils, yet they succeed in cold wet and undrained valleys and meadows, and are resistant to frost at all seasons, and are little liable to fungoid and insect attacks. From an ornamental point of view the black Italian poplar is inferior to the grey and the white species, but its large red clusters of flowers appearing in spring on the bare branches are very beautiful, and its extremely rapid growth makes it suitable for situations where no other tree will attain a large size in a lifetime.

Before planting poplars it is important to have a variety which has proved hardy and vigorous on a similar soil and situation; and though nothing seems likely to surpass *P. robusta* and *P. Eugenei* where the climate suits them, I shall not give up the propagation of the red-petioled *P. serotina* until the others have proved their ability to endure the worst vicissitudes of our climate. The green-petioled variety, though it seems equally vigorous and hardy in any soil, is not so erect, and seems to have more spreading branches.

Owing to the general confusion between this tree and the true black poplar which has prevailed among English botanists and foresters, few of whom seem to have distinguished the two trees, I must point out that many of the statements¹ which have been made about the latter species really apply to the former.

Grigor states² that on a sandy soil (probably in Morayshire) the black Italian poplar in a mixed plantation, twenty-four years planted, measured 60 ft. by 3½ ft., when larch was 48 ft. by 3 ft. 4 in., beech 40 ft. by 2½ ft., sycamore 34 ft. by 2 ft. 1 in., and Scotch elm 33 ft. by 3 ft.

Thirty trees planted by my father in a cold clay soil not worth 5s. per acre, in a situation remarkably subject to late and early frosts, in forty-eight years averaged 120 cubic feet and realised £3 each; and two trees planted by myself in a clay soil close to the stream at Colesborne attained in fifteen years 56 ft. by 5 ft. 3 in. and 50 ft. by 3 ft. 2 in. respectively. Fifteen trees felled recently in a more shaded position and closer together in the same valley were at eighty-five to ninety years old of considerably smaller girth, and had increased but little during the last thirty years, some of them being more or less decayed and hollow at the base. This lot, though much older, only averaged 70 cubic feet, and proved to me that a sunny situation and plenty of room are essential. In another part of the same valley where the land is

¹ In *Trans. Surveyors' Institution*, 1904, p. 226, my advocacy of *P. serotina* as a valuable timber tree was erroneously printed under the heading Black Poplar, instead of Black Italian Poplar; and my remarks have been quoted by Nisbet and Sir Herbert Maxwell (in Green, *Encyclopædia of Agric.* iii. 308) as referring to *P. nigra*.

² *Arboriculture*, 326 (1868).

densely covered with meadowsweet and rushes, and where water often stands on the surface in winter, poplars of the ordinary red-petioled kind ten years after planting are about 35 feet high, whilst one with green petioles, distinguished by its greyer bark and more spreading habit, is 44 ft. by 2 ft. 1 in.

Forbes¹ agrees with me that about fifty years is the most profitable age at which to cut this tree; but he recommends that it should be planted at 6 ft. apart unmixed with other trees, in which I disagree with him—first, because at least three-quarters of the trees planted would be worthless as thinnings, and, secondly, because if it is desired to make a plantation close enough to suppress side branches the common alder seems to me the most suitable tree. I should not plant poplars nearer than 15 or 20 feet apart, and would fill up the intervals with alder, which could be cut out for clog soles at about thirty years, when it had attained 6 to 8 in. diameter, leaving the poplars to stand at the rate of about 50 to the acre. Assuming that the alder would pay the rent of the land, which it ought to do, 50 poplars, averaging 80 ft. at £2 a-piece, would give a very handsome return for the interest of the outlay on planting and pruning them.

In France, where the cultivation of poplars is well understood, the general practice is to plant them in lines at about 20 ft. apart along the sides of ditches, and leave the intervening spaces in pasture; and in this way the trees attain a profitable size much quicker than if planted as closely as advised by Forbes.

As the tree can be very quickly and easily struck from cuttings, the only question to consider is whether they shall be planted without roots where they are intended to grow, as is done with willows, or kept in a nursery till larger. I have tried both methods, and think that the latter is best, as the tree gets a start sooner, and is not so liable to be choked by the rank vegetation which is always found in places suitable to it. The best way to procure strong cuttings is to take one- or two-year shoots from stools; side branches may be used, but they are not so erect in habit, and require more pruning. These cuttings are best from 4 to 6 ft. long, put in during early spring, and in good soil will make strong plants in one season. If left longer than a year they do not transplant so well. After the tree has begun to grow freely, it will make 3 to 5 ft. of annual growth; and it is important to prune the side branches before they become too thick. This pruning should be carried on with a pruning chisel up to 30 or 40 ft. high, in order to avoid knots and make clean timber, and is best done in summer.

In cold and shady situations the branches are apt to die off, and a canker produced by *Didymosphaeria populina* sometimes affects the trees.²

In a brochure which is published by M. Marion,³ he recommends planting either large cuttings, put into the ground at a depth of 1 to 2 ft., or rooted plants in pits; and in both cases advises that the grass shall not be allowed to grow over the roots till the trees are well established. He recommends a width of 6 to 10 yards for avenues, or 4 yards apart in lines, and that the trees shall never be mixed with or crowded by other trees, as they must have plenty of room to grow well—150 to

¹ *English Estate Forestry*, 82 (1904).

² Cf. Hartig, *Diseases of Trees*, Eng. Trans., 104 (1894).

³ *Petit Manuel du Propriétaire Sylviculteur* (Librairie Horticole, Paris (1909)).

200 to the hectare ($2\frac{1}{2}$ acres) being thick enough on the ground. He finds that though they grow best on damp soil, yet it should be drained first if the water stagnates; and that successive crops may be taken, at periods of thirty years, without diminishing the growth, provided the old stumps are grubbed. Pruning is considered essential, and this must be frequently attended to, up to a height of 20 to 30 ft. Though poplars are often pruned nearly up to the top in France, it is evidently very prejudicial to their good growth. The mistletoe, which infests these trees to such an extent in most parts of France, is not allowed to remain on the branches at Pontvallain, but when it appears on the trunk it cannot be eradicated, and usually ends by killing the tree.

REMARKABLE TREES

One of the largest poplars in England was cut down in March 1907, near Cassio Bridge, Herts, and was sold to Messrs. East and Son, of Berkhamsted. It was described and figured in the *Timber Trades Journal* of 13th April 1907, and when measured by Sir Hugh Beevor in 1902 was 130 ft. high and 16 ft. 11 in. in girth, and the contents of the butt alone were 56 ft. by $42\frac{1}{2}$ in. quarter girth, making 701 cubic feet. With the top and branches it was said to contain upwards of 1000 ft. of timber. Messrs. East inform me that at 15 ft. from the butt they counted only 97 rings, which would make the age of this tree little over 100 years. Probably no other tree on record in England has attained so great a size in so short a time. Sir Hugh Beevor tells me that another tree near the same place, though not quite so tall, measures 18 ft. in girth at 6 ft. from the ground.¹

A very large tree was blown down early in January 1908 in the meadow of Christ Church, Oxford. It was mentioned in the *Oxford Times* of 18th January 1908 as a Lombardy poplar, but leaves sent me by the late Prof. Fisher show that it was *P. serotina*. The approximate measurements of the trunk were given as follows: length 55 ft., girth 16 ft. at twelve feet from base, timber contents 1056 cubic feet, weight about 20 tons. The removal of this tree by a traction engine, aided by several horses, took several days.

Mr. A. B. Jackson measured in 1912 a tree growing in a dell by the stream near the old church at Albury, Sussex, which he could not make less than 150 ft. high, though on account of its situation it is difficult to measure accurately; its girth was 15 ft. 3 in.

At Shalford House, near Guildford, the property of Col. H. H. Godwin-Austen, F.R.S., there stands in a damp meadow an immense tree of this species, which in 1911 measured about 110 ft. high by 23 ft. in girth. Its upper branches were much damaged by a violent storm some years ago; and I am informed by its owner, who has a good photograph of it, that it was formerly at least twenty-five feet higher. It forks first at about ten feet up, and gives off very large branches at about twenty feet, which spread to a width of thirty-seven paces. This tree is known to have been

¹ Cf. D. Hill, in *Trans. Herts. Nat. Hist. Soc.* xiv. 133 (1911).

planted by Charles X. of France, who lived at Shalford House during his exile from France, sometime between 1789 and 1814.

Among notable trees of this species which I have measured are two at Belton, near Grantham—one in a meadow by the bridge, which, though difficult to measure, I believe to be at least 130 ft. high by 16 ft. in girth. Another by a pond in the private grounds is 125 ft. by 15 ft. (Plate 386). Most of the large trees of *P. serotina* at Belton were planted about 1818, and began to fall to pieces in 1907, from natural decay. After the death or cutting of the tree (but never before) suckers are produced.

Another even larger grows on the banks of a pond near the approach to Woburn Abbey; and though it has been injured by the wind, measured, in 1905, 125 ft. by 19 ft. 3 in.¹ On the banks of the Thames there may be larger trees than any I have seen; but at Fawley Court, near Henley, I saw one about 105 ft. high by 16 ft., with a clean bole 50 ft. long; and at Mapledurham, near the mill, there is a group of very tall slender trees, one of which measured, in 1907, 135 ft. by 6 ft. 7 in.

At Bicton, just outside the gardens, there is a very fine tree of this species, which I believe to be about 130 ft. high, though I could not measure it exactly, by $17\frac{1}{2}$ ft. in girth. Sir Hugh Beevor measured a tree at Petworth in 1904 which was 114 ft. by 18 ft. 10 in., with a bole 20 ft. long. At Mote Park, Maidstone, there is a group of fine trees, one of which in 1902 was 120 ft. by $11\frac{1}{2}$ ft. At Godinton, near Ashford, in Kent, I counted 100 rings on the stump of a tree 15 ft. in girth. At Hawstead, near Bury St. Edmunds, I measured in 1905 one of a row of young trees in a rich meadow, which, though only 6 ft. in girth, was 116 ft. high.

At Plas Machynlleth, Montgomeryshire, I saw in 1912 a black Italian poplar, about 100 ft. high, and $19\frac{1}{2}$ ft. in girth at 3 ft. up under a large limb, and $17\frac{1}{2}$ ft. in girth at 6 ft. from the ground, above the limb; a label attached to the tree stated that it was planted in 1794 by Sir John Edwards.

In Scotland the black Italian poplar is not so common as in England, but seems to grow equally well. At Scone Palace, Henry measured in 1904 one no less than 132 ft. high by 15 ft. 4 in. in girth, which eleven years previously was 14 ft. 9 in. It carried its full girth nearly to the first branch, over forty feet from the ground. Another, also measured by Henry, at Monzie, Perthshire, was 125 ft. by 9 ft. 2 in., with an absolutely straight trunk drawn up by beech trees, and clean to 71 ft. There are two good trees near Achnacarry, the seat of Cameron of Lochiel, one of which in 1910 measured 105 ft. by $10\frac{1}{2}$ ft. Renwick in 1909 measured two trees at Cambusnethan House, Lanarkshire, 112 ft. by 11 ft. 1 in. and 119 ft. by 11 ft. 5 in. respectively.

In Ireland it has not been planted so generally as in England. The best I have seen are at Adare, Co. Limerick, near the river, a tree 95 ft. by 15 ft., in 1909; at Abbeyleix, Queen's County, several fine old trees, one of which was 120 ft. by 13 ft. 4 in. in 1910.

On the Continent there are many large trees, of which the most interesting are those at Brunswick which formed the types described by Hartig. I visited Brunswick on purpose to see them in June 1910, and am much indebted to the late Dr. Blasius and to Mr. A. Hollmer for their guidance. The largest tree stands in the

¹ In 1911 this tree had increased in girth to 20 ft. 6 in.

Theatre Park, close to a pond, and is about 110 ft. by 18 ft. 9 in., with a bole about 30 ft. long. The habit was more spreading than usual in England, and the young leaves seemed less bronzy in tint. The second is a double-stemmed tree from a common base, in front of the Grand-ducal residence; it is about 110 ft. high, the two stems measuring 14 and 15 ft. respectively. The third, said to be the actual type described by Hartig, stands in the Railway Park, and has the trunk much covered with ivy. It was severely lopped about ten years ago, and now measures about 105 ft. by 16 ft. 4 in., but has been taller. All these trees are males and appear to be of the same age, probably about a hundred years.

In Denmark the black Italian poplar is rather commonly planted by the road as a shade tree; and I measured a fine old tree at Gisselfeld, the seat of Count Daneskjold-Samsö, 120 ft. by 14 ft. 9 in., in 1910. How far east and south this poplar has extended we are unable to say, as Hartig's description has been apparently overlooked by foresters, and many of the trees in Germany¹ named *P. canadensis* are *P. serotina*.

TIMBER

The timber of the various species of poplar is, or has been in the past, so little valued by merchants that "Acorn," in his work on English timber, speaks of it as hardly worth hauling for any great distance from the place where it grows. For many years it was supposed to be the best material for making railway brake-blocks, which are now commonly made of iron, and was also used for beds of wagons and wheel-barrow, for second-class spade handles, and to some extent for other purposes,² but its use for packing-case making has been entirely ignored in England.

In France, however, this poplar is one of the most common and abundant timbers, and is almost the only material used in making wine-cases and packing-boxes of all descriptions; and there is no reason why it should not be so used in England, except the very low price of foreign deal. From fivepence to eightpence per foot is the price which I have been able to realise for standing trees of black Italian poplar containing 100 ft. and upwards, growing seven to nine miles from a station; but I have no doubt that, for well-grown trees whose lower branches have been pruned when young, and which can be converted with little waste, eightpence to a shilling per foot could be obtained when near the place of conversion.

"Acorn" states that in buying poplar standing, the merchant is almost sure to gain a considerable advantage if the trees are measured or estimated in one length, as they carry their girth higher and taper less than most trees. I have had good evidence of this myself; as a tree, which was estimated standing to contain 110 to 125 ft., and sold on the higher estimate, actually contained 130 ft. as measured in one length after felling, and 165 ft. when measured in three lengths, as it would have been cross-cut for sawing.

¹ In *Mitt. Deut. Dend. Ges.* 1904, p. 19, a tree at Schloss Dyck, near Düsseldorf, named *P. monilifera*, which is probably *P. serotina*, is said to be 57 metres high by 5.25 metres in girth; but the height measurement is probably much exaggerated.

² A large quantity of black Italian poplar is used as blocks for polishing plate glass in the course of its manufacture at St. Helens and other places. Cf. also *Quart. Journ. Forestry*, vi. 264 (1912).

The conversion of poplar timber into boards for various purposes requires considerable experience, which English sawmills do not seem to possess. A number of specimens were shown in the Franco-British Exhibition of 1908 which displayed great ingenuity in conversion; and I am assured by reliable authorities that, when properly cut and seasoned, poplar boards are considered a perfectly suitable wood on which to lay veneers, and are used in France for all but the highest qualities of furniture. The increasing price of mahogany and of white wood (*Liriodendron*), on which veneers in England are laid, seems to point to an increased demand for poplar. Mr. A. Howard gave me some handsomely figured veneers showing a good deal of satiny lustre, cut from a flitch of poplar wood which he bought in France. These I have used for the front of a large bookcase, made from the burry wood of an old black poplar (*P. nigra*) grown in Herefordshire. From an ornamental, as well as from a structural point of view, the result is satisfactory.

M. Breton-Bonnard,¹ President of the French Timber Merchants' Society, classifies the timber of the various poplars as follows:—

White Poplar, Grey Poplar.—Considered the best poplar wood; wood white, light, tender and soft, capable of taking a good polish. Used by furniture makers, largely by railway companies for wagon-building, by coach-builders for the panels and bodies of carriages and carts, and in mines and for boat-building. It must be thoroughly dry, as it warps when green.

Aspen.—Used when sound for the same purposes, also for matches, toys, turning, carving, broom handles, and for packing-cases and paper pulp.

Black Poplar (P. nigra).—This wood, which is very stiff, warps much if cut soon after it is felled, and ought to lie a year in the log before converting. It is valued by trunk makers, and for wagon beds, and other objects subject to rough usage.

All the Hybrids.—All kinds of cheap furniture and painted work, packing-cases, for laying veneers, etc.

He states¹ that poplar sawdust is the best litter for stables and pig-sties, and the cheapest litter used by the Paris Omnibus Company, and gives figures to prove that the manure produced from it was equal or superior in effect, on beetroot and wheat, to that produced by peat-moss litter or straw. He gives¹ the following table, representing the returns of *peupliers régénérés* on the assumption that the increase in diameter is 10 millimetres, or $\frac{2}{5}$ inch per annum:—

Age.	Diameter at 1.33 m. from the Ground.	Girth at the same height.	Length of Timber.	Cubic Contents, $\frac{1}{4}$ Girth Measure.	Value at 17 francs per cubic metre = about 5d. per foot.
5 years.	0.08 m.	0.25 m.	5 m. = 16 ft.	Cubic Metres. ...	Francs. ...
10 "	0.18 m.	0.56 m.	8 m. = 25 ft.	0.09	1.53
15 "	0.28 m.	0.86 m.	10 m. = 33 ft.	0.30	5.10
20 "	0.38 m.	1.20 m.	12 m. = 39 ft.	0.70	12.00
25 "	0.48 m.	1.50 m.	14 m. = 45 ft.	1.26	21.42
30 "	0.58 m.	1.82 m.	16 m. = 54 ft.	2.10	35.70
35 "	0.68 m.	2.05 m.	18 m. = 60 ft.	3.30	56.10
40 "	0.78 m.	2.48 m.	20 m. = 66 ft.	4.80	81.60

¹ *Le Peuplier*, 176, 179, 182 (1902).

These returns, which are possible when the trees have been well cultivated, justify the common saying in France that poplar ought to produce one franc per tree annually. The price given in the table is often exceeded where the trees are of good size and in a favourable situation. Twenty-five to thirty francs per cubic metre is a common price, as I was informed by M. Marion at Pontvallain. M. Breton-Bonnard says that in 1900 the poplars of the valley of the Ourcq, near Paris, were sold at fifty francs per cubic metre and upwards; and he knew a case where a landowner took a meadow on a thirty years' lease, planted it with poplars, and, after paying the rent with the hay¹ and grazing, was able, by cutting down the trees before the end of his lease, to buy the land with the profit.

I certainly know of land in England, which could be bought at £10 per acre or less, that would produce in forty to fifty years poplars containing an average of 100 cubic ft., and if there were only thirty trees to the acre, and the price sixpence per foot, this would amount to 3000 cubic ft., worth £75 per acre.

According to Mathey,² the timbers of the different poplars may be distinguished as follows:—

A. Species in which the heart- and sap-wood are confused.

Black and Lombardy Poplars.—Heart-wood with black veins in old trees.

Black, Italian, and other Hybrid Poplars.—Heart-wood uniformly white or slightly reddish.

B. Species in which the heart- and sap-wood are distinct.

White Poplar.—Sap-wood white; heart-wood distinctly reddish.

Grey Poplar.—Sap-wood reddish; heart-wood reddish-brown.

C. *Aspen.*—Heart- and sap-wood confused in trees growing in the forests of the plain; heart-wood distinct and vinous red in trees growing on the hills and mountains.

(H. J. E.)

POPULUS REGENERATA

Populus regenerata, Schneider, *Laubholzkunde*, i. 7 (1904).

Peuplier régénéré, Carrière, in *Rev. Hort.* 1865, pp. 58 and 276; Lambin, in *Rev. Hort.* 1873, p. 47.

Populus canadensis, var. *grandifolia*, Dieck, *Nacht. Haupt. Verz. Zöschén*, 1887, p. 16.

A tree of hybrid origin (cf. p. 1815), resembling *P. serotina* in branchlets and foliage, but bearing pistillate flowers, and unfolding its leaves about a fortnight earlier. Pistillate catkins similar to those of *P. marilandica*, but with usually only two stigmas.

This hybrid, according to Carrière, originated in 1814 in the nursery of M. Michie at Arcueil near Paris, and was apparently a seedling of unknown origin,

¹ Balzac, *Vie de Province*, i. 255 (1855) gives calculations by Eugénie Grandet, showing that the loss of hay, due to the shade of the poplars which he had planted in lines on good grass land on the banks of the Loire, near Saumur, was not made up by the proceeds of the sale of their timber, if compound interest was allowed. Grandet drew the conclusion, not generally accepted in France, that poplars could only be grown at a profit on poor soil. A correspondent in the *Gard. Chron.* 1855, p. 102, states that near Diss in Norfolk, 336 black Italian poplars, which were planted at intervals between 1819 and 1822, were sold in 1854 for £124. They grew on an area of 4½ acres; and whilst the trees were standing, the pasture beneath them was let at five shillings an acre. This tree grows in low, marshy, boggy land, where almost every other species ceases to thrive.—A. H.

² *Traité d'Exploitation Commerciale des Bois*, i. 23 (1906).

though one of the parents was supposed to be *P. serotina* (*peuplier suisse*). Carrière believed it to be simply the pistillate form of the latter, distinguishable by its greater vigour and more conical stem, swollen at the base and not so cylindrical as *P. serotina*. M. Romanet of Montmirail obtained some plants, which he multiplied under the name of *Peuplier régénéré*; and M. Bujot, of Chiary near Château Thiery (Aisne), sold others as *Peuplier Bujot*, a name no longer in use. In 1865 this poplar had become very common in the valley of the Ourcq, and was then sold by M. Terré, at Lizy-sur-Ourcq (Seine et Marne).

The *Peuplier suisse rouge*, one of the two so-called "Eucalyptus" poplars, now propagated by M. Marion in his nurseries at Pontvallain, Sarthe, is identical in all its characters with *P. regenerata*, being a female tree with similar foliage and flowers. I examined flowers which were kindly sent to me in the spring of 1911; and I obtained good specimens of branches with leaves, when I visited Pontvallain in August 1912. This tree was chosen as the fastest-growing variety of poplar in 1880, by M. Sarcé, grandfather of the present proprietor. It had been obtained by a continuous selection for many years, as sets for planting, of the uppermost and straightest branches of the most vigorous trees. The variety is said to have been called *rouge* on account of the reddish colour of the petioles, which is supposed¹ to distinguish it from the other kind of "Eucalyptus" poplar in the same nursery. The latter, known as *Peuplier suisse blanc*, because it is reputed to have whitish petioles, is a less vigorous tree, which is propagated only to a slight extent, its sole merit being that it forms a straighter stem. This variety opens its leaves late in the season, fifteen days after the *Peuplier suisse rouge*, and is reputed to be a male tree.² It is apparently a form of *P. serotina*, with which it agrees in leaf, but I have had no opportunity of examining the flowers.

The cultivation of poplars at Pontvallain is extensive, covering about 500 acres. The land, which is flat and intersected by a stream, is laid out in grass meadows of small size, around which are single or double lines of poplars, pruned up to 30 ft., and at least 12 ft. apart. Experience here shows that this is the best method of obtaining a quick and large yield of timber. Poplars, especially the quick-growing kinds, being light-demanding trees, do not bear well any lateral shade. Attempts to grow them crowded in large plantations never succeed, as all the trees, except those on the outside, remain very slender, and yield timber too small in diameter to be of any value for planking. The soil here is a sandy loam, and is rich in humus, as it was formerly a coppice of oak and hornbeam. The growth of the red "Eucalyptus" poplar is astonishing on this soil, almost double that of the other kind in diameter, and somewhat more in height. The stems are invariably curved near the base, which is attributable to its rapid increase in height while in the young stage. At thirty-five years old they average at least 100 ft. in height, and 7 ft. in girth, producing over 100 cubic feet of timber, which is worth about 100 francs. Elwes, who visited Pontvallain in May 1908, measured two trees in an avenue planted twenty-two years; one was 114 ft. by 6 ft. 2 in.; the other was 118 ft. by 6 ft. 10 in.

¹ No difference in the colour of the petioles was discernible in August.

² Cf. Breton-Bonnard, *Le Peuplier*, 62 (1902).

Whether either of the "Eucalyptus" poplars will equal in vigour the black Italian poplar, if planted in this country, remains to be proved; but the trial is worth making, as they are evidently most profitable to grow in France.

Other reputed forms of *P. regenerata* or of *P. serotina*, which are classed under the term *Peupliers régénérés*, are mentioned by M. Breton-Bonnard; but none of these have as great a reputation as those which are propagated at Pontvallain.

Specimens sent by the late Dr. Blasius from trees growing in the garden of Cramer von Klausbruch at Brunswick, which he considered to be the pistillate form of *P. serotina*, are similar in foliage to *P. regenerata*.

This hybrid has lately come into cultivation in England, the only large tree which I have seen being one in the Queen's Cottage grounds, Kew, which displays no vigour of growth. A tree at Kew, obtained under the name *P. deltoidea erecta* from Dieck in 1889, and now about 35 ft. high, produced female flowers in 1911, which showed it to be identical with *P. regenerata*, of which it has the foliage and habit. A female tree at Glasnevin, cultivated under the name *P. régénéré*, and about 60 ft. in height and 4 ft. 11 in. in girth in 1912, resembles *P. Eugenei* in habit, and is very thriving. It was obtained from Simon-Louis in 1892.

Mention may be made here of a peculiar poplar¹ at Beauport, Sussex, 60 ft. by 3 ft. in 1909, which was blown down in August 1912, the day before I last visited this remarkable collection of trees of all kinds. It differed from *P. regenerata* in having smaller leaves, 2 to 2½ in. long and broad, similar to those of *P. monilifera*, var. *occidentalis*, in shape, size, and few coarse serrations; but like the hybrids in the sparse ciliation of the margin and the irregular number (0, 1, or 2) of glands at the base. It bore female catkins in April 1912; and the flowers with only two stigmas showed also its hybrid origin. A similar tree, judging from a specimen in the Kew Herbarium, grew at Carlsruhe in 1845.

(A. H.)

POPULUS EUGENEI

Populus Eugenei, Simon-Louis, ex Koch, *Dendrologie*, ii. pt. i. p. 493 (1872); Schneider, *Laubholzkunde*, i. 9 (1904); Dode, in *Mém. Soc. Hist. Nat. Autun*, xviii. 46 (1905); Ascherson and Graebner, *Syn. Mitteleurop. Fl.* iv. 45 (1908).

Peuplier Eugène, Carrière, in *Rev. Hort.* 1865, p. 58.

Populus pyramidalis meetensis, Mathieu, in *Gartenflora*, xxxvi. 674 (1887), translated in *Gard. Chron.* ii. 818 (1887).

A narrow pyramidal tree of hybrid origin, with a straight undivided stem and numerous short branches, mostly ascending at an angle of 30° to 45° with the stem. Young branchlets glabrous, slightly angled. Buds small, reddish-brown, viscid. Leaves (Plate 409, Fig. 17) unfolding early in the season, with a reddish tint, smaller than those of *P. serotina*, averaging 2½ in. in width, usually broadly cuneate, rarely

¹ This peculiar hybrid appears to be identical with *P. incrassata*, Dode, *op. cit.* 41 (1905), described as a pistillate tree, having flowers with two stigmas; leaves thick in texture, moderate in size, deeply cordate at the base, acuminate at the apex. The leaves of the Beauport tree, often cordate, occasionally truncate at the base, agree with those of a specimen kindly given me by Dr. Dode as the type of his *P. incrassata*.

truncate at the base, and terminating in a slender sharp-pointed non-serrated acuminate apex; margin with coarse crenate incurved serrations, few and wide apart on the base, and sparsely ciliate except near the insertion of the petiole, which with the midrib and veins is usually of a reddish tint; glands at the base variable in number.

Staminate catkins, 1½ to 2 in. long; axis slender, glabrous; scales obovate, concave, with irregular lobes ending in long filaments; disc shallow, cup-shaped, glabrous, entire in margin; stamens about fifteen to twenty, with white thread-like filaments and red anthers.

Messrs. Simon-Louis informed Carrière in 1865 that this tree, which bears staminate flowers, originated in their nursery at Plantières in 1832. It appeared in a seed-bed of silver firs, so that it was impossible to know from what poplar the seed had come. It is supposed to be a seedling of *P. marilandica* (*P. canadensis*, Hartig), which had been pollinated by a Lombardy poplar. The shape of the leaves, intermediate between those of the supposed parents, and the narrow pyramidal habit confirm to some degree this explanation of its origin.

(A. H.)

So far as I know, no attempt has ever been made by English nurserymen to improve poplars by selection, or to raise them from seed; but on the Continent, where they seed much more freely, some varieties have been selected by the firm of Simon-Louis frères at Metz. On this rich deep calcareous loam, poplars succeed to perfection; and the original tree of *P. Eugenei* is a marvellous instance of the size which a planted tree may attain in a man's lifetime. This was planted in 1834, and measured about 140 ft. high in August 1908. I was unable to see the topmost branch from the measuring point. At the ground it was 39 ft. round, at five feet 22½ ft. The main trunk divides at about 30 ft. into several immense limbs, one of which, broken off by the wind, was about 85 ft. long. A younger tree, planted in 1870 in rather better soil, measured, in 1908, 128 ft. by 14 ft., with a clean bole 56 ft. long, and contains 500 to 600 cubic feet, which at thirty-eight years old must I think, be a record for any species of planted tree. As M. Jouin told me that the rapidity of growth increases after the first twenty years, this tree is likely to surpass its parent.

I have planted this variety at Colesborne, where its growth, though not so rapid as in France, is very satisfactory, and have found it to resist late and early frosts without injury.

There are eight examples of this tree at Kew, which were procured from Metz in 1888. The two largest measured¹ in June 1912, 90 ft. by 5 ft. 1 in. and 84 ft. by 4 ft. 5 in.; whilst the others ranged from 50 to 60 feet in height and 2 ft. 4 in. to 3 ft. 5 in. in girth. All preserve the narrow pyramidal form, and are growing vigorously in sandy soil. The bark is slightly fissured into narrow longitudinal ridges. Another tree at Glasnevin in poor soil, planted in the same year, was about 55 ft. high and 4 ft. 5 in. in girth in April 1913.

(H. J. E.)

¹ Cf. *Kew Bull.* 1911, p. 310, where the height of the largest tree is given in excess.

POPULUS MARILANDICA

Populus marilandica,¹ Bosc, *ex* Poiret, in Lamarck, *Encycl. Suppl.* iv. 378 (1816).

Populus canadensis,² Hartig, *Naturges. Forstl. Culturpfl.* 436 (1851) (not Michaux); Koehne, *Deut. Dendr.* 81 (1893); Schneider, *Laubholzkunde*, i. 7 (1904) (in part); Ascherson and Graebner, *Syn. Mitteleurop. Fl.* iv. 33 (1908) (in part).

Populus euxylon, Dode, in *Mém. Soc. Hist. Nat. Autun*, xviii. 41, 69 (1905).

A tree of hybrid origin (cf. p. 1815) less vigorous in growth and not attaining so great a height as *P. serotina*, with branches wider apart and not regularly ascending. Young branchlets glabrous, rounded. Buds small, viscid. Leaves (Plate 409, Fig. 19) considerably earlier in unfolding than *P. serotina*, resembling in shape more those of *P. nigra* than those of the American parent; when well developed about 4 in. long and 3 in. broad, rhomboid, cuneate at the base, tapering above into a long acuminate apex; glabrous; serrations crenate, with incurved points, few and wide apart on the cuneate base; margin with scattered deciduous minute cilia; glands absent or one or two in number at the base; petiole greenish.

Pistillate catkins about 2½ in. long; axis slender, glabrous; pedicels stout, glabrous; scales obovate, with irregular lobes ending in long filaments; disc cup-shaped, glabrous, undulate in margin; stigmas sessile, yellowish, variable in number—two, three, or four—each appressed at the base to the summit of the glabrous globose ovary, and dividing above into two erect arms. Fruiting catkins, fertilised by other kinds of poplars, about 4 or 5 in. long; capsules usually three-valved on slender pedicels, ultimately immersed in the dense white silky wool of the seeds.

This tree, which is always female, is not uncommon on the Continent, where it is usually considered to be the pistillate form of the Canadian species. It is occasionally met with in nurseries; and should not be selected for planting either for ornament or profit, as its masses of cottony catkins in late spring are disagreeable, and its vigour of growth³ is considerably inferior to that of *P. serotina*.

The largest tree of this hybrid which we know in England is growing on the lawn near the Palm House at Kew, and measures 90 ft. by 8 ft. 9 in. Its history is unknown. On 5th July 1907 it was covered with downy seeds, a few of which proved fertile; and there is a young plant at Colesborne which was raised from them by Miss F. Woolward. (A. H.)

¹ The description by Bosc is imperfect, and there is no authentic specimen in the Paris Herbarium. A specimen in the Herbarium at Montpellier, from a tree cultivated in the garden there in 1833 under the name *P. marilandica*, and another in the Kew Herbarium labelled *P. marilandica*, from a tree cultivated at Carlsruhe in 1845, were probably correctly named, and may be accepted as the species meant by Bosc. The name *P. marilandica* may be objected to, as implying that the tree is a native of Maryland; but I prefer it to the later name of *P. euxylon*, Dode.

² Koehne's specimen of *P. canadensis* in the British Museum is identical with the Carlsruhe specimen. So far as I can judge, the hybrid female poplar, which I consider to be *P. marilandica*, is the *P. canadensis* of German dendrologists. Hartig's description is unmistakable, as he refers to its rhombic and scarcely ciliate leaves, with variable glands at the base, and to its peculiar stigmas. Schneider states that *P. canadensis* is nearly always a female tree in cultivation, and figures its rhombic leaves cuneate at the base.

³ Simon-Louis, *Catalogue*, 1869, p. 72, speaking of this tree as *P. canadensis*, states that it is much less vigorous than the *peuplier de Virginie*, meaning by the latter name *P. serotina*, Hartig.

POPULUS HENRYANA

Populus Henryana, Dode, in *Mém. Soc. Hist. Nat. Autun*, xviii. 39 (1905).

A large tree of hybrid origin, similar in bark to *P. serotina*, but differing in habit, forming a wide-branching round-headed crown of foliage. Young branchlets glabrous, becoming dull grey in the second year, with whitish raised lenticels. Buds viscid, with slightly pubescent scales. Leaves (Plate 409, Fig. 18) opening earlier than those of *P. serotina*, and not tinged with a bronzy red tint, ovate to ovate-triangular, about 3 in. long and 2¼ in. wide, truncate or slightly cuneate at the broad base, ending above in a long acuminate apex; serrations small, crenate, numerous, with incurved points; margin sparsely ciliate; glands minute, usually two present, occasionally absent; petiole reddish, glabrous. Leaves on the short shoots smaller, usually as broad as long, ovate, cuneate at the base.

Flower buds with densely pubescent ciliate scales, very viscid. Staminate catkins about 1½ in. long; axis glabrous; scales deeply divided into irregular lobes ending in long or short filaments; disc glabrous; stamens, thirty to thirty-five, with white filaments and dull red anthers.

This hybrid, which has peculiar pubescent buds, is of unknown origin and is staminate. The only tree which we have seen is in the park in front of the house at The Wilderness, White Knights, Reading. It measured in 1907 about 100 ft. by 14 ft., and was probably obtained as a young plant from France, where M. Dode¹ has observed trees of a similar kind. (A. H.)

POPULUS ROBUSTA

Populus robusta, Schneider, *Laubholzkunde*, i. 11 (1904); Dode, in *Mém. Soc. Hist. Autun*, xviii. 45 (1905); Ascherson and Graebner, *Syn. Mitteleurop. Fl.* iv. 45 (1908).

Populus angulata cordata robusta, Simon-Louis, *Catal.* 61 (1899).

A tree of hybrid origin remarkably vigorous in youth, with ascending branches. Young branchlets angled, minutely pubescent; on strong shoots, stout, grey with white lenticels, and with projecting ribs as in *P. angulata*. Buds reddish brown, viscid. Leaves (Plate 409, Fig. 20) unfolding early in the season with a deep red tint,² variable in shape, about 3 in. in length, ovate-deltoid or rhombic; cuneate, rounded, or truncate and sub-cordate at the base; acuminate at the apex; serrations coarse, with incurved tips, few and wide apart on the base; margin with scattered cilia; glands one, two, or absent; petiole reddish, with scattered short hairs.

Staminate catkins, borne on a tree at Glasnevin, 2½ in. long; flowers numerous, crowded; axis glabrous; scales deeply and irregularly lobed, ending in long

¹ M. Dode tells me that there is a fine tree at Paris in the Champs de Mars, near the Eiffel Tower, which was planted about 1888. There was an old tree, no longer living, in the Jardin de Luxembourg. He adds that the propagation by cuttings of this poplar fails in the open air, but succeeds under glass.

² As seen at Kew, it is the most beautiful of all the poplars when coming into leaf.

filaments; disc small, glabrous, oblique; stamens about twenty, with white filaments.

P. robusta is readily distinguished from most of the other hybrid poplars by the minute pubescence on the branchlets and petioles. It is said to have been raised about 1895 at Metz from seed of a female *P. angulata*, supposed to have been fertilised by the pollen of the large tree of *P. Eugenei* which grows near it; but this is improbable, as the branchlets of the latter tree, as well as those of *P. angulata*, are quite glabrous. In all probability the male parent was the common pubescent *P. nigra*, from which *P. plantiervensis*, its fastigiata variety, was also derived at Metz. (A. H.)

I saw in the nursery at Metz a large bed of plants from cuttings put in in 1909, which were 10 to 12 ft. high in 1910, and was told that its stem is straighter and more erect than that of the *peuplier régénéré*. The extraordinary vigour of the young trees justifies M. Jouin in believing that it will, in warm districts at least, surpass *P. Eugenei* in size. Whether it will succeed in England remains to be proved; but it has been largely planted for several years by Baron Aheré in Belgium, and in low damp ground near Metz, which is specially liable to spring frost. I have now had it planted for two years in the same situation in which I grow *P. serotina* at Colesborne. It seems perfectly hardy, but has not yet had time to show whether it is superior in vigour to *P. Eugenei* or *P. serotina*. A tree planted at Glasnevin in 1900 measured 42 ft. by 1 ft. 1 in. in April 1913. It is very narrow, almost columnar in habit, with short ascending branches. (H. J. E.)

POPULUS LLOYDII

Populus Lloydii, A. Henry (*hybrida nova*).

A tall tree of hybrid origin, with bark similar to that of *P. serotina*. Young branchlets slender, covered with a minute erect pubescence; glabrous and yellowish brown in the second year. Buds small, brownish, viscid. Leaves (Plate 409, Fig. 21) about 2½ in. wide and long; truncate, rounded, or cuneate at the base; tapering above into a short non-serrated acuminate or cuspidate apex; margin with crenate serrations, ending in incurved points, ciliate till late in summer; glands at the base minute, variable, often absent; petiole reddish, with a scattered minute erect pubescence.

Pistillate catkins, 2 to 2½ in. long; axis glabrous; pedicels short, glabrous; ovary globose, glabrous, in an oblique cup-shaped entire glabrous disc, crowned by two, rarely three, widely dilated spreading yellow stigmas. Fruiting catkins, about 4 in. long; capsules two-valved.

This remarkable hybrid, of which the parents are probably the common English black poplar (*P. nigra betulifolia*) and *P. serotina*, resembles the former in the pubescent branchlets and petioles, and the latter in the shape, ciliation, and glands of the leaves, which are bronze-coloured when opening. The leaves, being borne on old trees, are probably smaller than normal; and this tree, which is pistillate, is

scarcely to be distinguished in technical characters from *P. robusta*, which is staminate and bears considerably larger leaves, known from young trees only. *P. robusta* appears to differ, however, in the grey and not yellowish colour of the branchlets in their second year. (A. H.)

The only large trees which we have seen of this are at Leaton Knolls, Shrewsbury, the residence of Major Lloyd, who has no record of their origin or date of planting. The largest, which is growing on a hill at the edge of an old pit-hole, now dry, was 120 ft. by 13½ ft. in July 1910. The second tree is 110 ft. by 11 ft. 2 in., and the third is 95 ft. by 10½ ft., as measured by myself in July and by Major Lloyd in September 1910. None of the down lying on the ground in July contained good seed as far as I could see. The trees are clearly of the same age—possibly sixty or seventy years—and being all females, perhaps originated from cuttings of a tree which may have existed in the neighbourhood, where *P. nigra* is not uncommon.

This hybrid may possibly in some cases have been hitherto confused by botanists with *P. nigra*, var. *betulifolia*; but it is apparently rare. The only other specimen which we have seen is a tree¹ in a garden near Turnham Green Station, which is about 35 feet high. It produced numerous natural seedlings in 1907, ten of which were transplanted into the nursery at Kew, and were in 1912 vigorous plants 2 to 3½ ft. high. (H. J. E.)

POPULUS ANGUSTIFOLIA

- Populus angustifolia*, James, *Long's Expedition*, i. 497 (1823); Sargent, *Silva N. Amer.* ix. 171, t. 492 (1896), and *Trees N. Amer.* 159 (1905); Schneider, *Laubholzkunde*, i. 14 (1904); Dode, in *Mém. Soc. Hist. Nat. Autun*, xviii. 58 (1905); Gombocz, in *Math. Termes. Közl.* xxx. 105 (1911).
Populus salicifolia, Rafinesque, *Alsograph. Amer.* 43 (1838) (not Loudon).
Populus canadensis, Desfontaines, var. *angustifolia*, Wesmæl, in De Candolle, *Prod.* xvi. 2, 329 (1868).
Populus balsamifera, Linnæus, var. *angustifolia*, Watson, *King's Rep.* v. 327 (1871).
Populus coloradensis, Dode, in *Mém. Soc. Hist. Nat. Autun*, xviii. 58 (1905).

A tree, attaining in America 60 ft. in height and 5 ft. in girth. Bark smooth, yellowish green, becoming fissured at the base of old trunks. Young branchlets glabrous, rounded, yellowish grey. Buds minute, viscid, sharp-pointed. Leaves (Plate 410, Fig. 26), lanceolate on long shoots, resembling those of *Salix fragilis* in shape, about 2 to 4 in. long, ¾ to 1 in. wide, cuneate at the base, gradually tapering to a gland-tipped acute or rounded apex, glabrous, pale green and not whitish beneath; margin revolute, with close fine glandular serrations; lateral nerves, about fifteen pairs, all pinnate; petiole short, glabrous, flattened above. On the short shoots, the leaves become shorter and broader, almost rhombic in outline.

Catkins densely flowered, glabrous; scales obovate, with irregularly cut dark brown filiform lobes. Stamens twelve to twenty in a cup-shaped slightly oblique disc, with a thickened reflexed margin. Ovary two-lobed, with two stigmas, enclosed

¹ The pistillate catkins of this tree were figured in *Bot. Mag.* t. 8298 (1910), and show three-styled flowers, which never occur in true *P. nigra*. Cf. p. 1796, note 1.

in a shallow cup-shaped crenate disc. Fruiting catkins, 4 in. long; capsule two-valved, glabrous, on a $\frac{1}{8}$ in. long pedicel.

This species is a native of the Rocky Mountain region of North America, usually growing on the banks of streams between 5000 and 10,000 ft. It occurs as far north as south-western Assiniboia, extending southward through the Black Hills of Dakota, Montana, eastern Idaho, Wyoming, Utah, Colorado,¹ to central Nevada, Arizona, and New Mexico.

It is readily distinguishable amongst the balsam poplars by its willow-like leaves, which scarcely show any whitish tint beneath.

It was introduced into cultivation by Späth² of Berlin, who received young plants from Colorado in 1893. It forms at Kew small trees of spreading irregular habit, and may be looked upon as rather a shrub than a tree in this country. (A. H.)

POPULUS BALSAMIFERA, BALSAM POPLAR

Populus balsamifera, Linnæus, *Sp. Pl.* 1034 (*excl. syn.* Catesby et Gmelin) (1753); Loudon, *Arb. et Frut. Brit.* iii. 1673 (in part) (1838); Sargent, *Silva N. Amer.* ix. 167, t. 490 (1896), and *Trees N. Amer.* 157 (1905); Schneider, *Laubholzkunde*, i. 14 (1904); Dode, in *Mém. Soc. Hist. Nat. Autun*, xviii. 62 (1905); Gombocz, in *Math. Termes. Közl.* xxx. 108 (1911).
Populus Michauxi, Dode, *op. cit.* 62 (1905).

A tree, attaining in America 100 ft. in height and 20 ft. in girth. Bark at first smooth, light reddish brown; on old trunks deeply divided into broad rounded ridges. Young branchlets terete, without projecting ridges, glabrous. Buds elongated, sharp-pointed, exuding a yellowish strong-smelling resin. Leaves (Plate 410, Fig. 27) on long shoots averaging 4 in. long and 2 in. broad, ovate, rounded at the base, narrowing towards the apex, which is often abruptly acuminate, glabrous on both surfaces, whitish and often tinged with rusty red beneath; margin minutely and sparsely ciliate, with crenate serrations, ending in short incurved glandular points; lateral nerves about eight pairs, each of the lowest pair giving off at its origin usually one secondary nerve, making with the midrib the base of the blade pseudo-five-palminerved; petiole quadrangular, channelled above, with a minute scattered pubescence. Leaves on short shoots smaller, broader in proportion to their length.

Staminate catkins about 3 in. long; axis with a few scattered hairs; pedicels long and similarly pubescent; scales broadly obovate, often irregularly three-lobed at the apex, with numerous short thread-like divisions; stamens about twenty on an oblique crenate deep saucer-shaped glabrous disc. Pistillate catkins: disc cup-shaped; ovary ovoid, two-lobed, with two nearly sessile large oblique dilated crenulate stigmas. Fruiting catkins 5 in. long; capsule ovoid, curved at the apex, two-valved, on a slender pedicel about $\frac{1}{2}$ in. long.

This species, extending over a wide area in North America, is probably variable; and may hybridise with *P. candicans*. The form distinguished by Dode as

¹ F. von Holdt, of Arvada, Colorado, in *Mitt. Dent. Dend. Ges.*, 1912, pp. 118, 119, describes this poplar in its native home, and gives a fine photograph of it growing on the edge of a mountain lake.

² *Catalogue*, No. 91, p. 49 (1893-1894).

P. Michauxi has slightly pubescent branchlets and leaves which have occasionally a subcordate base, and is intermediate between the two species; but it has the narrow leaves of *P. balsamifera*, and cannot be confused with *P. candicans*, which has broadly ovate deeply cordate leaves. (A. H.)

P. balsamifera is confined to North America, where it is known as Balsam or Tacamahac, and ranges from far north in Alaska and Canada southwards to northern New England, New York, central Michigan and Minnesota, the Black Hills of Dakota, north-western Nebraska, northern Montana, Idaho, Oregon, and Nevada. It is the largest of sub-arctic American trees,¹ attaining its greatest size on the Peace river and other tributaries of the Mackenzie river, where, according to Macoun, it is often nearly 150 ft. high, with a trunk occasionally over 7 ft. in diameter and free of branches from 60 to 100 ft. up. It is the characteristic tree along the streams in the prairie regions of British America, and is common throughout the northern border of the United States, growing on alluvial lands liable to floods and on the borders of swamps.

According to Aiton it was cultivated at Hampton Court in 1692, and was again introduced in 1731, when a tree given by Queen Caroline to Sir Hans Sloane was planted in the Chelsea Botanic Garden. It was introduced² into Scotland in 1768 by seeds sent from Canada. We have seen no pistillate trees of this species, which has become exceedingly scarce in cultivation, being now almost entirely supplanted by *P. candicans*, the balsam poplar usually grown by nurserymen in England. It differs from *P. candicans* in habit, being a narrower tree with ascending branches, and seems to be short-lived in our climate, which is perhaps too warm³ for it.

The largest tree which we have seen in England is one (Plate 387) at Bute House, Petersham, which in 1905 was 71 ft. high by 7 ft. 10 in., and surrounded by a great number of suckers. The leaves of the suckers, as in other species of poplars, attain a large size, occasionally 6 to 8 inches in length. At Kew there are two small trees, obtained from Späth in 1905. At Syston Park, Lincolnshire, there was a tree of considerable size, growing on an island in the lake, which was cut down thirty years ago; but numerous suckers remain, about 18 ft. high, which produce flowers abundantly. A younger tree at Belton, 20 ft. high, planted fifteen years ago, produced staminate flowers, which were drawn by Miss F. H. Woolward. A tree at New Humberstone, Leicester, of which specimens in flower were collected by Mr. H. Burbank, was 50 ft. by 5 ft. 3 in. in 1905. It has since been topped.

In Scotland there is a large tree in the park at Castle Menzies, which looks older than any other I have seen, and in 1907 measured 68 ft. by 11 ft. 10 in. Another very old-looking tree grows by the schoolhouse at Achnacarry, and has bark more like that of an ash than a poplar. It measured in June 1910 about 60 ft. by 7 ft. I also saw several good-sized trees in Glen Urquhart.

¹ E. T. Seton, *Arctic Prairies*, 330 (1912), says: "The balsam poplar attains a large size on the lower Athabasca and the Slave rivers, at least 100 ft. We observed it as far as the eastern extremity of Great Slave Lake, but there it is scarcely more than a shrub. The leaves had partly turned colour near Caribou island on September 22."

² Walker, *Essays Nat. Hist.* 65 (1812).

³ Britton and Shafer, *N. Amer. Trees*, 172 (1908), state that this poplar is not much planted south of its natural range in America, as it does not well endure hot summers.

There are small trees doing badly at Glasnevin; but Mr. R. A. Phillips has seen four thriving trees at Staffordstown, Co. Antrim, the largest of which measured 40 ft. by 4 ft. in 1910.

According to Schübeler, it thrives in Norway as far north as Tromsö, lat. 69° 40', and succeeds in the Gudbrandsdal at an elevation of 1350 ft. (H. J. E.)

POPULUS CANDICANS, ONTARIO POPLAR

Populus candicans, Aiton, *Hort. Kew.* iii. 406 (1789); Michaux, *Hist. Arb. Am.* iii. 308 (1813); Loudon, *Arb. et Frut. Brit.* iii. 1676 (1838); Schneider, *Laubholzkunde*, i. 13 (1904); Dode, in *Mém. Soc. Hist. Nat. Autun*, xviii. 65 (1905); Gombocz, in *Math. Termes. Közl.* xxx. 115 (1911).

Populus Tacamahaca,¹ Miller, *Gard. Dict.* ed. 8, No. 6 (1768).

Populus macrophylla, Lindley, ex Loudon, *Encyc. Plants*, 840 (1829).

Populus ontariensis, Desfontaines, *Cat. Hort. Paris* (1829).

Populus balsamifera, Linnæus, var. *candicans*, Gray, *Manual*, 419 (1856); Sargent, *Silva N. Amer.* ix. 169, t. 491 (1896), and *Trees N. Amer.* 159 (1905).

A tree, similar in size and bark to *P. balsamifera*, but different in habit, with more spreading branches, forming a broad crown of foliage. Young branchlets terete or slightly angled, but without projecting ridges, pubescent. Buds large, reddish brown, sharp-pointed, parallel with the twig, exuding resin; scales ciliate. Leaves (Plate 410, Fig. 22) variable in size, averaging 5 to 6 in. in length, and 4 in. in width, broadly ovate-deltoid; widest near the base, which is cordate, subcordate, or rarely truncate; cuspidate at the apex; margin conspicuously ciliate, with coarse serrations, ending in incurved glandular points; upper surface green, with scattered pubescence, glandular at the junction of the petiole; lower surface whitish, but usually less so than in *P. balsamifera* and *P. trichocarpa*, and with scattered hairs, dense on the midrib and nerves; nervation as in *P. balsamifera*; petiole terete, grooved above, densely pubescent.

Staminate flowers not seen. Pistillate catkins; axis covered with stiff hairs; flowers numerous on short glabrous pedicels; scales broadly obovate, fimbriated with long thread-like lobes; ovary glabrous, half enclosed in a deep cup-shaped glabrous crenate disc, and surmounted by two sub-sessile large dilated crenulate yellowish or orange stigmas. Fruiting catkins,² 6 in. long; capsule, on a glabrous $\frac{1}{8}$ in. long pedicel, with two glabrous tuberculate valves; the whole catkin covered with the down of the seed after the capsules have opened.

A variegated form of the species is known, in which the leaves are blotched with yellow. Specimens of this may be seen at Woburn, and in the Glasnevin and Edinburgh Botanic Gardens.

This species is very distinct from *P. balsamifera*, and is closely allied to *P. ciliata* of the Himalayas, from which it differs in flowers, though the shape of the leaf is very similar.

¹ Miller's diagnosis applies plainly to this species; but his detailed description includes also *P. balsamifera*. I have, therefore, not thought it desirable to resuscitate Miller's name, though the oldest, for the Ontario poplar.

² Described from a tree at Belton, perhaps fertilised by some other species of poplar.

P. candicans appears to be unquestionably¹ a native of North America, though Sargent states that he has seen no wild specimens, and that it "does not appear to be indigenous in New England or eastern Canada, where the pistillate plant² has been used as a shade tree from very early times, as it has been in the Middle States and in Europe." L. H. Barclay,³ however, states that there was a grove of this species, "with many large trees, at South Haven, Michigan, when the first pioneers visited the place, and these appeared to be coeval with the surrounding forest, with which they were interspersed for some distance back from the lake shore." Gates states⁴ that on the west coast of Michigan, north of Waukegan, the sand dunes in some places are surmounted by narrow groves of *P. candicans*, consisting of trees of moderate size, which are associated with *Prunus pumila*. Seedlings of this poplar are rarely found on the dunes themselves, but are common on the adjoining heaths. A specimen in the Kew Herbarium, collected by Fernald along the St. John River in Aristook County, Maine, has a note attached stating that it is common north of lat. 47° along river banks and in low-lying woods. No further information of a positive kind is obtainable concerning its distribution; but Dame and Brooks⁵ state that trees of both sexes are found by collectors in New Hampshire and Vermont; while in central and southern New England the staminate tree is rarely, if ever seen. These authors conclude that the evidence points to the habitat of the wild tree being a narrow belt extending through northern New Hampshire, Vermont, the southern section of Ontario, and Michigan. Macoun says that it is the prevalent balsam poplar in Ontario, and that it is apparently wild in the neighbourhood of Picton, Nova Scotia.

(A. H.)

The Ontario poplar was introduced into England in 1772, and has been widely planted ever since, owing its popularity, no doubt, to the fact that it is more easily propagated by cuttings than the true balsam poplar, which it surpasses also in beauty of foliage. The Ontario poplar has no economic value; and as it is always female,⁶ producing downy fruit in quantity, and also produces suckers freely, it is objectionable in ornamental plantations.

Nearly all the balsam poplars in England belong to this species, and the finest specimen is probably a tree at Syon, which measured, in 1906, 85 ft. by 9 ft. Another at Bayfordbury was 70 ft. by 6½ ft. in 1910. Of the numerous trees which we have seen in other places, none are noteworthy as regards size, 60 to 70 ft. being apparently the average in England for full-grown trees.⁷

(H. J. E.)

¹ Michaux, however, states that it was common in Rhode Island, Massachusetts, and New Hampshire, but always planted. He had never seen it in forests. It is mentioned by Duhamel, *Traité des Arbres*, ii. 181 (1755), as a poplar found in the neighbourhood of Quebec, where it was known as *liard*, with a leaf like a maple, white beneath, and exhaling a very odorous balsam.

² Sargent, however, figures staminate as well as pistillate flowers.

³ In *Bot. Gaz.* v. 91 (1880).

⁴ *Bull. Illinois State Lab. Nat. Science, Urbana*, ix. 287, plate xlvi. fig. 2 (1912).

⁵ *Trees of New England*, 37 (1902). Britton and Shafer, *N. Amer. Trees*, 169 (1908), apparently do not agree with these authors, and simply state: "Evidence that it is wild in Michigan has been adduced, and it is probably indigenous farther to the north-west."

⁶ It is evident from Fougereux, in *Mém. d'Agric., Paris*, 1786, i. pp. 91, 94, that in France at that early period, *P. candicans* was always female, and *P. balsamifera* always male, as is now the case in England. His account is however confused, as he transfers the name *liard* to *P. balsamifera*, and *beauquier du Pérou* to *P. candicans*, the converse being correct.

⁷ In *Mitt. Deut. Dend. Ges.* 1904, p. 19, a tree named *Populus balsamea*, growing at Schloss Dyck near Dusseldorf, was reported to be 38 metres high by 4.25 metres in girth. It is unlikely that this tree was any species of balsam poplar.

POPULUS TRICHOCARPA, WESTERN BALSAM POPLAR

- Populus trichocarpa*, Torrey et Grey, ex Hooker, *Icon. Plant.* ix. t. 878 (1852); Sargent, *Silva N. Amer.* ix. 175, t. 493 (1896), and *Trees N. Amer.* 161 (1905); Schneider, *Laubholzkunde*, i. 16 (1904); Dode, in *Mém. Soc. Hist. Nat. Autun*, xviii. 64 (1905); Jepson, *Flora California*, 346 (1909), and *Silva California*, 188 (1910); Gombocz, in *Math. Termes. Közl.* xxx. 112 (1911).
Populus balsamifera, Linnæus, var. γ , Hooker, *Fl. Bor. Am.* ii. 154 (1839).
Populus balsamifera, Lyall, in *Journ. Linn. Soc. (Bot.)* vii. 134 (1864) (not Linnæus).
Populus angustifolia, Newberry, *Pacific R. R. Rep.* vi. pt. iii. 89 (1857) (not James).
Populus hastata, Dode, in *Mém. Soc. Hist. Nat. Autun*, xviii. 64 (1905).

A tree, attaining on the Pacific coast of North America 200 ft. in height and 20 ft. in girth. Bark of young stems peeling off in papery scales; on old stems grey and deeply divided into broad rounded scaly ridges. Young branchlets glabrous, shining, brown, marked with white linear lenticels, angled and with five prominent ridges on vigorous shoots, often retained in the second year. Buds brownish, very fragrant, resinous, glabrous, elongated, sharp-pointed, parallel with, but not appressed to the twig. Leaves (Plate 410, Fig. 31) variable in size, very large on upper vigorous branches; on lower terminal shoots averaging 5 in. long and 3 in. broad; ovate or ovate-deltoid; slightly cordate, truncate, or rounded at the base; broadest near the base, gradually narrowing towards the gland-tipped acuminate apex; upper surface light green, glabrescent; lower surface whiter than in the other balsam poplars, with a few short scattered hairs; lateral nerves about seven or eight pairs, each of the lowest pair giving off at its origin two secondary nerves, making with the midrib the base of the blade pseudo-seven-palminerved; margin ciliate, with incurved crenate glandular shallow serrations, often absent on large leaves towards the apex; petiole reddish, minutely pubescent, terete, channelled above, about 1 in. in length.

Staminate catkins (described from a living tree at Kew), about $2\frac{1}{2}$ in. long; axis green, pubescent, crowded with numerous sessile flowers; scales with numerous filiform ciliated divisions, quickly deciduous; stamens about fifty, on an oblique orbicular flat glabrous disc, which has an entire ciliate margin; filaments slender, white; anthers deep red. Pistillate catkins, according to Sargent, with a loosely-flowered tomentose axis; ovary densely tomentose, with three nearly sessile broadly dilated, deeply lobed stigmas, enclosed in a crenate or entire deep cup-shaped disc. Fruiting catkin, 4 in. to 5 in. long; capsule sub-sessile, globose, thick-walled, three-valved.

This species, which is readily distinguished from the other balsam poplars by its very white leaves, winged twigs, and bark peeling off in thin papery shreds, was founded by Hooker on a specimen collected by C. C. Parry in 1850, on the Santa Clara river near Buenaventura, California. This specimen and others from southern California in the Kew Herbarium, have small deltoid leaves scarcely acuminate at the apex, and with considerable pubescence on the midrib and veins beneath and on the

petiole; the capsules are also very pubescent. Specimens from Oregon, Washington, and British Columbia have usually larger leaves, much longer than broad, distinctly acuminate, and with less pubescence; and their capsules are sometimes nearly glabrous. The latter form, which is the one in cultivation, is considered by Dode (*op. cit.* 64) to be a distinct species, *P. hastata*; and may, on further investigation in the field, turn out to be worth ranking as a distinct variety, *P. trichocarpa*, var. *hastata*. Jepson also mentions a form *ingrata* from San Bernardino county, which has small lanceolate leaves.¹

This magnificent poplar, the largest of the genus, is a native of the Pacific coast region of North America from southern Alaska to San Diego county in California, extending inland in British Columbia as far as the valley of the Columbia river, and in California to the western slope of the Sierra Nevada. It is reported to occur in eastern Washington² and in western Montana;³ but the balsam poplar in these regions is possibly *P. balsamifera*. *P. trichocarpa* grows mainly in open groves in river valleys, attaining its largest size near sea-level in the coast region north of California; southward, it is a small tree rarely more than 40 ft. high,⁴ ascending to 6000 ft. altitude in the Sierra Nevada in central California. It is most abundant⁵ in Oregon and Washington, where its timber is used for making staves and wooden ware. Jepson states that the wood is light, soft, and fairly close-grained, but not strong. (A. H.)

It is the largest deciduous tree⁶ of the Pacific coast region, attaining its greatest size on Puget Sound, where it is sometimes 200 ft. in height and 6 to 8 ft. in diameter. I saw it in perfection on a farm in Vancouver Island called Swallowfield, some miles north of Duncans, and measured the tree here figured (Plate 388), which was growing in a meadow on rich alluvial soil, and was at least 140 ft. high with a bole 70 ft. long and 28 ft. 3 in. in girth. Another tree, with the top broken, had a bole 80 ft. by 21 ft. 3 in. which I estimated to contain 1300 to 1400 ft. of timber; and on 8th June it was covered with seed capsules which I gathered, but being unable to sow them till I came home, failed to raise any trees. A beautiful picture of a group of these trees on the banks of the Merced river in the Yosemite valley is given in *Garden and Forest*, v. 281.

This species is of recent introduction⁷ in England, the oldest specimen known to us being a tree in the Edinburgh Botanic Garden, which was planted in 1892, and measured in 1906, 39 ft. by 2 ft. 6 in. Another at Grayswood, planted in 1898, measured in 1906, 32 ft. by 2 ft. 1 in. The largest specimen at Kew was obtained from Späth in 1896, and measured 55 ft. by 3 ft. 10 in. in 1911.

¹ Var. *cupulata*, Watson, in *Amer. Journ. Science*, cxv. 136 (1878), was a name given to a specimen from Plumas County, California, with flowers, in which the disc was campanulate and pubescent.

² Piper in *Cont. U.S. Nat. Herb.* xi. 217 (1906).

³ M. E. Jones, *Montana Botany Notes*, 24 (1910).

⁴ Hilyard, *Soils*, 480 (1906), says that this species tolerates white alkaline soil, containing sodium sulphate and chloride; but remains dwarf and stunted on black alkaline soil, containing sodium carbonate.

⁵ Jepson, *op. cit.*

⁶ Dawson, *Cat. Can. Plants*, i. 457 (1884), states that there is some difficulty in separating this tree from *P. balsamifera* in the northern and north-eastern part of British Columbia, and perhaps the tree of the Yukon valley, which he refers to *P. balsamifera*, is the same which Sargent considers *P. trichocarpa*.

⁷ Dieck, *Neuh. Offert. Züschen*, 1889-1890, p. 13, introduced it on the Continent from British Columbia in 1889.

It seems likely to succeed as well and to grow larger in this climate than the common balsam poplar. Those which I have planted in a cold heavy soil and a situation where severe spring and autumn frosts occur regularly, grow very fast and are perfectly healthy. I received them from Messrs. Meehan of Philadelphia in 1903, and one of those measured in 1911 no less than 32 ft. high by 1 ft. 5 in. in girth, though its branches have been cut several times to propagate. On account of its large handsome leaves, which in hot weather diffuse a most fragrant smell for some distance, this is one of the best of all poplars for ornamental planting.

The largest tree on the continent, appears to be one in the Dresden Botanic Garden, which Mr. Bean¹ in 1908 estimated to be 70 to 80 ft. high, with a trunk 5 ft. 10 in. in girth. In the Copenhagen Botanic Garden it is 30 ft. high, and very thriving. A small tree in the Christiania Botanic Garden was also doing well in 1908.

(H. J. E.)

POPULUS MAXIMOWICZII

Populus Maximowiczii, A. Henry, in *Gard. Chron.* liii. 198, fig. 89 (1913).

Populus suaveolens, Regel, *Tent. Fl. Ussur.* 132 (1861); Maximowicz, in *Bull. Soc. Nat. Mosc.* liv. 51 (1879); Komarov, *Fl. Manshurica*, ii. pt. i. 17 (1903) (not Fischer).

Populus balsamifera, Linnæus, var. *suaveolens*, Burkill, in *Journ. Linn. Soc. (Bot.)* xxvi. 535 (1899) (not Loudon); Shirasawa, *Icon. Ess. Forest. Japon*, i. text 37, t. 18, figs. 11-24 (1900).

A tree, attaining 100 ft. in height and 10 ft. in girth. Branchlets densely pubescent. Leaves (Plate 410, Fig. 24), about 4 in. long, and 3 to 3½ in. broad, nearly orbicular, oval, or broadly elliptic; subcordate at the rounded base; cuspidate at the apex; pubescent on the midrib, nerves, and veinlets of both surfaces, whitish or tinged with rusty red beneath; densely ciliate and sharply serrate in margin; petiole densely pubescent. Fruiting catkins 7 to 10 in. long; capsules glabrous, sub-sessile, 3- to 4-valved.

This species, owing to the peculiar shape and pubescence of the leaf, is remarkably distinct from *P. suaveolens*, with which it has been confounded, and is most closely allied to the Himalayan *P. ciliata*. It is the common balsam poplar in eastern Asia, extending from Kamtschatka southwards through Saghalien to Japan, Amurland,² Manchuria, and Korea.

(A. H.)

This is the only poplar which attains a large size in Japan, where it is common in Hokkaido and in the north-eastern district of Honshu, and is called *doro-noki*. I saw it in the central parts of Hokkaido, the largest near Lake Shikotsu being about 100 ft. by 12 ft., growing on river banks and also mixed with other trees in deciduous forests;³ but in some parts of the country there

¹ Cf. *Kew Bull.* 1908, p. 397.

² Elwes found what he believes to be this tree planted at the railway stations on the Siberian Railway near Harbin in May 1912, and brought home cuttings which have rooted at Colesborne. It is recorded for Saghalien by Koidzumi in *Journ. Coll. Sci. Tokyo*, xxvii., art. 13, p. 44 (1910).

³ Such a forest is figured in *Forestry of Japan*, 96, issued in 1910 by the Bureau of Forestry, Department of Agriculture and Commerce, Tokyo. Jack, in *Mitt. Deut. Dend. Ges.* 1909, p. 282, fig. 285, gives an illustration of an old tree in Hokkaido with deeply furrowed bark.

are pure woods of this and *P. Sieboldii*. Both of these poplars are valued for their timber, which is considered the best for matches, and are being planted extensively by private persons. The seed was not ripe till the middle of July, but none of that which I brought home germinated, and I am not aware that any trees of Japanese origin have yet been introduced.

(H. J. E.)

POPULUS SIMONII

Populus Simonii, Carrière, in *Rev. Hort.* 1867, p. 360; Wesmael, in *Mém. Soc. Sc. Hainaut*, iii. 247 (1869); Schneider, *Laubholzkunde*, i. 16 (1904); Dode, in *Mém. Soc. Hist. Nat. Autun.*, xviii. 58 (1905); Gombocz, in *Math. Termes. Közl.* xxx. 105 (1911).

Populus balsamifera, Linnæus, var. *Simonii*, Wesmael, in *Bull. Soc. Roy. Bot. Belg.* xxvi. 378 (1887); Burkill, in *Journ. Linn. Soc. (Bot.)* xxvi. 536 (1899).

A tree, the dimensions of which in the wild state are unknown. Young branchlets glabrous, usually reddish brown, with five projecting ribs. Buds viscid, glabrous, sharp-pointed, parallel with the twig. Leaves¹ (Plate 410, Fig. 28), on young trees rhombic-elliptic, averaging 3 in. long and 1½ in. broad, cuneate at the base, contracted at the apex into a short cuspidate point, glabrous, dull whitish beneath; margin with deciduous cilia and crenulate serrations, ending in minute glandular incurved points; lateral nerves seven to nine pairs, all pinnate; petiole short, often not ½ in. long, channelled above, glabrous, reddish, the red colour being continued along the midrib² on the upper surface of the blade. Leaves on short shoots and on older trees, smaller and on long petioles, which are often 1½ in. in length. Leaves on vigorous shoots and at the summit of the tree, very large, often 5 in. long and 4 in. broad, ovate-elliptical, cuspidate, on petioles ½ to 1 in. long.

Staminate catkins, according to Schneider, 1 in. long; stamens about eight in a cup-shaped disc. Pistillate flowers and fruit unknown.

This species occurs in north China, where it was collected by Simon in 1862, at Si-wan, north-east of Kalgan, and by Bushell³ in 1868 in the neighbourhood of Peking. Simon sent living plants about 1862 to the Museum at Paris, where the original tree, described by Carrière, is still living, and to Simon-Louis at Plantières, Metz.

This poplar is little known in England, where we have only seen small living trees at Kew. Elwes received some short truncheons of this from Peking in 1907, of which, though three months in transit, two grew, and seem likely to succeed at Colesborne. A thriving tree at Grignon, near Paris, which measured 58 ft. by 2½ ft. in 1906, is narrow in habit, with short branches and pendulous branchlets; and young specimens show a similar weeping habit.

Prof. Craig, of the Central Experimental Farm, Ottawa, states⁴ that this tree

¹ This species is remarkable for the variation in the length of the petioles, which appear to remain short only in young trees. The large leaves are characteristic of the summit of adult trees, but may appear on vigorous lateral branches also.

² The midrib is yellow throughout on old trees.

³ Erroneously identified as *P. laurifolia* in *Journ. Linn. Soc. (Bot.)* xxvi. 536 (1899).

⁴ Quoted by L. H. Bailey, in *Cornell Univ. Agric. Station, Bull.* 68, p. 221 (1894).

grows very rapidly in Canada, making a yearly growth of 6 to 10 ft. It is not killed by the severe winters of Manitoba, and is useful for planting where wind-breaks are desired quickly.

P. yunnanensis, Dode, *op. cit.* 63 (1905), agrees in technical characters with *P. Simonii*, from which it mainly differs in the brilliant red colour of the branchlets, petioles, and midrib and nerves on the upper surface of the leaves. As in that species, the glabrous branches have five projecting ribs, and the leaves are variable, both in size and shape, and in the length of their petioles. The leaves on the long shoots of young trees are narrowly elliptic or rhombic-elliptic, 3 to 4 in. long, $1\frac{1}{2}$ to 2 in. wide, glabrous, white beneath, cuspidate at the apex, cuneate at the base, closely crenulate in margin, and with very short petioles, about $\frac{1}{4}$ in. long. On vigorous shoots they are broadly ovate, 5 in. long, $3\frac{1}{2}$ in. wide, with the cuspidate point directed to one side; petioles about 1 in. long.

This poplar, which is very ornamental, is probably a sport or a geographical form of *P. Simonii*; and was introduced from Yunnan, China, in 1906 by a cutting, sent to Dr. Dode, which has been propagated by Chenault of Orleans. There are young and thriving plants at Glasnevin, Casewick, Borde Hill, and Colesborne, the leaves of which were still green on 15th November 1912. (A. H.)

POPULUS TRISTIS

Populus tristis, Fischer, in *Allg. Gartenzeit.* ix. 402 (1841), and *Bull. Sc. Acad. Imp. Pétersb.* ix. 343 (1842); Koehne, *Deut. Dend.* 82 (1893); Schneider, *Laubholzkunde*, i. 13 (1904); Dode, in *Mém. Soc. Hist. Nat. Autun*, xviii. 62 (1905); Ascherson and Graebner, *Syn. Mitteleurop.* Fl. iv. 49 (1908); Gombocz, in *Math. Termes. Közl.* xxx. 98 (1911).

(?) *Populus balsamifera*,¹ J. D. Hooker, *Fl. Brit. India*, v. 638 (1888) (not Linnæus); Gamble, *Indian Timbers*, 691 (1902).

A small tree. Branchlets as in *P. candicans*. Buds viscid, pubescent, ciliate, often subtended by persistent ovate acuminate pubescent stipules. Leaves (Plate 410, Fig. 23), similar to those of *P. candicans* in colour, pubescence, and ciliated margin; but narrowly ovate, about 4 in. long and 2 in. broad, acuminate at the apex, subcordate or rounded at the base.² Flowers and fruit of the cultivated plant unknown.

This species was described by Fischer from a cultivated tree at St. Petersburg, supposed to have been introduced³ from central Asia. Koehne identifies with *P. tristis*, the poplar which has been found by various travellers⁴ in the north-west

¹ *P. balsamifera* is confined to North America, and is very distinct from any of the Asiatic species.

² Glands are only present at the base of large, well-developed leaves.

³ *P. tristis* was mentioned as newly introduced into Germany, by Späth, *Catalogue*, No. 91, p. 96 (1893-1894).

⁴ Thomson, who collected this poplar in the Zaskar district and other places near Leh in Ladak, describes it in *W. Himalaya and Tibet*, 180 (1852), as "a spreading tree, with large cordate leaves, which was first seen in Upper Kunawar, and is common in all the Tibetan villages, up to the highest limit of tree cultivation." It was also collected "in N.-W. India" by Dr. J. S. Stewart (specimens in the Edinburgh Herbarium); and in the Nubra valley in Tibet by Schlagintweit in 1856. It appears to be a pubescent form of *P. ciliata*, modified by a high and arid situation. The latter species, which, so far as we know, is not in cultivation, has much larger, broad ovate-cordate densely ciliate leaves; glabrous branchlets, buds, and pistillate catkins; disc of the flower lobed; and grows at lower elevations in the Himalayas, from 4000 to 10,000 feet.

Himalayas, occurring both wild and cultivated, at high elevations, 8000 to 14,000 ft. Herbarium specimens of this poplar agree with *P. tristis* in the pubescent buds, with occasional persistent stipules, hairy branchlets, and narrow leaves usually rounded but occasionally subcordate at the base. They bear pistillate catkins, 4 to 6 in. long, with densely pubescent axes and pedicels; disc crenate; ovary pubescent, globose, crowned by three two-lobed stigmas; capsule, pubescent with scattered long hairs, and splitting into three valves, each with a deep longitudinal furrow on the outer surface, not seen in any other species. Koehne's identification is probably correct, but the material for comparison is not sufficient.

I am indebted to Späth of Berlin for fresh branches of this poplar which agree perfectly with Fischer's type specimen of *P. tristis*, preserved in the Kew Herbarium. So far as I know, it is rare in cultivation in England. At Grayswood, Haslemere, it is slow in growth, a plant obtained from Späth in 1896 being only about 4 ft. high, but quite healthy. At Kew there are several small specimens, which retain their foliage hanging withered on the branches during winter. There is also a specimen in the Edinburgh Botanic Garden, about 6 ft. high, and not in a thriving state.

(A. H.)

POPULUS SUAVEOLENS

Populus suaveolens,¹ Fischer, in *Allgem. Gartenzeit.* ix. 404 (1841), and *Bull. Sc. Ac. Imp. Pétersb.* ix. 348 (1842); A. Henry, in *Gard. Chron.* liii. 198, fig. 88 (1913).

Populus balsamifera, Pallas, *Fl. Ross.* i. 67, t. xli. fig. 1, A and C (1784) (not Linnæus).

Populus balsamifera, Linnæus, vars. *intermedia* and *suaveolens*, Loudon, *Arb. et Frut. Brit.* iii. 1674 (1838).

A tree, attaining in central Asia 50 ft. in height. Young branchlets terete, slightly pubescent above the nodes. Leaves (Plate 410, Fig. 25) ovate-lanceolate or ovate, 3 to $3\frac{1}{2}$ in. long, $1\frac{1}{4}$ to 2 in. wide, rounded at the base, usually abruptly narrowed towards the acuminate apex; margin ciliate, finely crenate-serrate, with incurved glandular points; nerves running to the margin about eight pairs, the lower two or three pairs arising close together at the base, making it palmately five-nerved; glabrous on both surfaces, whitish beneath.

Staminate catkins not seen. Pistillate catkins about 3 in. long; axis densely pubescent, with white stiff hairs, which are also present on the three-valved globose ovary, and on the extremely short pedicels; disc orbicular, slightly concave, pubescent beneath, with a wavy and densely ciliate margin; stigma two-lobed.

This species in the wild state appears to be variable in the width of the leaf, and in the amount of pubescence on the branchlets and petioles. It has smaller and narrower leaves than any of the balsam poplars, which have whitish leaves beneath.

P. Przewalskii,² Maximowicz, in *Mél. Biol.* xi. 321 (1881), founded on

¹ Fischer's description is founded on Pallas's figure, and agrees with a specimen collected in Soongaria by Schrenk in 1840. Cf. my article in *Gard. Chron.* cited above.

² Dode, in *Mém. Soc. Hist. Nat. Autun*, xviii. 55 (1905), identifies with this species *P. rasumowskyana* and *P. petrowskyana*, hybrid poplars originating in Europe, which resemble in no respect the type specimen of *P. Przewalskii*, preserved in the Kew Herbarium. Cf. pp. 1843, 1844.

specimens collected by Przewalsky in the Ordos territory in Mongolia, seems to be a variety with quite glabrous branchlets and petioles.

P. suaveolens appears to be confined¹ to western and northern Siberia, and to Mongolia. It has sweet-scented foliage, resembling in this respect *P. trichocarpa*. Introduced in 1834, it has apparently never thriven in this country, where we have seen no living specimens, except small stunted trees at Kew. It appears to thrive better in Späth's nursery at Berlin, from which we have received specimens, showing healthy foliage and vigorous shoots. Elwes found a fine tree of it in the rich arboretum at Gissfeld in Denmark, the property of Count Danneskjold-Samsö. It measured 65 ft. by 4 ft., and bore the name of *P. Simonii*. (A. H.)

POPULUS LAURIFOLIA

Populus laurifolia, Ledebour, *Fl. Alt.* iv. 297 (1833), and *Icon. Fl. Ross.* v. t. 479 (1834); Fischer, in *Allgem. Gartenzeit.* ix. 404 (1841); Schneider, *Laubholzkunde*, i. 16 (1904); Dode, in *Mém. Soc. Hist. Nat. Autun*, xviii. 59 (1905); Gombocz, in *Math. Termes. Köz.* xxx. 102 (1911).
Populus balsamifera, Linnæus, var. *viminialis*, Loudon, *Arb. et Frut. Brit.* iii. 1673 (1838).
Populus balsamifera, Linnæus, var. *laurifolia*, Wesmael, in De Candolle, *Prod.* xvi. 2, p. 330 (1868).
Populus Lindleyana,² Carrière, in *Rev. Hort.* 1867, p. 380 (not Booth, *ex Loudon, op. cit.* 1657); Dode, *op. cit.* 59.

A tree, attaining 40 ft. in height. Young branchlets greyish yellow, pubescent especially near the apex, angled with five ridges, which are very prominent in the second year; lenticels few, scattered, lanceolate. Buds elongated, acute, parallel but not appressed to the twig, exuding a brownish strong-smelling resin. Leaves (Plate 410, Fig. 30) on long shoots, 3 to 5 in. long and 1 to 2 in. broad, lanceolate, rounded at the base, gradually tapering to an acuminate apex; margin finely and regularly glandular-serrate and ciliate; upper surface green, pubescent on the midrib; lower surface whitish, with scattered pubescence, most marked on the midrib; petiole short, terete, but channelled above, pubescent. Leaves on short shoots, smaller, oval, abruptly acuminate at the apex, rounded at the base, on long petioles, which are often two-thirds the length of the blade.

Staminate catkins (described from a tree at Kew) about 2 in. long, with a greenish white densely pubescent axis, bearing about thirty flowers; scales large, with about ten densely fringed lobes, and covered with long hairs on both surfaces; stamens about sixty, with short white filaments and red anthers, on a shallow oblique disc, which is entire and ciliate in margin, glabrous on both surfaces, nearly orbicular, and with a projecting point on one side; pedicel $\frac{1}{2}$ in., with a few scattered hairs. Pistillate flowers not seen. Fruit two- to three-valved, slightly pubescent.

¹ *P. suaveolens* is the poplar referred to by Gmelin, *Fl. Sibirica*, i. 152, fig. 33 (1747), who says that it grows in most places on the rivers emptying into Lake Baikal, being a little less in size than the tree willow; while in the upper regions of the Lena, Yenesei, and other northern rivers, it assumes a dwarf form, not exceeding 3 ft. in height.

² Dode keeps this distinct, though it is identical in foliage, on account of its pubescent capsules. Wild specimens of *P. laurifolia*, which I have seen, appear, however, to have pubescent capsules.

P. laurifolia appears to be confined¹ to the Altai mountains; and little is known of its habit in the wild state. It is said to be often planted as a street tree in northern Russia, and apparently thrives in Sweden, where I saw two fine trees in the public park at Gefle, about 70 ft. by 5 ft., in 1908.

Though introduced in Loudon's time, it has always been a scarce tree in England; and the only specimen which we know of considerable size is a tree at Kew, about 30 ft. high, with a furrowed bark, a crooked stem, and pendulous branches and branchlets. There is also a small stunted tree at Beauport, Sussex. This poplar is only suitable for cultivation in this country as a curiosity in botanic gardens; but it is said² to bear pruning well, and on the continent is often trimmed to form pyramidal and globose shrubs.

P. laurifolia is supposed to be one of the parents of the four hybrids which follow.

I. POPULUS WOBSTII, Schroeder, *ex Dippel, Laubholzkunde*, ii. 207 (1892).

This poplar, of which I have only seen branches sent me by Späth, has glabrous branchlets, slightly ribbed and marked with orange lenticels. Buds very viscid. Leaves (Plate 410, Fig. 32), 4 to 6 in. long, about 2 in. broad, lanceolate, widest about the middle, rounded but narrow at the base, gradually tapering towards the blunt acuminate apex, slightly pubescent on the midrib and veins, very white beneath, ciliate and crenately serrate in margin; lateral nerves pinnate at the base; petioles with a few scattered hairs.

Its origin is unknown;³ but it is possibly a hybrid of *P. laurifolia* with *P. tristis*, as surmised by Schneider, *Laubholzkunde*, i. 16 (1904). According to Späth it is slow in growth, and apparently has little to recommend it, except as a curiosity in botanical gardens. I have seen no living specimens in England.

The remaining three hybrid poplars show *P. laurifolia* parentage in the peculiar greyish yellow colour of the branchlets, which are slightly ribbed. The other parent is one of the black poplars, from which the leaves derive the translucent border to their margin, which is, however, very narrow, and can only be made out on careful examination. The foliage and buds have merely a feeble balsamic odour, and the under surface of the leaves is only slightly whitish, being in these respects intermediate between the balsam and the black poplars.

II. POPULUS RASUMOWSKYANA, Schroeder, in Regel, *Russ. Dend.* 133 (1889).

Young branchlets glabrous, angled, with projecting ridges and numerous white lenticels. Buds viscid, sharp-pointed. Leaves on young trees on vigorous shoots, 4 in. long, 3 in. wide, orbicular-ovate, rounded or subcordate at the base, contracted above into a gland-tipped acuminate apex, glabrous except for slight pubescence at

¹ The Chinese specimens referred to this species in *Journ. Linn. Soc. (Bot.)* xxvi. 536 (1899), appear to be *P. Simonii*.

² Cf. Ascherson and Graebner, *Syn. Mitteleurop. Fl.* iv. 47 (1908).

³ *P. Wobstii* appears as a novelty in Späth's *Catalogue*, No. 76, p. 108 (1889-1890); and in his *Catalogue*, No. 95, p. 100 (1894-1895), is said not to be a hybrid, but a narrow-leaved form of *P. suaveolens*; but Schneider controverts this, while admitting the possibility of its being a distinct species.

the base of the midrib on the upper surface, pale beneath; margin glandular-crenate, non-ciliate, with a very narrow translucent border; petiole terete, grooved above. Leaves on older trees smaller, about 3 in. long and $2\frac{1}{2}$ in. wide, elliptic-rhomboidal, with an acute or a short cuspidate apex.

III. *POPULUS PETROWSKYANA*, Schroeder, *ex* Dippel, *Laubholzkunde*, ii. 200 (1892).

Very similar to the last, but with minute pubescence on the branchlets and the petioles. Leaves on vigorous shoots about 5 in. long and 4 in. wide, ovate, cordate at the base, where there are usually one or two glands on the upper surface; contracted above into a long acuminate apex; pale beneath; serrations deeper than in the preceding hybrid.

Both these hybrid poplars¹ originated in the garden of the Imperial Agricultural Institute at Petrowskoje-Rasumowskoje, near Moscow, and were exhibited by Schroeder at the Moscow Exhibition in 1882, with three other hybrid poplars, which do not appear to have been propagated. *P. rasumowskyana* was reported to have originated from a *P. nigra*, pollinated by *P. suaveolens*; and *P. petrowskyana* from a *P. canadensis*,² pollinated by the same species; but in all probability the balsam poplar concerned was *P. laurifolia*.

Both kinds are said by Späth to be vigorous in growth, but apparently are much less known than *P. berolinensis*, and have only lately been tried at Kew. I have no information concerning the habit of adult trees, and am doubtful as to whether these two hybrids are really distinct, the material which I have examined being very scanty.

IV. *POPULUS BEROLINENSIS*.

Populus berolinensis, Dippel, *Laubholzkunde*, ii. 210 (1892); Schneider, *Laubholzkunde*, i. 11 (1904).

Populus hybrida berolinensis, Koch, in *Wochenschr. Gärt. Pflanzenkunde*, viii. 225 (1865), and *Dendrologie*, ii. pt. i. p. 497 (1872).

Populus certinensis, Dieck, *Hauptcatalog. Baumschul. Zöschchen* (1885).

Populus nigra, var. *italica* × *laurifolia*, Koehne, *Deut. Dendr.* 85 (1893).

(?) *Populus pseudobalsamifera*,³ Fischer, in *Allgemein. Gartenseit.* ix. 402 (1841), *ex* Dode, in *Mém. Soc. Hist. Nat. Autun*, xviii. 55 (1905).

A tree, columnar in habit, with short ascending branches, and bark similar to that of *P. serotina*. Young branchlets slightly winged, densely pubescent; older branchlets also pubescent, rounded, yellowish grey. Buds greenish, viscid, sharp-pointed. Leaves (Plate 410, Fig. 29) on long shoots, ovate or ovate-rhombic, 3 to

¹ First mentioned with a brief description as *P. rasumovskoe* and *P. petrowskoe*, Schroeder, in *Gard. Chron.* xviii. 108 (1882). These ill-spelled names were perhaps misprints for the correct names given above, which appear to have been first published with marks of interrogation by Dieck, *Haupt-Catalog Zöschchen*, 1886, p. 56.

² By *P. canadensis*, possibly *P. marilandica* is meant and not *P. monilifera*. The glands at the base of the leaf confirm the correctness of this parentage. Schneider, *Laubholzkunde*, i. 11, gives the different opinions that have been advanced concerning these hybrids. He considers *P. Rasumowskyana* to be a cross between the Lombardy poplar and *P. suaveolens*.

³ Fischer describes here a balsam poplar, commonly cultivated in Russia, the earliest in leaf at St. Petersburg, and on that account probably not a native of Russia. There is no specimen of this poplar available for comparison; and it is doubtful if it is the same as *P. berolinensis*. In any case the name is invalid, as *P. pseudobalsamifera*, Fischer, *ex* Turczaninow, in *Bull. Soc. Mosc.* i. 101 (1838) is the name given earlier to a specimen, collected by Turczaninow near Lake Baikal, which is preserved in the Kew Herbarium, and is *P. suaveolens*.

4 in. long, about 2 in. broad, rounded or occasionally cuneate at the base, contracted at the apex into a long glandular acuminate point; glabrous on both surfaces, greenish or slightly whitish beneath, but never so plainly white as in the ordinary balsam poplars; margin non-ciliate, with a very narrow translucent border, only visible with a strong lens, and usually with regular crenate serrations ending in incurved glandular points, occasionally irregular with shallow lobes; nerves seven to eight pairs, those at the base arising together and making the leaf pseudo-five- to seven-palminerved; glands at the base of the leaf on the upper surface variable, none, one, or two being present; petiole variable in length, with scattered pubescence, terete, with the groove on the upper surface well-marked or not apparent. Leaves on short shoots, small, rhombic.

Staminate catkins, $2\frac{1}{2}$ to 3 in. long; scales pale green with a brownish edge, ending in about fifteen long filaments; axis glabrous, crowded with flowers; stamens about sixty, with salmon-red anthers and very short slender white filaments; disc glabrous, oblique, slightly concave. Pistillate catkins and fruit not seen; according to Koehne the ovary, fruit, and disc are glabrous.

This poplar occurs in both sexes, the staminate tree being the one commonly known as *P. certinensis*, which is a finer tree at Kew than those labelled *P. berolinensis*, which are probably pistillate, though they have not yet flowered; the latter differ in the looser longer pubescence of the branchlets.

This beautiful tree is stated by Koch to have originated in the old Botanic Garden at Berlin, through the pollination of a tree of *P. laurifolia* by the pollen of either an adjacent black Italian poplar or of a Lombardy poplar. It is a remarkable hybrid, between two species belonging to different sections of the genus (a black poplar and a balsam poplar), and shows intermediate characters, the thin translucent border to the leaf being a character of the black poplar, while the viscid buds and slightly whitish leaves show the influence of the balsam poplar parent. The original tree is no longer living, but dried specimens of it in the Berlin Herbarium show that it was pistillate. The origin of the staminate tree is unknown, but the late Herr Späth informed us that he received it under the name of *P. certinensis* from Dieck of Zöschchen in 1885, and from Transon of Orleans in 1886; and, as Dieck's catalogue of 1885 mentions it as "*P. certinensis* (?) *h. Gall.*," it is likely that it came originally from France.

There are two fine examples of the staminate tree at Kew, which were obtained from Dieck in 1889; these measured, in June 1912, 57 ft. by 3 ft. 5 in. and 50 ft. by 2 ft. 8 in. There is also a good specimen, nearly as tall, at Grayswood, near Haslemere; and another at Glasnevin, about 30 ft. high in 1913.

This species was introduced into America by the Arnold Arboretum, and, according to Professor S. B. Green,¹ is perhaps the best poplar for planting on the prairies of the north-west, as it is perfectly hardy in even the most exposed situations, and is rarely if ever affected with leaf rust, which so often checks the growth of the native cottonwood. Its timber is useful for buildings and floors. It grows readily from cuttings, and bears close planting well. (A. H.)

¹ Cf. L. H. Bailey, *Cornell Univ. Agric. Exp. Station, Bull.* 68, p. 213 (1894).

POPULUS LASIOCARPA

Populus lasiocarpa, Oliver, in Hooker, *Icon. Plant.* xx. t. 1943 (1891); Burkill, in *Journ. Linn. Soc. (Bot.)* xxvi. 536 (1899); J. H. Veitch, in *Journ. R. Hort. Soc.* xxviii. 65, fig. 27 (1903); Schneider, *Laubholzkunde*, i. 17 (1904); Dode, in *Mém. Soc. Hist. Nat. Autun*, xviii. 66 (1905); Gambocz, in *Math. Termes. Közl.* xxx. 120 (1911).
Populus Fargesii, Franchet, in *Bull. Mus. Hist. Nat. Paris*, ii. 280 (1896).

A tree, attaining in China about 60 ft. high. Young branchlets angled, more or less covered with a loose pubescence, very short and yellowish on old trees. Buds large, slightly viscid, with pubescent basal scales. Leaves (Plate 408, Fig. 9) larger than in any other species, about 9 in. long and 6 in. broad, ovate, deeply cordate at the base, with a gland-tipped acuminate apex; margin revolute, glandular and crenately serrate, the serrations uniform and regular throughout; upper surface with a dense pubescent tuft¹ at the base, elsewhere glabrescent; lower surface pale green, with a scattered tomentum, dense on the midrib and nerves, pseudo-five- or seven-palminerved at the base; petiole slightly tomentose, about one-third as long as the blade, rounded with a groove above.

Staminate catkins with numerous flowers on a short pubescent axis; stamens thirty to forty, on a thick slightly concave disc, which has a thin and lobed margin. Fruiting catkins, 5 to 8 in. long, axis pubescent; capsules two- to three-valved, densely tomentose, shortly stalked, with a lobed glabrous disc.

This remarkable species, which is closely allied to the North American *P. heterophylla*,² was discovered by me in 1888, in the mountains of central China, where it occurs in the provinces of Hupeh and Szechwan at 4000 to 6000 ft. elevation.

It was introduced by E. H. Wilson in 1904 into Veitch's nursery at Coombe Wood, where it has proved perfectly hardy.³ It is worth cultivating on account of its large handsome foliage.

(A. H.)

¹ On old trees this pubescent tuft covers two large glands, which appear to be absent on the leaves of young trees.

² *Populus heterophylla*, Linnæus, *Sp. Pl.* 1034 (1753). This species (Plate 408, Fig. 10), which grows in swamps in the United States, along the Atlantic coast and in the Mississippi valley, does not thrive in England, where we have seen no living specimens. Loudon, *Arb. et Frut. Brit.* iii. 1672 (1838), mentions two plants at Syon and in the Mile End Nursery, which, though over fifty years old, were only 5 or 6 ft. in height. According to Späth, *Catalogue*, No. 91, p. 51 (1893-1894), it was not in cultivation on the Continent in 1893, but in that year he reintroduced it. Ascherson and Graebner, *Syn. Mitteleurop. Flora*, iv. 52 (1908), state that it is grown in school gardens for the study of the flowers, which are borne on quite small plants.

³ It was awarded a first-class certificate by the Royal Horticultural Society in 1908. Cf. *Proc. R.H.S.* xxxiv., p. cccxi, fig. 111 (1909).

ULMUS

Ulmus, Linnæus, *Gen. Pl.* 68 (1737) and *Sp. Pl.* 225 (1753); Lindley, in Rees, *Cyclopædia*, xxxvii. Nos. 1 to 13 (1818); Planchon, in De Candolle, *Prod.* xvii. 154 (1873); Bentham et Hooker, *Gen. Pl.* iii. 351 (1880); Schneider, *Laubholzkunde*, i. 212 (1904); Ascherson and Graebner, *Syn. Mitteleurop. Flora*, iv. 546 (1911).
Microptelea, Spach, in *Ann. Sc. Nat.* xv. 358 (1841).
Chaetoptelea, Liebmann, in *Vidensk. Medd. Kjöbenhavn*. 1850, p. 76.

DECIDUOUS or rarely sub-evergreen trees, with furrowed bark, and zigzag branchlets, which are often provided with corky wings. Terminal leaf-buds not formed, the tip of the branchlet dying and dropping off early in the season, leaving a small circular scar close to the uppermost axillary bud, the latter in the following season prolonging the branch. Buds composed of numerous ovate rounded scales, imbricated in two ranks, those of the inner rows accrescent, and marking, when they fall, the base of the branchlet with ring-like scars.

Leaves simple, alternate, placed on the branchlet in two ranks, stalked, simply or doubly serrate, penninerved, asymmetrical at the base,¹ the inner half of the blade being the larger. Stipules lateral, entire, free or connate at the base, usually early deciduous.

Flowers minute, perfect, appearing either in early spring before the leaves in the axils of the leaf-scars of the previous year, or in autumn in the axils of the leaves of the current year; in stalked or sub-sessile fascicles or cymes; articulated on slender two-bracteolate pedicels: calyx, campanulate or funnel-shaped, with four to nine short or deeply divided lobes: stamens three to eight, inserted under the ovary, with thread-like filaments, and two-celled dorsifixed extrorse anthers, which dehisce by two longitudinal openings; ovary usually one-celled by abortion, sessile or stalked; style with two spreading lobes, stigmatic on the inner surface; ovule solitary, suspended from the apex of the cell.

Fruit, a samara, ripening in two or three months after flowering, surrounded at the base by the remains of the calyx, notched at the apex, the notch open or closed by the incurved persistent stigmas and ciliate within; seed-cavity in the centre or above it, compressed, slightly thickened in margin, and produced into a thin peripheral reticulate membranous wing. Seed solitary, suspended from the apex of the cavity, without albumen; cotyledons flat, raised above the ground in germination.

¹ Cf. Van Tieghem in *Ann. Sci. Nat. (Bot.)*, iii. 377 (1906), on the peculiar asymmetry in the leaves and stipules of the elm.

The genus *Ulmus* comprises about twenty species, natives of the extra-tropical parts of the northern hemisphere, extending in North America to the mountains of southern Mexico, but not occurring in the Pacific coast region; widely distributed in the Old World, throughout Europe, and in Algeria and Morocco, and spread through Asia in Siberia, Asia Minor, Persia, Turkestan, Afghanistan, the Himalayas, China, Tongking, Japan, and Formosa.

The genus is divided into three sections:—

I. BLEPHAROCARPUS, Dumortier, *Fl. Belg.* 25 (1827).

Orioptelea, Spach, in *Ann. Sc. Nat.* xv. 363 (1841).

Leaves, deciduous in autumn. Flowers opening early in spring before the leaves, on elongated unequal pedicels; calyx oblique, with five to eight unequal short lobes. Samaræ densely ciliate in margin.

Of the species in cultivation, *U. americana*, *U. racemosa*, *U. alata*, and *U. pedunculata* belong to this section.

II. MADOCARPUS, Dumortier, *Fl. Belg.* 25 (1827).

Dryoptelea, Spach, in *Ann. Sc. Nat.* xv. 363 (1841).

Leaves deciduous in autumn. Flowers opening early in spring before the leaves, on very short pedicels; calyx with four to seven equal short lobes. Samaræ non-ciliate.

Of the species in cultivation, *U. montana*, *U. nitens*, *U. campestris*, *U. major*, *U. minor*, *U. pumila*, *U. japonica*, and *U. fulva* belong to this section.

III. MICROPTOLEA, Planchon, in *Ann. Sc. Nat.* x. 260 (1848).

Leaves sub-persistent or tardily deciduous. Flowers opening in autumn, on short pedicels; calyx deeply divided into four to eight equal long lobes. Samaræ ciliate or non-ciliate.

Of the species in cultivation, *U. parvifolia* and *U. crassifolia* belong to this section.

About fifteen species of *Ulmus* are in cultivation, and may be arranged as follows:—

I. *Leaves with sixteen to twenty pairs of lateral nerves.*

* *Leaves, with lateral nerves rarely forked; axil-tufts inconspicuous or absent.*

(a) *Leaves ciliate in margin. Branchlets without corky ridges.*

1. *Ulmus pedunculata*, Fougereux. Europe. See p. 1851.

Leaves usually obovate and widest above the middle, 2 to 4 in. long, biserrate with incurved serrations, smooth above, densely pubescent beneath. Buds elongated, fusiform, sharp-pointed.

2. *Ulmus americana*, Linnæus. North America. See p. 1855.

Leaves oval, widest about the middle, 3 to 5 in. long, biserrate with incurved serrations, scabrous or smooth above, more or less pubescent beneath. Buds ovoid, obtuse.

(b) *Leaves non-ciliate in margin. Branchlets developing corky ridges in the second or third year.*

3. *Ulmus racemosa*, Thomas. North America. See p. 1860.

Leaves oval or elliptic, about 3 in. long, usually sub-cordate at the base, biserrate with incurved points, glabrous and smooth above, slightly pubescent beneath without any trace of axil-tufts.

** *Leaves, with lateral nerves often forked, and with conspicuous axil-tufts.*

(a) *Young branchlets scabrous with numerous minute tubercles. Leaves ciliate in margin.*

4. *Ulmus fulva*, Michaux. North America. See p. 1862.

Leaves oval or obovate, 5 to 7 in. long, scabrous above with minute tubercles and short bristles, densely pubescent beneath, coarsely biserrate.

(b) *Young branchlets smooth. Leaves non-ciliate.*

5. *Ulmus montana*, Stokes. Europe, Asia Minor, Caucasus, Amurland, Manchuria, Japan. See p. 1864.

Branchlets stout, pubescent with stiff hairs. Leaves obovate or oval, 3 to 5 in. long, with short stout petioles, not exceeding $\frac{1}{8}$ in. in length; scabrous above, densely pubescent beneath.

6. *Ulmus vegeta*, Lindley. A hybrid.¹ See p. 1879.

Branches long, straight, and ascending. Branchlets slender, glabrous or with a few scattered hairs. Leaves oval, $3\frac{1}{2}$ to 5 in. long; smooth or nearly so and glabrous above; glabrous beneath except for axil-tufts; petiole $\frac{1}{4}$ to $\frac{3}{8}$ in. long.

II. *Leaves, with eight to fourteen pairs of lateral nerves; very unequal at the base; plainly biserrate; and with conspicuous axil-tufts beneath.*

* *Young branchlets glabrous, or with only a few scattered hairs.*

7. *Ulmus major*, Smith. Europe. See p. 1883.

Leaves broadly oval, 3 to 5 in. long, nearly smooth above, with a scattered minute pubescence on both surfaces, and dense axil-tufts beneath; petiole $\frac{1}{4}$ to $\frac{3}{8}$ in. long, pubescent. Epicormic branches with large corky ridges are usually present on the stem.

8. *Ulmus nitens*,² Moench. Europe, Algeria, Asia Minor, Caucasus, Persia, Turkestan. See p. 1887.

Leaves oval or obovate, 2 to $3\frac{1}{2}$ in. long, shining and smooth above; with scattered minute pubescence on both surfaces in spring, disappearing in summer; glandular beneath; petiole $\frac{1}{4}$ to $\frac{1}{2}$ in. long, pubescent.

9. *Ulmus minor*, Miller. Europe. See p. 1901.

Leaves elliptic, $1\frac{1}{2}$ to $2\frac{1}{2}$ in. long, acute or acuminate at the apex; dull and

¹ The other less common hybrids, having *U. montana* as one of the parents, are described, pp. 1868-1874. Most of these hybrids have leaves with numerous lateral nerves; but differ in habit and other characters from *U. montana* and *U. vegeta*.

² This species is very variable, and only the typical form is here indicated.

slightly scabrous above; glandular and ultimately glabrescent beneath, except for conspicuous axil-tufts; lateral nerves few, 8 to 10 pairs; petiole, $\frac{1}{3}$ in. long.

** *Young branchlets densely pubescent.*

10. *Ulmus campestris*, Linnæus. Southern England, Spain(?). See p. 1903.

Leaves broadly oval or ovate, 2 to 3 in. long; scabrous and minutely pubescent above; covered beneath with a dense soft pubescence: lateral nerves, 10 to 12 pairs; petiole $\frac{1}{5}$ in. long, densely pubescent. Branchlets without corky wings.

11. *Ulmus japonica*, Sargent. Japan, Manchuria. See p. 1923.

Young branchlets light brown, often roughened with minute tubercles or ridges. Leaves obovate or elliptic, 3 to 4 in. long; scabrous above with minute tubercles and short bristles; densely pubescent beneath; lateral nerves 12 to 16 pairs. Branchlets often with corky wings.

- III. *Leaves, with eight to twelve pairs of lateral nerves; often nearly equal at the base; often simply serrate; axil-tufts inconspicuous or absent.*

* *Leaves deciduous in autumn.*

(a) *Branchlets with corky wings.*

12. *Ulmus alata*, Michaux. North America. See p. 1924.

Leaves light green, thin in texture, oblong-lanceolate, about 2 in. long, acute or acuminate at the apex, smooth above, with axil-tufts beneath, biserrate; nerves rarely forked.

13. *Ulmus crassifolia*, Nuttall. North America. See p. 1925.

Leaves light green, coriaceous, oval, 1 to 2 in. long, acute or rounded at the apex, often subcordate at the base, scabrous above, without axil-tufts beneath; often biserrate; nerves usually forked; stipules persistent till May.

(b) *Branchlets without corky wings.*

14. *Ulmus pumila*, Linnæus. Turkestan, Eastern Siberia, Manchuria, Korea, North China. See p. 1926.

Leaves thin and flexible in texture, ovate to ovate-lanceolate, 1 to 2 in. long, acute or acuminate at the apex, scabrous or smooth above, with axil-tufts and scattered minute pubescence beneath.

** *Leaves deciduous in January.*

15. *Ulmus parvifolia*, Jacquin. China, Tongking, Formosa, Japan. See p. 1928.

Leaves coriaceous, obovate or ovate-lanceolate, 1 to $1\frac{3}{4}$ in. long; shining, dark green, smooth and glabrous above; glabrous beneath, but occasionally with axil-tufts near the base. (A. H.)

ULMUS PEDUNCULATA, EUROPEAN WHITE ELM

Ulmus pedunculata,¹ Fougereux, in *Mem. Acad. Roy. Sc.* 1784, p. 215, t. 2.

Ulmus levis, Pallas, *Fl. Ross.* i. 75, t. 48, fig. F. (1784); Ascherson and Graebner,² *Syn. Mitteleurop. Flora*, iv. 548 (1911).

Ulmus effusa, Willdenow, *Fl. Berol. Prod.* 97 (1787) and *Berl. Baumz.* 393 (1796); Loudon, *Arb. et Frut. Brit.* iii. 1397 (1838); Willkomm, *Forstl. Flora*, 559 (1887); Fliche, *Flore Forestière*, 304 (1897).

Ulmus ciliata, Ehrhart, *Beitr.* vi. 88 (1791).

Ulmus octandra, Schkuhr, *Handb.* i. 178, t. 57 (1791).

Ulmus racemosa, Borkhausen, *Forstbot.* i. 851 (1800) (not Thomas).

A tree, attaining about 100 ft. in height and 12 to 20 ft. in girth. Bark similar to that of *U. americana*, smooth at first, then exfoliating in broad thin scales, and ultimately deeply fissured as in the other elms. Young branchlets densely clothed with white short wavy pubescence, partly retained on the branchlets of the second year which are slightly fissured but not finely striate. Buds longer and more sharply pointed than those of *U. americana*; with glabrous scales, which are minutely ciliate in margin. Leaves (Plate 411, Fig. 7), obovate and widest above the middle, or oval, 2 to 4 in. long, and $1\frac{1}{2}$ to $2\frac{1}{2}$ in. wide; very oblique and unequal at the base, the upper side rounded, the lower side rounded or straight; suddenly contracted at the apex into a serrated point; upper surface smooth to the touch, pubescent on the midrib and veins, elsewhere glabrous or with a few scattered hairs; lower surface pale green, covered with a dense short white pubescence; margin coarsely biserrate, with sharp incurved points, ciliate; nerves about sixteen pairs, running straight and parallel to the margin, with one or two rarely forked; petiole $\frac{1}{4}$ in. long, densely pubescent.

Flowers, twenty to twenty-five in a cluster, on long slender pedicels ($\frac{1}{4}$ to $\frac{3}{4}$ in. in length); calyx campanulate, oblique, with five to seven short pink lobes; stamens five to seven, with white filaments and red anthers; ovary green, pubescent on the margins, with white stigmas. Samaræ, on long slender stalks, oval or ovate, $\frac{3}{8}$ to $\frac{1}{2}$ in. long, conspicuously reticulate and glabrous on the surface, densely ciliate in margin with long white hairs; apex with a deep cleft, usually closed by the incurved stigmas; seed situated towards the base of the samara, with its apex close to the base of the notch.

Seedlings, raised in 1909 at Cambridge, were very uniform, all bearing in the first year six to eight pairs of opposite leaves. In 1911, these seedlings still preserved their uniform character, and were readily distinguishable by their ciliate leaves, and the absence of corkiness on the branchlets.

This species, like *U. americana*, is often remarkable in old age for the sharp

¹ This name was published by Fougereux in a paper, read at Paris on 1st September 1784. Pallas's name was published later in the same year, according to a note by Fougereux, appended to his paper when it appeared in the volume of the *Mém. Acad. Roy. Sc.*, for 1784, which was issued in a complete form in 1787.

² *U. alba*, Kitaibel, in Willdenow, *Berl. Baumz.* 318 (1796), judging from the description, and also from a tree so named in the Leyden Botanic Garden, is a variety of *U. nitens*, and not a synonym of this species, as stated by Ascherson and Graebner. *U. alba*, Besser, *Enum. Pl. Volhynia*, pp. 43, 92 (1822), is *U. pedunculata*.

protruding ribs at the base of the trunk, with deep concave recesses between them. The stem, as in the American species, usually produces an abundance of pendulous epicormic shoots. Fliche states that it suckers freely from the roots, and gives abundant coppice shoots.¹ It does not appear ever to form corky wings on the twigs. The leaves usually turn a yellowish colour in autumn.

Klotzsch,² who was curator of the Berlin Herbarium, crossed *U. pedunculata* with "*U. campestris*" (probably *U. nitens*) in 1845; and raised seedlings from both the cross-fertilised seeds and from the seeds of the parent trees; and after eight years' growth under similar conditions, the hybrid seedlings were one-third taller than the others.

VARIETIES

U. pedunculata does not differ from *U. americana* in the characters of the flowers or fruits; and can only be kept distinct³ from that species, on account of its usually smaller and more oblique leaves, which are smooth above to the touch. *U. pedunculata* as described above has usually leaves densely pubescent beneath; but trees with almost glabrous leaves are occasionally seen in cultivation. The most remarkable variety in the wild state⁴ is the following:—

1. Var. *celtidea*, Rogowicz, *Fl. Kief*, 229 (1869); Köppen, *Holzgewächse Europ. Russlands*, ii. 33 (1889); Chitrovo, in *Bull. Soc. Nat. Orel*, i. 50, t. 1 (1907).

Var. *glabra*, Trautvetter, in *Bull. Phys. Math. Acad. Imp. Sc. St. Petersburg*, xv. 349 (1857).
Ulmus celtidea, Litwinow, *Schedæ Herb. Fl. Ross.* vi. 167 (1908).

Leaves oblong-lanceolate, about 1 in. in length, long acuminate at the apex, coarsely and sharply serrate, cuneate and subequal at the base, nearly quite glabrous beneath. Stamens five or six. Samaræ smaller than in the type.

This peculiar elm was found by Rogowicz in 1856 near Chernigof. Lately, another remarkable tree has been discovered near Briansk in the Orel province, which has similarly shaped trees, but much larger in size, 4 to 5 in. long, and pubescent beneath. Seedlings of this tree raised at Kief have broad leaves as in the typical form of the species.

The following horticultural varieties,⁴ none of which are in cultivation in England, have been described.

2. Var. *punctata*, Schelle, *Laubholz-Benennung*, 87 (1903).

Leaves variegated with white.

¹ The leaves on coppice shoots, which I gathered in 1912 near Rochefort in Belgium, are very large, 6 to 9 in. long and 4 to 5 in. broad, oval, with a single long cuspidate point at the apex, nearly equal at the rounded base, scabrous with short bristles on the upper surface, sparsely pubescent beneath.

² In *Monatsbericht K. Preuss. Akad. Wiss. Berlin*, 1854, pp. 535-562, abstracted in *Bull. Soc. Bot. France*, ii. 327 (1855). Klotzsch, whose article is of great interest, seems to have been the first botanist to make experiments in crossing forest trees. In 1845 he also crossed *Pinus sylvestris* and *P. austriaca*, *Quercus sessiliflora* and *Q. pedunculata*, *Alnus incana* and *A. glutinosa*; and in each case raised hybrid seedlings of great vigour; and claimed that by hybridisation, both the rapidity of growth and durability of the timber of forest trees could be augmented considerably. Cf. Darwin, *Animals and Plants under Domestication*, ii. 130 (1868).

³ Jouin showed Elwes in Simon-Louis's nursery at Metz young trees of both species. Those of *U. pedunculata* had much smoother bark; but it is doubtful if this character is a constant one.

⁴ Hayne, *Arz. Gew.* iii. t. 17 (1813), described four varieties, which are unworthy of retention, being based on trifling variations in the flowers and leaves. Zapalowicz, *Consp. Fl. Galic.* ii. 96 (1908), has lately described two varieties, which I have not seen.

3. Var. *aureo-variegata*, Schelle, *loc. cit.*

Leaves spotted with yellow.

4. Var. *erubescens*, Von Schwerin, in *Mitt. Deut. Dend. Ges.* 1911, p. 423. Leaves turning a beautiful red in autumn.

5. Var. *urticæfolia*, Jacques, *ex De Vries, Plant Breeding*, 614 (1906).

A chance seedling, with lacinate leaves, which was raised by Jacques in 1830, and subsequently was multiplied by grafting. This variety appears to be lost, as it is not now known in cultivation.

6. Bolle mentions a pyramidal form, which is growing in the cemetery at Fredericksfelde near Berlin.

DISTRIBUTION

U. pedunculata is a native of central Europe, being distributed from eastern France to Russia. It is not a native of the British Isles or of Scandinavia,¹ and is nearly absent from the Mediterranean region, being unknown in Spain and Portugal, only recorded from two stations in northern Italy, and very rare in Greece.

It appears to be most widely spread in Russia,² where it is prevalent except in the extreme north and the region of the steppes, its northern limit extending from southern Finland across Lake Onega, the valley of the Dwina as far north as lat. 63°, and Perm, to the western side of the Ural range. It usually occurs scattered in the broad-leaved forests, but is more common than *U. montana* in the governments of Tula and Moscow. In Russia³ it is planted along the railways as a protection against snowdrifts in winter. It also occurs in the Crimea and the Caucasus.

It is a rare tree in Belgium, Holland, and Denmark; but is met with in central and northern Germany, especially in Brandenburg,⁴ where the finest trees occur on the banks of the Havel and Spree, some being 100 feet in height and 20 ft. in girth. In Germany it usually grows in damp deciduous woods, and on the swampy banks of streams and lakes. It is recorded for a few stations in Switzerland,⁵ Montenegro, Roumania, Bulgaria, and Servia, where I saw in 1909 a tree about 50 ft. high on the banks of the Drina, near Zvornik. (A. H.)

In France it is only found in the north-east, in a few stations, though according to Fliche⁶ it has probably been more abundant, as it occurs mostly on rich and fertile soils in the plains which are now cultivated. It is most numerous in the south-east of the department of the Ardennes in the forest of Mondieu and at Stenay, both in the valley of the Meuse. It never grows in quantity, but is scattered in mixture with *Quercus pedunculata* in damp places, associated with ash, willow, aspen, birch, and alder. It is also found near Gray in the upper Saône valley, and

¹ Schübeler says it grows well on the south and west coast of Scandinavia, and Elwes saw it planted near Stockholm.

² Köppen, *Holzgewächse Europ. Russlands*, ii. 26 (1889). It occurs in Finland on the shores of the Gulf, but Elwes did not see it in the forest of Raivola.

³ *Garden and Forest*, 1890, p. 475.

⁴ Bolle, in *Garden and Forest*, 1888, p. 381.

⁵ Dr. Christ says it occurs wild only at Schaffhausen; but I have a specimen from Mr. A. B. Jackson, collected at the foot of the Harderberg, near Interlaken.

⁶ In *Bull. Soc. Bot. France*, xlvi. 381 (1901).

near Luneville, in the Meurthe valley. M. Guinier, of the Forestry School at Nancy, to whom I am indebted for the above information, was good enough to show me this tree on the banks of the Moselle, just below the Château de la Fli, near Liverdun, on 5th May 1911 when it was in flower, and the leaves about half expanded. The trees were not large, and their bark seemed more scaly than that of *U. montana*. Though the habit seemed more pendulous than that of the wych elm, I do not think the tree could be certainly distinguished in winter except by the buds, and some trees looked as though they might be hybrids. Reuss states¹ that a few trees of *U. pedunculata* occur in the forest of Fontainebleau. M. Jouin at Plantières, near Metz, informed me that, as this species is much less subject to the attacks of the elm-leaf beetle² than *U. nitens*, it is likely to be much more generally planted in that part of France, but the wood is considered inferior to that of the other elms by those who distinguish it.³ Loudon⁴ mentions in 1841 an enormous tree of this species, with three great trunks, in the nursery ground at Neuilly, near Paris; but we do not know if it is still living. I saw a log under this name in the Hungarian Exhibition at London in 1908, which was very similar in appearance to *U. montana*.

In Belgium, according to Huberty,⁵ this tree is only found in the district about Rochefort, where it grows on calcareous soil in fertile valleys on the edge of woods, but is rather local, and of no economic importance. The largest tree I heard of grows at the mouth of the Gouffre de Belvaux, where a stream disappears in the limestone rock and comes up again some way off at Han-sur-Lesse, celebrated for its extensive caverns. This tree was pollarded many years ago, and has a sound trunk about 15 ft. high by 16 ft. in girth, its total height being about 60 ft. It has been figured by Huberty.⁵ I could find no other trees of the sort near it except some small bushy ones apparently produced from suckers.

Hempel and Wilhelm⁶ give an illustration of a tree, about 80 ft. high, in the Prater at Vienna, which has wide-spreading branches. I saw this elm in June 1910 in west Slavonia, in the virgin forest of Subanja, which is mainly composed of old oak trees, with a mixture of hornbeam, lime, maple, and ash.

Loudon states that the date of the introduction of this species is unknown; and

¹ *Compte Rendu Congrès Internat. Sylviculture, Paris, 1900*, p. 683.

² *Galericella luteola*, Müll. (more widely known as *G. xanthomelana*, Schr.), a small beetle belonging to the family Chrysomelidae, 6 to 8 mm. long, pale sordid yellow or yellowish brown above, with a stripe along the outer margin of the elytra, a short line on each side of the scutellum, a central and two lateral spots on the thorax, and a spot on the head, black. This insect is very destructive to the foliage of young elms both in its larval and perfect states; and, as I was assured by M. Jouin, is a serious hindrance to the raising of elms in his nursery. It is not, however, a native of Britain, and in the opinion of Mr. G. C. Champion, a competent coleopterist who has observed its ravages on the Continent, the climate of this country is unsuitable for its establishment, even if it were introduced with plants. In America, where it was introduced from Europe in 1837, its depredations have of late years attracted considerable attention. Pardé, in *Bull. Soc. Dend. France*, 1909, p. 100, agrees with Jouin as to the comparative immunity from this pest of *U. pedunculata*.

³ Fliche, in *Bull. Soc. Bot. France*, xlviii. 381 (1901), states that the wood is little esteemed, partly on account of its pale yellowish colour, whence it is called *orme blanc*; but mainly because it fails in strength and elasticity, and is unfit for many purposes for which the other elms are valuable. It even makes poor fuel; and is always classed in commerce with soft woods, like poplar, etc.

⁴ *Gard. Mag.* xvii. 389 (1841).

⁵ In *Bull. Soc. Cent. Forest. Belg.* xi. 634, pl. xii. (1904).

⁶ *Bäume u. Sträucher des Waldes*, iii. 9, figs. 234, 235 (1889). The botanical details are well illustrated in t. 39 of this work.

the only large tree which he mentions, one at White Knights, which was 63 ft. high in 1838, is no longer living.

The finest specimen in England is a tree (Plate 389) at Syon,¹ which is 90 ft. in height and 12 ft. 8 in. in girth. This was long supposed to be *U. americana*; but it agrees better in the characters of the foliage with *U. pedunculata*, and like the latter species at Kew and elsewhere, produces flowers regularly every year, which is not the case with trees of *U. americana* in this country. There are two good specimens at Kew, one about 25 ft. high, which was obtained from Späth in 1895. It produced good seed in 1909, from which seedlings were raised at Cambridge. Another tree, obtained from Booth in 1872, is about 35 ft. high, and very thriving.

At Ugbrooke Park, Devonshire, the seat of Lord Clifford of Chudleigh, I found in April 1908 a row of seven large trees, in the park near the house, which I at once recognised by their flowers, though the leaves were not yet out. I saw these again on 28th November of the same year, when the leaves had fallen about three weeks previously, though those of the English elm were still of a golden colour. Their buds were more swollen than those of the Dutch elms near, which also had some leaves on, and the bark and habit differs from that of English and wych elms. I could find no suckers near any of the trees,² one of which is figured in Plate 390. The average height was 80 to 85 ft., and the girth of ten trees, three of which are on the other side of the avenue above the oaks, varied from 11 ft. to 14 ft. 8 in. Neither Lord Clifford nor the gardener, Mr. Abraham, could tell me anything of the age or history of these trees, which must have been brought from abroad over a century ago.

(H. J. E.)

ULMUS AMERICANA, AMERICAN WHITE ELM

Ulmus americana, Linnæus, *Sp. Pl.* 226 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1406 (1838);

Sargent, *Silva N. Amer.* vii. 43, t. 311 (1895), and *Trees N. Amer.* 289 (1905).

Ulmus mollifolia, Marshall, *Arb. Amer.* 156 (1783).

Ulmus pendula, Willdenow, *Berl. Baumz.* 519 (1811).

Ulmus alba, Rafinesque, *Fl. Ludovic.* 115 (1817), and *New Fl.* iii. 39 (1836), (not Kitaibel).³

Ulmus floridana, Chapman, *Flora*, 416 (1865).

A tree, attaining in America 120 ft. in height and 30 ft. in girth. Bark grey, divided by deep fissures into broad scaly ridges. Young branchlets occasionally glabrous but usually clothed with a soft white pubescence, more or less retained on the second year's branchlets, which are fissured but not finely striate on the surface. Buds ovoid, obtuse, with glabrous ciliate scales. Leaves (Plate 411, Fig. 11) oval, usually widest about the middle or below it, 3 to 5 in. long, 1½ to 2½ in. wide; oblique and unequal at the base, with the upper side rounded and the lower side straight;

¹ In the Syon catalogue of 1849, this tree is noted as having then measured 85 ft. by 10 ft.

² These trees were found to be infested with the elm Psylla (*Psylla ulmi*, L.), but the circumstance is not of economic importance, since there is no reason to believe that this insect is more detrimental to the elm than is its congener *Psylla alni* to the common alder. The nymphs of the elm Psylla live in the axils of the leaves on the ends of the twigs, and enter the imago state in June. The imagines do not hibernate, but lay their eggs in the autumn; a circumstance which would point to the introduction of the species with young trees. It is remarkable that the elm Psylla has never been found in this country on any other species of elm.

³ Cf. p. 1851, note 2.

abruptly narrowed at the apex into a serrated point; upper surface dark green, smooth or scabrous to the touch, with scattered stiff short hairs arising from minute tubercles; lower surface pale, covered with a soft dense pubescence, conspicuous on the midrib and nerves, and occasionally forming minute axil-tufts at their junctions;¹ nerves sixteen to twenty pairs, running straight and parallel to the margin, only one or two being forked; margin coarsely biserrate with sharp incurved points, ciliate; petiole $\frac{1}{4}$ in. long, densely pubescent.

Flowers, about twenty in a cluster, on long slender pedicels (about $\frac{1}{2}$ to $\frac{3}{4}$ in. in length); calyx broadly campanulate, oblique, with six to eight short pinkish lobes; stamens six, seven or eight, exerted, with white filaments and red anthers; ovary green, with ciliated margins, and white stigmas. Samaræ, on long slender stalks, ovate or elliptic, $\frac{3}{8}$ to $\frac{1}{2}$ in. long, with prominent reticulations, glabrous on the surface, densely ciliate on the margin with long white hairs; with a deep notch at the apex, closed by the incurved stigmas. Seed towards the base of the samara, with its apex close to the base of the notch.

This tree, which never develops corky ridges on the branchlets, usually produces short pendulous epicormic shoots on the stem. It is very variable in habit, as is well seen in the trees at Hargham in Norfolk. In America, when growing in the forest, the stem is usually undivided for a great height, and surmounted by a compact crown. When growing in the open the tree shows well-marked differences in habit, which are described by Dame and Brooks,² as follows:—

“1. In the vase-shaped tree,³ usually regarded as the type, the trunk separates into several large branches, which rise, slowly diverging 40 to 50 ft., and then sweep outward in wide arches, the smaller branches and spray becoming pendent.

2. In the umbrella form, the trunk remains entire nearly to the top of the tree, when the branches spread out abruptly, forming a broad shallow arch, fringed with long drooping branchlets.

3. The slender trunk of the plume elm⁴ rises, usually undivided, a considerable height, begins to curve midway, and is capped with a one-sided tuft of branches and delicate elongated branchlets.

4. The drooping elm⁵ differs from the type in the height of the arch, and greater droop of the branches, which sometimes sweep the ground.

5. In the oak form the limbs are more or less tortuous, and less arching, forming a wide-spreading rounded head.”

Only a few horticultural varieties are known:—

1. Var. *pendula*, Aiton, *Hort. Kew.* i. 320 (1789).

Branches wide-spreading and arching downwards, with pendulous branchlets. This is said by Aiton to have been cultivated by Mr. James Gordon in 1752.

¹ Loudon says that *U. americana* is readily distinguished by the peculiar membrane in the axils of the veins. This membrane, uniting the base of the nerve with the midrib, is usually present only on the nerves of the outer half of the leaf.

² *Trees of New England*, 95 (1902).

³ Figured by Sargent, in *Garden and Forest*, iii. 287 (1890).

⁴ A tree of this kind, called the “feathered” form by Sargent, growing at Sandwich, New Hampshire, is figured in *Garden and Forest*, iii. 467 (1890).

⁵ The Clark elm at Lexington, with pendulous branches, which sweep the ground, is figured in *Garden and Forest*, iii. 443 (1890).

There are two specimens at Kew, about 20 ft. high, which were obtained from Späth in 1896. These occasionally develop stray branchlets, bearing enormous leaves, 7 in. long by $4\frac{1}{2}$ in. broad.

This is probably not quite the same as Beebe's weeping elm, which was distributed by Meehan as *U. fulva*, var. *pendula*, but which, according to Sargent¹ is really a form of *U. americana*. It was propagated from a tree, resembling in habit a weeping willow, which was found growing wild near Galena, Illinois.

2. Var. *aurea*, Temple, *ex* Rehder, in Bailey, *Cycl. Amer. Hort.* 1880 (1902). Leaves yellow. This was found in Vermont by F. L. Temple.

U. americana,^p which is known, on account of the light colour of its bark, as “white elm” in America, is widely distributed, occurring from southern Newfoundland through Canada to the northern shores of Lake Superior and the eastern base of the Rocky Mountains, ascending the Saskatchewan river to lat. $54^{\circ} 30'$; and extending through the United States southwards to Florida, and westwards to the Black Hills of Dakota, western Nebraska, western Kansas, Indian Territory, and the valley of the Rio Concho in Texas.

The tree does not occur in pure stands, but sparingly in mixture with oak, ash, plane, tulip tree, and other hard woods; and attains its best development on deep fertile alluvial soil. It, however, readily adapts itself to less favourable soils, and is a hardy tree enduring great extremes of temperature and moisture. It is somewhat intolerant of shade.²

This species produces coppice shoots, when the tree is cut down; and at Hargham, numerous suckers, some of which are now trees 30 ft. in height, were produced after a tree had been felled. No suckers are produced, so far as we know, by living trees either in this country or in America. (A. H.)

No tree has attracted more attention among American writers, or is more dear to the natives of New England, than the American elm, which is a conspicuous ornament and the favourite shade tree in the older cities, and has quite a literature of its own.

Though some of the historic trees mentioned by Emerson and other writers are now dead or decayed, there are still many splendored survivors of the original forest. Among these none is larger and more symmetrical than the Lancaster Elm in Massachusetts, which Prof. Sargent showed me in May 1904. It grows on deep sandy soil in the rich valley of the Nashua river, and measured 105 ft. by 24 ft. at five feet from the ground. The roots spread so widely that at ground level they are 45 ft. round. The trunk forks at 10 ft. into three tall stems; and though some holes and cracks show that the tree is past maturity, these wounds have been so carefully stopped with cement, by its owner, Mr. J. E. Thayer, that it may live for many years. Plate 391, for which I am indebted to Mr. A. H. French, of Brookline, Mass., gives an excellent picture of it.

A monster elm³ on the Avery Durfee farm in Wayne County, New York,

¹ *Garden and Forest*, i. 286 (1889).

² Cf. Pinchot, *U.S. Forest Circ.* No. 66 (1907), which gives directions for planting this tree in the United States.

³ *Garden and Forest*, iii. 60 (1890).

between Palmyra and Marion, measures, at two feet above the ground, 33 ft. 10 in. in circumference, and at five feet above the ground 20 ft. 10 in. It is 60 ft. to the first limb; and the total amount of lumber in the body of the tree is 16,250 board ft. Eighty years ago, when the farm was cleared, this tree was left as a landmark. It was then a giant amongst the surrounding forest trees.

A very fine elm, presumably of this species, which differs much in habit from any *U. americana* that I have seen, is figured and described¹ by Mr. T. H. Hoskins, who, however, does not say what the species is. The tree is evidently a relic of the original virgin forest, and grows near the highway at Derby Line close to the Canadian boundary in Orleans County, Vermont. It has a clean bole for more than half its height with a very small head, and measures 102 ft. in height with a girth of 18 ft. 2 in. at five feet from the ground.

To give an idea of the rapidity with which this species grows I may cite Emerson, who says,² quoting from the *N. E. Farmer*, vii. 299, "An elm tree nearly opposite the house of Heman Day, Esq., in West Springfield, was planted by him on 8th January 1775, when it was a sapling carried in the hand. In 1829 the trunk was 18 ft. in circumference to the height of 12 ft. above the ground, where it divides into branches which overhang a circle of more than 300 ft. in circuit covering 7500 square ft. of area." It had thus grown 216 in. in girth in fifty-four years, or at a rate of 4 in. a year. In 1845 this tree was carefully measured by a gentleman at Springfield, who found it 7 ft. in diameter at three feet from the ground, and 7 ft. 4 in. at eleven feet. The spread of the top was 134 ft.

CULTIVATION

According to Loudon this tree was introduced to England by James Gordon in 1752, though unnoticed in Miller's Dictionary published sixteen years later. It appears to have been short lived, as none were to be found in Loudon's time either at Kew or Syon, and the only specimens he mentions as then living in England were young trees 15 to 30 ft. high in the Horticultural Society's Garden at Chiswick. We have been able to recognise no old trees of it now in the country, and very few young ones. Of these the best are those at Hargham, Norfolk, where they were planted by Sir Thomas Beevor about 1854. Here there are now thirty trees varying somewhat in habit. The largest of these is one of a group of three by a sunk fence south-west of the house, and measured 85 ft. by 7½ ft. in 1911. Another in 1905 measured 68 ft. by 8 ft. 4 in. (Plate 392). A third near the farm buildings has more spreading and drooping branches, some of which have been broken by wind; its leaves are thicker and more glabrous than those of the others. I showed fresh specimens of these to Dr. N. L. Britton of New York, who thought that they all belonged to *U. americana*. I could find no suberous branchlets on any of these trees, but noticed on 24th August 1909, that their leaves were much eaten by caterpillars, which had not

¹ *Garden and Forest*, v. 303, fig. 55 (1892).

² *Trees and Shrubs of Massachusetts*, ii. 332 (1875).

injured the native elms. They seldom flower, but one of these trees has borne seed from which plants were raised in 1909. The soil on which they grow is a light sandy loam of one or two feet depth on the chalky boulder clay. At one spot only, and in a hawthorn thicket, two young trees about 30 feet seem to have sprung from suckers. The parents of these, a thickly-planted cluster, died about seventeen years ago. Sir Hugh Beevor states that there are six trees of the same age at Wilby Hall, about a mile and a half from Hargham; and says that this species has a distinctive charm and moreover very rarely suckers, and that he will plant it for ornament in future at Hargham, in preference to other elms.

Another tree, growing at Hildenley, Yorkshire, was raised from seed by the late Sir Charles Strickland about 1870 and measured in 1905 44 ft. by 3 ft. There are also two small trees by the garden road at Tortworth; a small tree in Silkwood, Weston Birt; small trees planted by myself in Congham Wood, Norfolk, which are growing fairly well in sandy soil; and several at Colesborne which at present do not seem to suffer from the lime in the soil.

In Scotland Henry found a tree at Methven, Perthshire, which in 1904 was about 60 ft. by 5½ ft. Loudon says that in 1828 there was a tree in the Botanic Garden at Edinburgh which we cannot now find.

In Ireland Henry saw in 1903 the stump of a tree¹ blown down in that year which grew in Trinity College Botanic Garden, Dublin, and was said by the late F. W. Burbidge to have been 80 ft. high.

In France it seems to succeed no better than in England; and M. Jouin informs me that many specimens in the east of France and in Alsace grown as *U. americana* are in reality *U. pedunculata*.

TIMBER

Sargent says of this wood that it is heavy, hard, strong, tough, difficult to split, and rather coarse-grained, light brown in colour, with thick sap wood which is paler. It is largely used in the States for wheel hubs, saddle trees, flooring, and cooperage, and in boat- and ship-building. It is now imported to London in the form of boards which are used as a cheap substitute for coffin boards. I am informed by Mr. A. H. Ross of the Toronto University that a great deal of what is now known in the trade as rock elm, a name properly used for *U. racemosa*, is really taken from *U. americana*; and judging from the specimens I have seen, and from those in Hough's *American Woods*, the two are difficult to distinguish. (H. J. E.)

¹ The lower part of the stem of this tree, which is 21 in. in diameter and shows eighty-two annual rings, is preserved in the Forestry Museum at Avondale.

ULMUS RACEMOSA, ROCK ELM

Ulmus racemosa, Thomas, in *Amer. Journ. Sci.* xix. 170 (1831) (not Borkhausen¹); Sargent, *Silva N. Amer.* vii. 47, t. 312 (1895), and in *Bot. Gaz.* xlv. 225 (1907).
Ulmus Thomasi, Sargent, *Silva N. Amer.* xiv. 102 (1902), and *Trees N. Amer.* 290 (1905).

A tree, attaining in America 100 ft. in height and 10 ft. in girth. Bark deeply divided by wide irregular interrupted fissures into broad flat scaly ridges. Young branchlets densely clothed with soft white pubescence, more or less persistent in the second year, when the branches are smooth, brown, and not finely striated; usually in the third year furnished with three or four irregular corky wings. Buds conic, sharp-pointed, with chestnut-brown scales, covered with appressed hairs and ciliate in margin. Leaves (Plate 411, Fig. 10) elliptic or oval, averaging 3 in. long and 1½ in. broad, unequal and usually subcordate at the base, shortly acuminate at the apex; upper surface glabrous, smooth, shining; lower surface with a scattered minute white pubescence throughout, conspicuous on the sides of the midrib and on the nerves, not forming axil-tufts; lateral nerves fourteen to eighteen pairs, running parallel and straight to the margin, occasionally forked; margin biserrate, non-ciliate; petiole ¼ in. long, glabrescent.

Flowers in a racemose inflorescence, about 1½ in. long, composed of two or three cymes, each with about three flowers; axis pubescent; pedicels slender, up to ⅜ in. long, pubescent; calyx funnel-shaped, with six to eight rounded red lobes; stamens six to eight, with slender filaments and red anthers; stigmas pale green. Samara obovate or oval, ½ to ¾ in. long, with a slight notch at the apex, pubescent on both surfaces, and densely ciliate with long white hairs on the slightly thickened margin.

The rock elm is distributed in Canada from the province of Quebec westward through Ontario, where it mainly grows on limestone, and extends southwards in the United States through northern New Hampshire to southern Vermont and northern New Jersey, and westward through northern New York, southern Michigan, and central Wisconsin to north-eastern Nebraska and western Missouri. It is rare in the east and towards the extreme western and southern limits of its range; and is most abundant and of its largest size in Ontario and the southern peninsula of Michigan. It grows mainly on dry gravelly uplands, on low heavy clay soils, and on rocky slopes and cliffs, in company with the sugar maple, butternut, lime, white ash, beech, and other trees, but is less abundant everywhere than *U. americana*.

U. racemosa is one of the rarest of American trees in this country, the only specimens which we have seen being a tree at Kew, about 25 ft. high and doing very badly, which was obtained from Sargent in 1875; a smaller tree in the Edinburgh Botanic Garden, which is not thriving; and another about 20 ft. high, growing slowly at Tortworth. The tree at Kew has never produced flowers or fruit, and scarcely ever develops foliage of a normal size or appearance, as it is hurt by both late and early frosts. Judging from these specimens, this species, like certain

¹ *U. racemosa*, Borkhausen, *Forstbot.* i. 851 (1800), is *U. pedunculata*, Fougereux.

other Eastern American trees, as white oak and black ash, is totally unsuitable for our climate. (A. H.)

Plants at Colesborne, received from Meehan in 1903, have succeeded better, though this may be only for a time. These are now about 14 ft. high, and show the characteristic corky branches, but bear leaves much smaller in size and with fewer nerves than those on adult trees in America. This small foliage is probably characteristic of the juvenile stage in the life of the tree, and matches a branch which I gathered at Ottawa. In France the tree seems to thrive no better, the only specimen which I have seen being a poor tree at Segrez, and it does not exist in the National Arboretum at Les Barres.

TIMBER

Macoun¹ says:—"The rock elm grows in southern Quebec and westward to Lake Superior, being best developed in south Ontario, to which part of Canada it is, as a commercial wood, now confined. It is much superior to the other elms, and for many purposes unequalled by any other wood. It is tough, strong, elastic, and very heavy. Its chief use is in the manufacture of agricultural implements, bicycle rims, and wheel stock. It is largely used in bridge- and ship-building and for heavy furniture. When highly polished the wood is very beautiful, and repays a greater expenditure of time in polishing than is usually given to elm."

Known in the trade as Canada rock elm, this wood long had a high reputation among ship- and boat-builders, perhaps, because it was grown very slowly in dense forests, and free from knots and defects. A large quantity of elm still comes under this name to the Liverpool and London importers, but it is difficult to say what proportion of it is genuine rock elm.

Laslett² gives a good account of its properties and resistance to transverse, tensile, and crushing strains from experiments made by him in the Royal Dockyards, where in his time 600 to 700 loads were annually used for garboards and planking on account of its durability under water, and for ladder-steps and gratings on account of its clean whitish appearance. Laslett said that it was one of the slowest grown woods he knew of, making only 1 in. in diameter in fourteen years. I have seen in the yard of Messrs. White and Company, the well-known boat- and yacht-builders of Cowes, a square log 59 ft. long and only 9½ in. square at 56 ft. from the butt, in which with a lens upwards of 250 annual growths could be counted. This was being cut into gunwales for boats. The wood is also used by makers of agricultural implements in this country, who complain of the difficulty of getting it of reliable quality. As the supply of the genuine slow-grown rock elm seems to be rapidly diminishing, whilst logs of good size are now worth 3s. 6d. per foot and upwards, it seems as though a substitute must be sought for, and may be found in home-grown wych elm if this was closely crowded on suitable land. (H. J. E.)

¹ *Forest Wealth of Canada*, 24 (1900).

² *Timber and Timber Trees*, 225 (1875), where the rock elm of Canada is erroneously named *U. americana*.

ULMUS FULVA, SLIPPERY ELM

Ulmus fulva, A. Michaux, *Fl. Bor. Amer.* i. 172 (1803); Loudon, *Arb. et Frut. Brit.* iii. 1407 (1838); Bentley and Trimen, *Medicinal Plants*, t. 233 (1880); Sargent, *Silva N. Amer.* vii. 53, t. 314 (1895), and *Trees N. Amer.* 293 (1905).

Ulmus americana, Linnæus, var. *rubra*, Aiton, *Hort. Kew.* i. 319 (1789).

Ulmus rubra, F. A. Michaux, *Hist. Arb. Amer.* iii. 278, t. 6 (1813).

(?) *Ulmus pubescens*,¹ Walter, *Fl. Carol.* 112 (1788); Sudworth, *U.S. Forest. Bull.* No. 17, p. 60 (1898); Pinchot, *U.S. Forest. Circ.* No. 85 (1907).

A tree, attaining in America 70 ft. in height and 6 ft. in girth. Bark with shallow fissures and covered with large thick appressed scales. Young branchlets, fawn-coloured, with numerous minute tubercles, and densely clothed with a short white pubescence; those of the second year tuberculate, fissured but not finely striate on the surface; remaining smooth and not developing corky ridges in the third and fourth years. Buds ovoid, with reddish brown scales, covered with long silky appressed hairs. Leaves (Plate 411, Fig. 8) oval to obovate-oblong, about 5 to 7 in. long and 2 to 3½ in. broad, very oblique and unequal at the base, acuminate at the apex; upper surface scabrous with minute sharp-pointed tubercles, and short stiff hairs; lower surface densely clothed with white soft pubescence, conspicuous on the midrib and veins, and forming axil-tufts at their junctions; lateral nerves about sixteen pairs, often forking before reaching the margin, which is ciliate and coarsely biserrate; petioles stout, ½ to ¼ in. long, glandular, densely pubescent.

Flowers in crowded fascicles on short pedicels; calyx campanulate, with a narrow tubular part below; sepals five or six, faintly pink, often irregular in size; stamens five, six, or seven, with white filaments and dark red anthers; stigmas tinged with pink on their inner side. Fruit nearly orbicular or obovate, ½ in. in diameter, rounded or slightly emarginate at the apex, with a minute notch closed by the incurved stigmas, pubescent over the seed-cavity, but elsewhere glabrous and non-ciliate; seed in the centre of the samara.

The slippery elm is distributed from the valley of the lower St. Lawrence southwards to western Florida, central Alabama and Mississippi, and the valley of the San Antonio river in Texas, and westwards through Ontario to north Dakota, eastern Nebraska, and northern and western Kansas. Throughout its entire range it is less common than *U. americana*, often occurring as a solitary tree in open woods, or less frequently on the moist banks of streams in almost pure stands. It is always a small tree, the largest measured by Emerson being 6 ft. 10 in. in girth. It thrives best in rich alluvial soil, but grows fairly well on rocky hill sides, and is often found on dry limestone ridges. It is called *orme gras* by the French Canadians, and is more common than *U. americana* in some localities near Montreal.²

The inner bark is fragrant and mucilaginous, and is officinal in the United States

¹ It is not certain whether the description by Walter, which is unsatisfactory, refers to *U. fulva* or another species, and his name, though older than that of Michaux, cannot be adopted.

² *Garden and Forest*, 1894, p. 413.

Pharmacopœia. It is frequently chewed by children, and when macerated in water yields a thick and abundant mucilage, which was formerly used as a refreshing drink for colds. The powdered inner bark is used for poultices, and is said to preserve butter and lard from rancidity if the latter are melted with it.¹

The date of introduction of *U. fulva* into England was unknown to Loudon, who mentions no large trees. It is probably short-lived in our climate, as we have seen no specimens except young trees, of which there are good examples, 15 to 20 ft. high, at Kew. It is rare except in botanic gardens; but there is a tree at Hildenley of no great size, and another at Colesborne, procured from Simon-Louis, which seems healthy at present.

The timber is not of much importance commercially, and is not found anywhere in great quantity. Macoun² says that it is more durable than that of the other elms, and is better suited for railway ties, fence-posts, and rails. Pinchot³ recommends the planting of the slippery elm in the Mississippi valley, as it grows fast in youth, and can be utilised for fence-posts when quite young, since the sapwood, if thoroughly dried, is quite as durable as the heartwood.

U. fulva has been much confused with the following species:—

ULMUS ELLIPTICA, Koch, in *Linnaea*, xxii. 599 (1849), and *Dendrologie*, ii. pt. i. 420 (1872) (not⁴ Koehne, Schneider, or Ascherson and Graebner).

A tree,⁵ similar in size and habit to *U. montana*. Young branchlets pubescent, smooth and not tuberculate as in *U. fulva*. Leaves similar to those of *U. montana*, in being nearly sessile, with the inner side of the base overlapping the branchlet; elliptic, 3½ to 6 in. long, 1½ to 2¼ in. wide, scarcely scabrous above, sparingly pubescent and with inconspicuous axil-tufts beneath; lateral nerves 18 to 20 pairs, often forked; biserrate in margin. Samaræ, obovate or oval, ¾ in. long, ⅝ in. wide, emarginate at the apex, with a minute aperture formed by the incurved stigmas; seed-cavity in the centre, and pubescent on both surfaces, the rest of the samara being glabrous and non-ciliate.

This species is closely allied to *U. montana*, differing mainly in the pubescence on the centre of the samara, in which respect it resembles *U. fulva*; but the samara in the latter species is much smaller. *U. elliptica* is imperfectly known,⁶ but is said by Koch to form extensive woods in the Caucasus, which are either pure or mixed with other broad-leaved trees. It is not in cultivation, so far as I know.

The trees cultivated by Späth, under the names *U. elliptica* or *U. Heyderi*,⁷ are

¹ Flückiger and Hanbury, *Pharmacographia*, 557 (1879). Cf. also Loudon, *Gard. Mag.* xv. 574 (1839), and xvi. 231 (1840).

² *Forest Wealth of Canada*, 24 (1900).

³ *U.S. Forest Circular*, No. 85 (1907).

⁴ *U. elliptica*, Koehne, *Dendrologie*, 136 (1893), Schneider, *Laubholzkunde*, i. 216, fig. 136 (1904), and Ascherson and Graebner, *Syn. Mitteleurop. Flora*, 550 (1911), is *U. fulva*.

⁵ This description is drawn up from a specimen in the Kew Herbarium, collected by Markowicz in the Caucasus, which agrees with Koch's description. Markowicz wrote a pamphlet on this elm, which was published at Moscow in 1900. Elwes saw specimens in the St. Petersburg Herbarium which were collected in Abchasia and near Alagir in Ossetia.

⁶ Köppen, *Holzgewächse Europ. Russlands und Kaukasus*, ii. 41 (1889), and other Russian botanists regard *U. elliptica* as a dubious species.

⁷ Späth, *Catal.* No. 57, p. 4 (1883). Koehne's description of *U. elliptica* was apparently taken from one of these trees, which produced flowers and fruit in Späth's nursery, and not from the typical tree in the Caucasus.

identical in all respects with *U. fulva*. This is remarkable, as I am informed by Mr. Jensen that one of these trees was obtained from Dieck,¹ while another was sent from Tashkend by Koopmann. There must be some error in the account of their origin, as it is improbable that *U. fulva* is either wild or cultivated in Turkestan. (A. H.)

ULMUS MONTANA, WYCH ELM

Ulmus montana,² Stokes, in Withering, *Bot. Arrange. Veget. Great Brit.* i. 259 (1787); Smith,³ *Eng. Bot.* t. 1887 (1808); Loudon, *Arb. et Frut. Brit.* iii. 1398 (1838); Mathieu, *Flore Forestière*, 302 (1897).

Ulmus campestris, Linnæus, *Sp. Pl.* 225 (1753) (in part); Miller,⁴ *Gard. Dict.*, ed. 8, No. 1 (1762); Willkomm, *Forstl. Flora*, 555 (1887).

Ulmus glabra,² Hudson, *Fl. Angl.* 95 (1762) (not Miller); Rehder, in *Mitt. Deut. Dend. Ges.* 1908, p. 157; Moss, in *Gard. Chron.* li. 217 (1912).

Ulmus scabra,⁴ Miller, *Gard. Dict.* ed. 8, No. 2 (1762); Schneider, *Laubholzkunde*, i. 216 (1904), 805 (1906); Ley, in *Journ. Bot.* xlviii. 67 (1910); Ascherson and Graebner, *Syn. Mitteleurop. Flora*, iv. 560 (1911).

Ulmus suberosa, Michaux, *N. Amer. Sylva*, ii. 244, pl. 129, fig. 2 (1819) (not Moench, Ehrhart, or Smith).

A tree, attaining 120 ft. in height and 20 ft. or more in girth. Bark remaining smooth on the stem and branches for many years, ultimately on the trunk divided by shallow longitudinal fissures into scaly plates. Young branchlets stout, more or less covered with stiff hairs; in the second year smooth or slightly fissured, not showing the fine striation of *U. nitens*. Buds conical, obtuse, with dark brown scales, which are ciliate in margin and densely pubescent on the surface with yellowish brown hair. Leaves (Plate 412, Fig. 13) variable in size and shape, but averaging 3 to 5 in. long, and readily distinguishable from the other species by the short stout densely pubescent petioles, not exceeding $\frac{1}{8}$ in. in length; mostly obovate-elliptic, very unequal at the base, cuspidate-acuminate at the apex, on vigorous branches and coppice shoots often with three cuspidate points; sharply biserrate; lateral nerves fifteen to eighteen pairs, often forked; upper surface scabrous with scattered short hairs; lower surface with a soft white pubescence, dense on the midrib and lateral nerves, forming axil-tufts at their junctions, and scattered on the surface between the nerves.

Flowers twenty to thirty in a cluster, on very short pedicels, regularly pentamerous, hexamerous, and heptamerous; calyx campanulate, contracted towards the base into a narrow wrinkled tubular part, about $\frac{1}{6}$ to $\frac{1}{7}$ in. long; sepals five, six, or

¹ *Neuh. Offer. Nat. Arb. Züschen*, 1889-1890, p. 22.

² The oldest tenable name for this species appears to be *U. glabra*, Hudson; but as *U. glabra*, Miller, has been much used for another species, I retain *U. montana*, Stokes, as a name which has been long in use, and never applied to any other species.

³ Smith's description applies to *U. montana*; but the leaves are badly drawn in the figure, the stalks being too long. *U. nuda*, Ehrhart, *Beit.* v. 160 (1790), vi. 86 (1791), judging from his specimen in Smith's herbarium at the Linnean Society, is *U. montana*.

⁴ Miller, whose account of the elms is very confused, gives two names to *U. montana*, his No. 1 being "the common rough or broad-leaved witch elm, very common in the north-west counties of England, where it is generally believed to grow naturally in woods." His No. 2 is "the witch hazel or rough and very broad-leaved elm," also said by him to "grow naturally in some of the northern counties of England." Woodmen in the Chiltern Hills and in Sussex (cf. p. 1874) at the present day sometimes similarly attempt to make a distinction between the wych elm and the wych hazel.

seven, pinkish; stamens five, six, or seven, with deep pink filaments and red anthers; stigmas red. Fruit, very shortly stalked, oval, about 1 in. long and $\frac{3}{4}$ in. broad, glabrous except in the interior of the notch, non-ciliate, rounded or pointed at the apex, with a minute notch, usually closed by the incurved stigmas. Seed in the centre of the samara, with its apex distant from the base of the notch.

The seedling¹ of *U. montana* differs from that of *U. nitens* in all the leaves above the first two pairs being alternate in the first year, and considerably larger than in the latter species. The stem is stout and usually bent to one side near the apex, and attains at the end of the first season about 6 to 12 in. in length, developing about nine to thirteen leaves in all.

The flowers of *U. montana*, which is a tree of more northerly distribution than the other European elms, are scarcely ever injured by late frosts; and in consequence ripe seed is produced regularly every year in most parts of Britain, often in great abundance and invariably fertile.

U. montana never produces suckers² in England, differing in this respect from all the other British elms. There is, however, in the neighbourhood of Cambridge, in hedgerows, a peculiar elm, closely resembling *U. montana*, but producing suckers, though in no great quantity. This elm³ is a low tree, with wide-spreading branches, forming a globose crown of foliage, and seems to be less vigorous in growth than ordinary *U. montana*. The leaves and buds cannot be distinguished from those of the last, but the branchlets are glabrous, or nearly so. The flowers of one tree which I examined differ from those of *U. montana* in the irregular number of the sepals and stamens; calyx-tube funnel-shaped and scarcely narrowed into a tubular basal part, with five or six lobes; stamens five or six, or often four, one occasionally being aborted and sterile; filaments white, not pink as in *U. montana*. Samaræ similar to those of the last, but rarely ripening, being injured by late frosts. The suckers bear small leaves, 2 to 3 in. in length, with a long acuminate apex, and often one or two additional points on each side of it. This peculiar elm³ is probably one of the descendants of the Huntingdon elm, in which nearly all the characters of *U. montana* appear; but differing in the irregularity of the flowers, the infertile samaræ, and in the occurrence of suckers.

VARIETIES

U. montana shows little variation in the wild state; but trees growing in dense woods usually bear smaller and thinner leaves than those which stand in the open.

I. The following geographical form has been described:—

1. Var. *laciniata*, Trautvetter, in Maximowicz, *Fl. Amur.* 246 (1859); Maximowicz, in *Mél. Biol.* ix. 25 (1872); Shirasawa, *Icon. Ess. Forest. Japon.* ii. t. 15, figs. 1-9 (1908).

¹ Cf. *Journ. Linn. Soc. (Bot.)* xxxix. 292, pl. 22 (1910).

² Mr. A. P. Long saw in 1912 several large trees of *U. montana* producing suckers freely in the Sihlwald, near Zurich. The leaves of these suckers differ in no respect from those produced by the peculiar Cambridge trees here described; but the leaves and branchlets of adult trees are like those of typical *U. montana*.

³ This hybrid may be named *U. Mossii* after Dr. C. E. Moss, who drew my attention to it.

Ulmus major, var. *heterophylla*, Maximowicz and Ruprecht, in *Bull. Acad. Ptersb.* xv. 139 (1857).

Ulmus laciniata, Mayr, *Fremdländ. Wald- u. Parkbäume*, 523 (1906).

Ulmus scabra, var. *heterophylla*, Schneider, *Laubholzkunde*, i. 218 (1904).

Young branchlets glabrous or with a few scattered hairs. Leaves, at the end of the branchlets, large, 6 to 7 in. long, 3 to 4 in. wide; usually with three, occasionally five, large cuspidate-acuminate lobes; upper surface scabrous, with minute tubercles, each of which bears a short bristle; lower surface covered with a dense soft pubescence. Samara, about $\frac{7}{8}$ in. long, $\frac{1}{2}$ in. wide; narrower than in the type.

This is a common form of *U. montana* in eastern Asia, where it is widely spread, but apparently mixed with the typical form in Amurland, Manchuria, Saghalien, and Japan. Both normal and tricuspidate leaves occur occasionally on the same individual tree. Similar leaves¹ in all respects occur on coppice shoots and on epicormic branches of *U. montana* in Europe, but are rarely seen on ordinary branches. In eastern Asia the peculiar tricuspidate leaves occur normally on adult trees; and young trees raised in the Arnold Arboretum from Japanese seed preserve the remarkable character of the foliage.

Sargent states² that in Japan this variety is usually a small tree, about 30 ft. high; but Mayr says that it attains 100 ft. in height in the broad-leaved forests of central Yezo.

The inner bark of this tree is taken off in narrow strips by the Ainos, and after being soaked in water, is woven into a coarse cloth, from which they make their garments. It is also woven into baskets, of which Elwes brought home specimens. The wood is not used at present to any extent; but may possibly become a substitute for Canadian rock elm when the latter becomes scarce.

II. The following varieties have arisen in cultivation:—

2. Var. *fastigiata*,³ Loudon, *op. cit.* 1399.

Ulmus Fordii and *Ulmus exoniensis*, Loudon, *op. cit.* 1399.

Branches directed vertically upwards. Leaves clustered at the ends of short shoots, dark green, small, obovate, more or less uneven and wrinkled on the surface; margin with coarse serrated teeth.

This variety was raised at Exeter by Mr. Ford about 1826, and hence is generally known as Ford's elm or the Exeter elm. The finest specimen which we have seen is one in Canon Ellacombe's garden at Bitton, which was 65 ft. by 12 ft. in 1908. There are two good trees at Bayfordbury, 45 ft. by 5 ft. 8 in., and 35 ft. by 6 ft. 8 in. in 1911. At Drumlanrig Castle, Elwes measured a fine specimen 60 ft. by 8 ft. in 1911. One at Dawyck is reported by Mr. F. R. S. Balfour to be 48 ft. by 7½ ft. in 1911.

¹ Leaves gathered by Elwes in Croatia, and others taken by me from the epicormic branches of a tree at Wyfold Grange, Henley, are identical with specimens collected in Japan by Elwes, who found it growing with *U. japonica* in a virgin forest near Asabigawa in Yezo. Trees with tricuspidate leaves occurring in Galicia have been named *U. montana*, var. *corylifolia*, Zapalowicz, *Consp. Fl. Galic.* ii. 98 (1908). Similar trees are said by Koch, *Dendrologie*, ii. pt. i. 415 (1872), to have been propagated in gardens under the names *U. tricuspis*, *U. tridens*, *U. triserrata*, and *U. intermedia*.

² *Garden and Forest*, vi. 323 (1893), and *Forest Flora of Japan*, 57 (1894).

³ There are several small trees at Kew, with ascending branches, which have been obtained under various names, as var. *etrusca*, var. *gigantea*, and var. *macrophylla fastigiata*; but none of these appear to me to be distinct enough to deserve a special name.

A sub-variety with yellowish foliage, known as var. *fastigiata aurea*, is occasionally seen in botanic gardens. A tree at Kew, 20 ft. high, which was obtained from Lee in 1879, is narrowly pyramidal and not strictly fastigiata in habit.

3. Var. *cinerea*, Lavallée, *Arb. Segrez.* 237 (1877).

Ulmus cinerea, Planchon, in De Candolle, *Prod.* xvii. 160 (1873).

Branches stunted and tortuous, the upper ascending, the lower more or less pendulous. Leaves crowded and similar to those of var. *fastigiata*, from which var. *cinerea* appears to differ only in not being fastigiata in habit.

This is represented at Kew by a tree about 25 ft. high, of unknown origin. Elwes found a small tree of it in the late Mrs. Robb's garden at Liphook.

4. Var. *pendula*, Loudon, *op. cit.* 1398.

Var. *horizontalis*,¹ Petzold and Kirchner, *Arb. Musc.* 564 (1864).

Ulmus pendula, Loddiges, *Cat.* 1836.

Ulmus horizontalis, Loudon, *op. cit.* 1398.

Branches horizontally spreading, branchlets more or less pendulous. This is the common weeping wych elm, which is much planted as an ornamental small tree, and is usually grafted high on a stock of the common species. It occasionally attains 30 ft. in height, and bears flowers and fruit abundantly every year. Booth states² that this variety was found in a bed of seedlings in the Perth nursery about 1816. He purchased the plant, from which all the stock, both in England and on the Continent, originated. A fine tree in the Glasnevin Botanic Garden (Plate 393) is grafted at 10 ft. from the ground, and grows to a height of about 30 ft., with a circumference of branches of 54 paces.

5. Var. *pendula Camperdowni*, Hort.

Branches and branchlets pendulous, forming a globose head, in marked contrast to the flat stiff-looking crown of var. *pendula*, Loudon. The original plant grew at Camperdown House, near Dundee; and, according to Mr. Mitchell, of Messrs. R. B. Laird and Sons, Edinburgh, was of considerable age thirty years ago, and quite prostrate in habit, creeping along the ground amongst other elms. There are good specimens of both these weeping elms in the Grange Cemetery, Edinburgh; and the difference in habit is well shown in a photograph by Mr. A. D. Richardson, reproduced in *Gard. Chron.* l. 221, fig. 105 (1911).

6. Var. *crispa*, Loudon, *op. cit.* 1399.

Ulmus crispa, Willdenow, *Enum. Pl. Hort. Berol.* 295 (1809).

Ulmus urticæfolia, Audibert, *Cat. Hort. Tonn.* 23 (1817).

Leaves very narrow, linear to oblanceolate, wrinkled, lacinate, with numerous incised curved teeth. This variety usually forms a small tree with pendulous branches. There is a fine specimen, about 25 ft. high, at Howden and Company's nursery, Inverness, and smaller ones at Kew, Revesby, and elsewhere.

¹ Var. *horizontalis* is the name generally used in continental nurseries for the common form of the weeping wych elm (var. *pendula*, Loudon); while their var. *pendula* is either identical with or very similar to *U. pendula Camperdowni*.

² In Loudon, *Gard. Mag.* 1843, p. 442.

Var. *crispa aurea*, Schelle, *Laubholz-Benennung*, 86 (1903), is a form of the preceding, with yellowish leaves.

7. Var. *libro rubro*,¹ Planchon, in De Candolle, *Prod.* xvii. 160 (1873).

Inner bark of the young branchlets deep red in colour. A tree of this at Kew, about 20 ft. high, was obtained from Van Houtte in 1871. It appears to differ in no respect from the type, except in the colour of the inner bark. This variety is said by Loudon² to have been found by M. de Vilmorin in a wood near Verrières some time before 1840. Loudon explains that it was propagated by grafting, and was not a local peculiarity arising from something in the soil, as in the case of the blue flowers of *Hydrangea*.

8. Var. *nana*, Simon-Louis, *Cat.* 1869, p. 98.

A shrub, attaining about 6 ft. in height, with wide-spreading horizontal branches, stunted branchlets, and small leaves. This variety, the origin of which is unknown, forms at Kew a peculiar slow-growing hemispherical bush, which has not increased appreciably in size for many years.³

9. Var. *atropurpurea*, Späth, *Cat.* No. 57, p. 4 (1883-1884).

Leaves dark purple and folded. This was raised from seed in Späth's nursery; but is very similar to or perhaps identical with *U. purpurea*, Koch, *Dend.* ii. pt. i. 416 (1872), of which there was a fine specimen growing in front of Petzold's house at Muskau.

10. Var. *lutescens*, Schelle, *Laubholz-Benennung*, 86 (1903).

Leaves of a beautiful yellow colour. I saw a fine specimen in the Calmpthout Nursery, Belgium, where it was cultivated under the name *U. americana aurea*. Loudon⁴ states that in Mr. Jessop's garden at Derby he found a variety, the leaves of which were of a fine yellow colour at the time of expanding in May. This tree was planted by Pontey, and known as the gallows elm, because the original tree grew near a gallows at York.

HYBRIDS

U. montana is one of the parents in the following hybrids:—

1. *U. vegeta*, Huntingdon elm. See p. 1879.
2. *U. major*, Dutch elm. See p. 1883.
3. *Ulmus Smithii*, Henry. Downton elm.

Ulmus montana, var. *Smithii*, Hort. Kew.

Ulmus pendula, W. Masters, *Hortus Duroverni*, 66 (1831) (not Willdenow).

Ulmus glabra, var. *pendula*, Loudon, *Arb. et Frut. Brit.* iii. 1405 (1838).

A tree with ascending branches, and long pendulous branchlets. Young branchlets stout, more or less pubescent with long hairs. Leaves (Plate 412, Fig. 24) firm in texture, oval, about $3\frac{1}{2}$ in. long and $1\frac{3}{4}$ in. wide, very unequal at the base, long

¹ *U. campestris rubra*, Simon-Louis, *Cat.* p. 97 (1869), from the description is identical with this variety, which appears in more recent catalogues under the name given above.

² *Derby Arboretum*, 52 (1840). Loudon, *op. cit.* 51, states that a similar variety of the white mulberry, *Morus alba*, var. *Morettiana*, was then cultivated in the Jardin des Plantes at Paris; "the soft wood or cambium of the current year's shoot was of a deep red."

³ Cf. *Woods and Forests*, 1884, p. 482, where an account of this remarkable bush at Kew is given. It may have originated from a witches' broom.

⁴ *Gard. Mag.* xv. 449 (1839).

acuminate at the apex; upper surface shining, dark green, glabrous, smooth; lower surface with scattered pubescence and with axil-tufts; margin coarsely biserrate; lateral nerves fourteen to sixteen pairs, very prominent beneath, straight, close, parallel, occasionally forked; petiole $\frac{1}{2}$ in. long, densely pubescent.

Flowers irregular in the number of the sepals and stamens; calyx funnel-shaped, $\frac{1}{10}$ to $\frac{1}{8}$ in. long, with four, five, or six bright pink lobes; stamens, three to five, with whitish filaments and dark red anthers; stigmas bright red. Samara obovate, $\frac{3}{4}$ in. long, $\frac{5}{8}$ in. broad, emarginate at the wide apex, with a shallow rounded notch not closed by the incurved stigmas; seed above the centre of the samara.

This tree has usually slight corky ridges with peculiar brown fissures on the branchlets of the third and fourth years. The leaves are thicker in texture, and with more nerves than those of *U. nitens*.

It was raised in Smith's nursery at Worcester, from seeds obtained from a tree in Nottinghamshire. Some of the seedlings were purchased by Mr. Knight of Downton Castle; and one of them, which turned out to be of weeping habit, was propagated. There are two Downton elms at Kew, about 25 ft. and 35 ft. high. One of these produced ripe fruit in 1909, from which I raised twenty-nine seedlings, very unlike in appearance, twenty-six having alternate leaves, and three having opposite leaves. Mr. Knight informed Loudon¹ that he had raised plants of various kinds from the seed of the Downton elm; and specimens of these seedlings, representing seven remarkably different elms, which were sent from Downton Castle in 1835, are preserved in the Kew Herbarium. A Downton elm, labelled *U. Smithii*, was 25 ft. high at Glasnevin in 1912.

4. *Ulmus belgica*,² Burgsdorf, *Anleit. Holzart.* 270 (1805) (*excl. syn.* Du Roi, Miller). Belgian Elm.

Ulmus latifolia, Poederlé, *Man. de l'Arbor.* ii. 117 (1792); Petzold and Kirchner, *Arb. Musc.* 561 (1864) (not Moench³).

Ulmus bataviana, Koch, *Dendrologie*, ii. pt. i. 414 (1872).

Ulmus campestris, var. *bataviana*, Simon-Louis, *Cat.* 1869, p. 96.

Ulmus campestris, var. *belgica*, Lavallée, *Arb. Segrez.* 235 (1877).

Ulmus campestris, var. *latifolia*, Gillekens, *Arboric. Forest.* 38 (1891) (not Persoon⁴).

Ulmus hollandica, Späth, *Cat.* No. 113, p. 158 (1903-1904) (not Miller⁵).

Ulmus montana, var. *hollandica*,⁶ Huberty, in *Bull. Soc. Cent. Forest. Belg.* xi. 566 (1904); Aigret, in *Ann. Trav. Publ. Belg.* x. 1230 (1905).

A vigorous tree, with a straight rough-barked stem, and widely extending branches, forming a broad crown of foliage. Young branchlets more or less pubescent with scattered long white hairs, which are usually deciduous in summer,

¹ *Arb. et Frut. Brit.* iii. 1404, paragraph 1 (1838).

² The adoption of this name, justified by Burgsdorf's description, "Die holländische Ulme, le Yypreau de Holland," will avoid the confusion that has been almost universal of this elm with the "Dutch elm" of England, and with *U. hollandica*, Miller. The latter is an uncertain name, and cannot signify the Belgian elm, which has not the corky bark on the twigs, characteristic of Miller's Dutch elm. Cf. p. 1883, note 1.

³ *U. latifolia*, Moench, *Meth.* 333 (1794), appears to be *U. montana*, to which Moench referred *U. hollandica* as a form. While these sheets were passing through the press, I have been able to consult the *Mannuel* by Poederlé, one of whose names for the Belgian elm, *U. latifolia*, is possibly its oldest certain name.

⁴ *U. campestris*, var. *latifolia*, Persoon, *Syn. Pl.* i. 291 (1805) is an uncertain name.

⁵ Cf. note 2 above.

⁶ *U. montana hollandica*, Planchon, in De Candolle, *Prod.* xvii. 160 (1873) is a doubtful name.

but are occasionally retained in the second year. Leaves (Plate 412, Fig. 18) obovate-elliptic, $3\frac{1}{2}$ to 5 in. long, $1\frac{1}{2}$ to 2 in. wide, very oblique at the base, abruptly contracted at the apex into a long serrated point; upper surface slightly scabrous, with a minute scattered pubescence; lower surface densely covered with a soft pubescence, conspicuous on the midrib, and with white axil-tufts; lateral nerves fourteen to eighteen pairs, often forked; margin coarsely biserrate; petiole $\frac{1}{8}$ to $\frac{1}{5}$ in. long, densely pubescent.

Samaræ differing little from those of *U. montana*, except in their smaller size, about $\frac{7}{8}$ in. long and $\frac{5}{8}$ in. wide, obovate, rounded and slightly emarginate at the apex, below which is a minute aperture formed by the incurved stigmas. Seed in the centre of the samara, at the base of which the persistent calyx is five-lobed, with remains of five stamens.

This elm is readily distinguishable from *U. montana* by the glabrescent and more slender twigs, and by the narrower leaf, which is usually prolonged at the apex into a long serrated point. The appearance of the stem in mature trees is very characteristic, as it is remarkably cylindrical, being rarely swollen or buttressed at the base, and tapers less than other elms. The tree produces suckers, but not very freely. These have pubescent branchlets, and scabrous leaves, similar in shape to those of the parent tree.

This tree is said by Huberty,¹ who quotes Poederlé's *Manuel de l'Arboriste*, ii. 117 (1792), to have been cultivated in the eighteenth century in the nurseries of the Abbey of Dunes, which was first established at Furnes and later was transferred to Bruges. It was then known by the Flemish name of *Hollander's olm* or elm of Holland, but is now more commonly called *orme gras*.² It is undoubtedly a hybrid, as Mr. Springer,³ who sowed its seed, obtained mixed seedlings, of which I have received specimens. One of these is three weeks later in losing its leaves than the parent. Samaræ which he sent me in 1911 were very variable in size, but uniform as regards the position of the seed in the centre. Those which I sowed failed to germinate. This elm is always propagated in nurseries⁴ by layering; and is most extensively cultivated in Belgium and Holland, where it is the principal tree⁵ planted along the roads, as well as in parks and avenues. It grows with astonishing vigour, much faster than other elms, according to Mr. Huberty, who states that it yields a soft wood, little used by carriage builders, but valuable for making furniture.

¹ *Bull. Soc. Cent. Forest. Belg.* xi. 564 (1904). This elm is probably referred to in the Dictionary of the French Academy, published in 1694: "Ypreau, espèce d'orme à larges feuilles qui est venu premièrement des environs de la ville d'Ypres." Ypres is not far distant from Furnes and Bruges; and it is in this district that the other peculiar elms of Belgium, the Klemmer and Dumont varieties, have originated. Plukenet's *Ulmus hollandica* was possibly the ypreau. The word ypreau, which is also written ypreau and ipreau, meaning elm, was first used in 1432, according to Godefroy, *Dict. Anc. Lang. Franc.* x. 873 (1902); and only in the nineteenth century came to mean the grey poplar in the north of France; but it is still used in Flanders for the hybrid elm. Cf. *Bull. Soc. Cent. Forest. Belg.* ii. 817 (1895), and xi. 572 (1906). Gleditsch, *Forstwissenschaft*, i. 285 (1775), thought that the Holland "Yper" originated from the wild elm of North America, but there is no evidence of hybridisation with either *U. americana* or *U. pedunculata*.

² It is often called *orme gras de Malines*, because it has been long propagated by the nurserymen of this city; but there are no grounds for believing with Gillekens, *Arboric. Forest.* 39 (1891), that it originated at Malines.

³ *Mitt. Deut. Dend. Ges.* 1910, p. 272.

⁴ Attempts have been made to divide the Belgian elm into numerous varieties; but only two kinds are ordinarily propagated in Belgian and Dutch nurseries, viz., *orme gras* and *orme Dumont*.

⁵ Aigret, in *Ann. Trav. Publ. Belg.* x. 477 (1905), gives a table of the numbers of the various species of trees planted along the main roads in Belgium. The elm is the most numerous, 294,725 out of a total of 806,985 trees.

A fine plantation of these elms is reported¹ near Châtelineau, in the Parc de Presles, where on deep fertile soil, resting on limestone, there are sixty-one trees to the acre, averaging $4\frac{1}{2}$ ft. in girth, with a total volume in the round of 3500 cubic ft. These trees are said to be only thirty-four years old. I measured in 1912 a young Belgian elm, which had just been blown down in the Royal Park of Laeken. It was 108 ft. high by 4 ft. 8 in. in girth; but I was unable to count the annual rings. In the poor soil of the Brussels Park, one of these elms averaged² six rings to the inch of radius during the first eighty years. Huberty gives³ a good photograph of two Belgian elms, growing on the road between Jemelle and Rochefort, which, though only forty-eight years old, are 9 ft. in girth. Others near Genappe, thirty-five years old, are 4 to 5 ft. in girth; while some fifty-eight years old are only 7 ft. round.

The elms which were planted in the park at Brussels by Zimmer in 1790, have been described by M. Bommer,² who states that they have passed their prime, and that many are suffering from the attack of *Polyporus squamosus*. These elms are very fine trees, growing in sandy soil. The leaves, when seen by Elwes on May 9, 1911, were not fully out, and there were no flowers visible. They have trunks clear of branches to 40 to 60 ft., probably due to pruning, with a total height of 110 ft. to 125 ft.

In the park at Haarlem, and in the "Bosch" at the Hague, there are many fine trees of the same type, on a somewhat similar soil. Some of those at the Hague, which looked quite young, were 120 ft. or more in height; and Elwes was told by Mr. Westbrook, superintendent of the municipal parks and nurseries at the Hague, that the best elms in the country were grown in the large nurseries at Oudenbosch and Calmpthout, north of Antwerp. I was informed at these nurseries in 1912, that the Belgian elm was exported to England on rare occasions; but we have seen no old trees of the kind in this country, except one at Kew, about 35 ft. high, which was obtained under the name *U. Pitteursii* from Lee in 1879. It is possible, however, that it may have escaped the notice of ourselves and of our correspondents, on account of its resemblance to *U. montana*.

Hübner reports⁴ that the Belgian elm thrives on the worst soils, and on that account is planted in belts on the margins of pine woods in Prussia. All the indications in Belgium also point to the fact that this elm succeeds better on poor sandy soils than any other variety.

5. *Ulmus belgica*, var. *Dumontii*, Henry. Dumont Elm.

Ulmus campestris, var. *Dumontii*, Nicholson and Mottet, *Dict. Prat. Hort.* v. 383 (1898).

Ulmus montana, var. *Dumontii*, Aigret, in *Ann. Trav. Publ. Belg.* x. 1231 (1905).

Branches ascending, forming a narrow pyramidal tree. This scarcely differs from the common Belgian elm, except in height, and like it, is propagated by layering.⁵ The original tree is said to have been found about 1865 in the park of M. Dumont at Tournai, where it was growing amidst a plantation of ordinary *orme gras*; and was subsequently propagated and sold under the name of *orme Dumont*.

¹ *Bull. Soc. Cent. Forest. Belg.* xvi. 346 (1909).

² *Ibid.* iv. 105-109 (1899).

³ *Ibid.* xi. 571, t. vi. (1904).

⁴ *Mitt. Deut. Dend. Ges.* 1908, p. 122.

⁵ I have not been able to examine specimens from adult trees. Young nursery plants of *orme gras* and *orme Dumont* are very similar, and resemble *U. montana* in foliage and branchlets, more than the old trees do.

On account of its narrow form, it has become a favourite tree for planting in streets; but is believed not to be so fast in growth as the ordinary Belgian elm. It is much planted in the neighbourhood of Lille, Roubaix, and Tournai; and grows well in the district of Ypres. The finest avenue of this elm is said¹ to be on the road between Wareme and the park of Longchamps; but a specimen brought from there by Elwes, who describes the trees as having the habit of the Wheatley elm, is indistinguishable in branchlets and foliage from *U. montana*. There are peculiar clipped avenues of the Dumont elm in the streets near Moser's nursery at Versailles.

6. *Ulmus Klemmeri*,² Späth, *Cat.* No. 104, p. 134 (1899); Huberty, in *Bull. Soc. Cent. Forest. Belg.* xi. 495 (1904), and xii. 173, pl. xxi. (1905). Klemmer or Flanders Elm.

Ulmus campestris, var. *Klemmer*, Gillekens, *Arboric. Forest.* 40 (1891); Aigret, in *Ann. Trav. Publ. Belg.* x. 1224 (1905).

A tall tree, narrowly pyramidal in habit, with ascending branches, and a straight cylindrical stem, covered with smooth bark. Young branchlets slender, pubescent with short hairs that are deciduous in summer. Leaves ovate, about 3 in. long and 2 in. broad, shortly acuminate at the apex, oblique at the base; scabrous and glabrescent above; lower surface smooth to the touch, covered with a minute pubescence, and with small axil-tufts; lateral nerves about twelve pairs, often forked; margin regularly biserrate. Aigret states that the seed is situated close to the emargination of the samara.

This elm, though similar in some respects to the southern variety of *U. campestris*, is probably a hybrid between *U. nitens* and *U. montana*, but closer to *U. nitens*, in the size of the leaf and the position of the seed in the samara. Leaves on vigorous shoots from the stem are like those of *U. belgica*, in texture and size, and it is possible that the Klemmer elm may be a seedling of the latter, but its origin is unknown.³

The Klemmer elm is propagated by layering, and is widely planted in West Flanders, in Belgium, and the adjoining Departement du Nord of France, where it is much esteemed on account of its rapid growth and excellent timber. Its wood is superior to that of *U. belgica* in strength and elasticity, and is preferred by wheelwrights. It grows to a great height, and on account of its narrow form is suitable for planting in streets in towns and along roads in the country. Gillekens states that six trees, which he planted in 1878 amidst a plantation of oaks that were about 20 ft. high, soon outgrew the latter, and in 1891 had attained 60 ft. in height and 2 ft. 9 in. in girth. The finest trees were those recently felled near Alveringhem, which were 10 to 12 ft. in girth. There are good specimens in the avenues adjoining the town of Ypres, which I saw in 1912. The Klemmer elm is sold⁴ by French nurseries, and is represented at Kew by two specimens about 15 ft. high, which were obtained from Barbier in 1908.

¹ *Bull. Soc. Cent. Forest. Belg.* ix. 839 (1902).

² *Klemmer*, signifying climber in Flemish, is the name given to this elm in Flanders on account of its ascending habit and great height. The name *Klemmeri*, implying a supposed person named Klemer, is objectionable, but must be maintained.

³ Cf. p. 1895, note 1.

⁴ I was informed that this elm was also obtainable in nurseries at Ypres and Bruges.

7. *Ulmus Pitteursii*, Petzold and Kirchner, *Arb. Musc.* 566 (1864).

Lorme Pitteurs, Morren, in *Journ. Agric. Prat.* 1848, p. 114, and in *Belgique Horticole*, ii. 133 (1852).

This name was given to two varieties which were obtained as seedlings of the *orme gras* in 1845, by M. de Pitteurs at St. Trond near Liège. One variety, described as making annual shoots of 3 ft. in length, and with large leaves, 8 in. long and 7 in. broad, is now little known; but is probably identical with elms propagated by layers, called *orme St. Trond*, which I saw in Looymans' nursery at Oudenbosch in 1912. These were undistinguishable in the young stage from *U. montana*, but bore leaves 5 to 6 in. in breadth; and are perhaps identical with a variety of the latter species, which is occasionally sold as var. *macrophylla*.¹

The other variety of *U. Pitteursii* apparently differed but little from the ordinary Belgian elm (*U. belgica*) and may be² the form of it which is prevalent in the provinces of Liège and Limburg, if this is really distinct. It is said³ to be represented by a tree so-named in the botanic garden at Liège, which is reputed to have been planted by Morren. This I have had no opportunity of examining.⁴

8. *Ulmus superba*, Henry.

Ulmus montana superba,⁵ Späth, *Cat.* No. 62, p. 102 (1885-1886).

A narrow pyramidal tree, with smooth bark and very ascending branches. Branchlets glabrous, remaining smooth and without fine striations, corky ridges not being developed. Leaves, similar to those of *U. montana* in shape and numerous nerves, but with long stalks; variable in size,⁶ 3 to 4 in. long, 1½ to 2 in. broad, obovate or obovate-elliptic, acuminate at the apex, very oblique at the base; glabrous, dark green, and smooth above; lower surface glabrous, except for minute axil-tufts of pubescence; margin biserrate, non-ciliate; petiole ¼ to ⅓ in. long, with scattered hairs.

Flowers regularly pentamerous; calyx campanulate, like that of *U. montana*, with five pink lobes; stamens five, with pink filaments and red anthers; stigmas white. Samaræ not seen.

This tree is probably identical with the variety⁵ of the same name described long ago by Morren; but this is uncertain. Späth states that it is much esteemed at Magdeburg as a street tree. A tree at Kew, obtained from him in 1900, and now about 25 ft. high, is remarkably fast in growth, and peculiar in its narrow pyramidal habit. Another tree at Kew, labelled *U. montana macrophylla fastigiata*,

¹ Possibly identical with *U. campestris*, var. *macrophylla*, Spach, in *Ann. Sc. Nat.* xv. 363 (1841).

² Cf. Gillekens, *Arboric. Forest.* 40 (1891).

³ Aigret, in *Ann. Trav. Publ. Belg.* x. 1230 (1905).

⁴ Koch, *Dendrologie*, ii. pt. i. 417 (1872), states that *U. Pitteursii* had scabrous branchlets and brownish leaves. Petzold and Kirchner, *Arb. Musc.* 566 (1864), describe it as having oblong ovate obtuse-toothed dark green leaves, which were reddish brown at the time of unfolding.

⁵ *U. montana superba*, Morren, in *Journ. Agric. Prat.* 1848, p. 411, is said to have been introduced into Belgium in 1845 under the name *superba* from Osborne's nursery at Fulham. Morren figures a form of *U. montana* with leaves, up to 10 in. long and 6 in. broad. Morren, who was unacquainted with *U. montana*, which he believed to be identical with *U. pedunculata*, adds to his otherwise correct account of var. *superba* a description of the flowers and fruits of *U. pedunculata*. *U. præstans*, Schoch, ex *Mitt. Deut. Dend. Ges.* 1912, p. 227, appears to be a name, without any description, of *U. superba*, Henry.

⁶ Specimens sent by Späth, apparently from young trees, have leaves 4 to 5 in. long, 2½ to 3 in. broad, which are said to fall late in autumn.

the history of which is unknown, is about the same height and is similar in all respects.

9. *Ulmus Dawvessci*, Henry.

Ulmus montana, var. *Dawvessci*, Nicholson, *Kew Hand-List Trees*, 139 (1896).

Branches ascending, forming a broad pyramidal tree. Leaves similar to those of *U. montana*, but smaller and thinner in texture, rarely exceeding 4 in. long and $2\frac{1}{4}$ in. wide, with petioles up to $\frac{1}{4}$ in. long. Flowers more irregular than in *U. montana*, funnel-shaped or campanulate with a narrowed tubular base; sepals five or six, pink; stamens four to seven, with bright pink filaments and dark red anthers; stigmas pink.

The irregularity of the flowers, the lengthened petioles, the small leaves, and the peculiar habit of this tree, all point to its being of hybrid origin; but its history is unknown to me. It is represented at Kew by a tree, about 40 ft. high and $2\frac{1}{2}$ ft. in girth, which was obtained from Lee in 1879.

DISTRIBUTION

U. montana is a native of Europe, Asia Minor, and the Caucasus; but seems to be unknown in Siberia,¹ though it occurs in Amurland, Manchuria, and Japan.

In Europe it is a more northerly species than *U. nitens*, and only occurs in the Mediterranean region at high elevations in the mountains, as in the Pyrenees,² Apennines, Balkan States, and Greece. It is not known in Portugal, and is limited in Spain³ to a few mountain woods in Asturias, the Basque Provinces, Aragon, and Navarre. It is the only species in Scandinavia, where it is met with in the wild state as far north as lat. 67° in Norway, and lat. 64° 50' in Sweden. Its northern limit in Russia⁴ extends from southern Finland through Olonetz, Archangel (lat. 62°), and Viatka to Perm (lat. 60° 40'); and it extends southwards to the border of the steppes. In Switzerland, southern Germany, and Austro-Hungary, it is essentially a mountain tree, ascending in the Tyrol and in the Carpathians to 4000 ft. Farther north it descends into the plains, and is common in north Germany on the banks of streams and in alluvial land. It is not known to form pure woods, being always mingled as isolated trees in the mixed broad-leaved forest.

In the British Isles, it is widely spread throughout Ireland and Scotland; and occurs in coppices and woods on hilly ground in most parts of England. In Bucks, Surrey, and Sussex, where it is often seen in coppice, it is commonly known as wych-hazel; while in Scotland and Ireland, it is always known as wych-elm; but the latter name is usually applied to the eastern counties of England, to *U. nitens*, which is a much more common tree there.

Mr. Clement Reid records⁵ the remains of elms in interglacial deposits at

¹ Maximowicz, in *Mé. Biol.* ix. 25 (1872).

² *U. pyrenaica*, Lapeyrouse, *Hist. Pl. Pyrén. Suppl.* 154 (1818), judging from a specimen in Gay's herbarium at Kew, is *U. montana*.

³ Willkomm, *Pflanzenverbräit. Iber. Halbinsel*, 126, 202 (1896).

⁴ Köppen, *Holzgewächse Europ. Russlands*, ii. 43 (1889).

⁵ *Origin of British Flora*, 59, 66, 69, 74, 142 (1899). We are indebted for part of the above information to a recent letter from Mr. Clement Reid.

Grays, Essex, in the form of badly preserved leaves; and in preglacial beds at Happisburg, Norfolk, leaves better preserved, but which cannot be matched with any British elm, being too small for *U. montana*, and having more nerves than the Cornish elm, which it otherwise resembles. He also records elm leaves in a neolithic deposit at Blashenwell, Dorset, and in calcareous tuff of doubtful age at Dursley, Gloucester, and elm wood in Digby Fen, where it was found by Skertchly at a depth of ten feet. The geological evidence¹ throws no light on the present distribution of the elms in Britain. (A. H.)

Sir Herbert Maxwell gives² the following account of names of places, derived from *U. montana* in Britain and Ireland:—

“The old Gaelic name for it was *leam* (lam), plural, *leaman*. Ptolemy's *Leamanonius Lacus* is now Loch Lomond, the lake of the elms, out of which flows the Leven, which is the aspirated form *leamhan* (lavan); and it is interesting to find these two forms again side by side in Fife, where are the Lomond Hills overlooking the town of Leven. The two forms come together again in Warwickshire, where, not far from Leamington is Levenhull—*leamhan choill*, elm-wood, and, in the same neighbourhood, a place called Elmdon. The Lennox, a district formerly written Levenax, is the adjectival form *leamhnach* (lavnah), an elm-wood; and in England the river Leam, giving its name to Leamington, the Leven in Cumberland, the Lune in Lancashire (Alauna of Ptolemy), and in Ireland the Laune at Killarney, must all once have been named *amhuinn leamhan*, elm-river. *Leamh chuill* (lav whill), elm-wood, appears as Barluel in Galloway, the hill-top of the elm-wood; the derivative *leamhraidhean* (lavran or lowran), elm-wood, becomes Lowran and Loring, also in Galloway; and in the same province I have picked up an alternative form to *leamhan*, common in Ireland—namely, *sleamh* (slav) and *sleamhan* (slavvan), whence the names Craigslove and Craigslovan. Yet another derivative, *leamhreach* (lavrah), seems to be the origin of Caerlaverock, *cathair* (caher) *leamhreach*, fortress in the elm-wood.”

REMARKABLE TREES

The finest wych elm that I have seen is one at Studley Royal, Yorkshire (Plate 394), which is not mentioned by Loudon, though many trees in the same park were figured in his work. When I measured it in February 1905 it was 105 ft. high by 23 ft. in girth, at 5 feet up, but the roots spread so much below this, that at the ground it measured 37 to 40 ft. This tree is very sound-looking and has lost no branch of any size.

There is an immense wych elm at Cassiobury Park, the seat of the Earl of Essex, which Henry found in 1904 to be about 100 ft. high by 26 ft. 4 in. in girth with two immense branches coming off near the ground and spreading to a diameter of 153 ft. This type of branching is not uncommon in the wych elm and usually leads to premature decay, as the weight of these great limbs tears out a hole in the

¹ Samuel Hassel, in Loudon, *Gard. Mag.* xiii. 477 (1837), states that remains of “the small-leaved elm” are found deep in the bogs of Somersetshire, and also in the foundations of Roman villas.

² *Scottish Land-Names*, 110 (1894).

trunk. A wych elm with a remarkably burry trunk, which is growing in the same park, is figured in Plate 400.

In the Park at Stowe, Buckingham, there is a large wych elm with the trunk much buttressed, but a very well-shaped handsome and sound-looking tree. It measures about 110 ft. by 19 ft. 9 in.

At Barham Court, Kent, there is a tree which I have not seen; but Mr. H. Key informs me that it covers a quarter of an acre and girths 21 ft. below the fork, where it divides into several large branches, three of which are rooted in the ground and have thrown up strong upright growths.

The largest wych elm in Gloucestershire, which was blown down some years ago before I began to measure trees, grew close to the church at Rendcombe Park, and was said to have been planted to commemorate the Restoration of Charles II. It was an immense tree of very picturesque shape. A tree at Middle Hill near Broadway, Worcestershire, in 1910 had a girth of $24\frac{1}{2}$ ft., and was 85 ft. high with very wide-spreading branches.

Lees¹ gives a very good account of this species and figures some remarkable old specimens, one of which in Earl Bathurst's park no longer exists. He gives a sketch of it showing great limbs supported by props on each side, and says that it was no less than 36 ft. in girth at 3 ft. from the ground, and 47 ft. round the base. Lees also figures a very remarkable pollard with huge burrs at Cradley, Herefordshire, another at Llanthony, and a curious old stump of great age at Shrawley, which has thrown roots 20 to 30 ft. long to the bottom of the sandstone rock on which it grows. Lees quotes from Dr. Bull who says² that in Herefordshire "Weird-like superstitions attach to the wych elm or wych hazel as it is generally called. A spray of wych hazel is at once a potent safeguard against witchcraft, and a wand of awful import in the hand of a witch. It was formerly used as a riding switch, to ensure good luck on the journey. Until quite recently, if not to this very day, not a rural churn was made in the midland districts without a small hole being left in it, for the insertion of a bit of wych elm wood, in order to ensure the quick coming of the butter."

Lord Walsingham sent me a photograph of a very large and handsome wych elm at Rochels near Watton, Norfolk. In Burleigh Park, Notts, I measured in 1903 a tree 110 ft. by $15\frac{1}{2}$ ft., which divided at 10 ft. into three main trunks. At Eaton Hall, Chester, a tree, which I found to be 90 ft. by 20 ft. in 1905, is said to be the finest in Cheshire.

A very fine old tree is growing in Wensleydale, on the village green just before the gate of Bolton Castle, which is said by Spaight³ to have been planted in 1690. When I saw it in 1906 it was sound and healthy and measured 18 ft. in girth. This is a very characteristic tree of the limestone formation in Wensleydale and Yorkshire generally, but I know of no trees larger than this one. Watson⁴ in 1825 mentions as the largest elm which he had seen, a tree growing in the village of Bishop Burton, near Beverley, Yorkshire, which measured $31\frac{1}{2}$ ft. in girth at five feet from the ground, and 44 ft. at the base.

¹ *Gard. Chron.* ii. 102, figs. 20-23 (1874).

² *Trans. Woolhope Nat. Field Club*, 1868, p. 83 (1869).

³ *History of Richmondshire*, p. 293.

⁴ *Dendr. Brit.* i. introduction, p. ii. (1825).

As a remarkable instance of the rapid growth of this tree I may mention one on the lawn in front of the late Sir Charles Strickland's house at Hildenley, Yorkshire, which cannot be more than about eighty years old, as he distinctly remembered that when a boy he could step over it. In 1905, when I saw it, it was 100 to 105 ft. high with a bole clean to about 25 ft. and 13 ft. 3 in. in girth. This may become one of the tallest trees of its sort in England. Another instance is a log which I saw in Mr. G. Miles's yard at Stamford in March 1908, which had recently been cut at Clipsham, near Stamford. On a diameter of 6 ft. 3 in. I counted only 110 rings.

In Piercefield Park, near Chepstow, there stands one of the most symmetrical trees of this kind that I know, which measures about 100 ft. by 18 ft. It was covered with half-ripe samaræ on 15th April 1906, and I noticed everywhere in this year that the wych elms were carrying an unusual crop of seeds, which in some places in Wales were so abundant as to give a distinct pink tinge to the trees, seen from a distance in May before they were in leaf. This was particularly noticed at Llandilo on 25th May 1906, when Lord Dynevor showed me what he considers the finest wych elm in that district, which is growing in a meadow by the river in Dynevor Park. This tree measures about 103 ft. by 17 ft., and was covered with nearly ripe seed, though the leaves in this early district were not yet unfolded.

All of these existing trees, however, were far eclipsed by a tree mentioned in Plot's *Natural History of Staffordshire*, p. 210 (1636), which seems so well attested that I quote it as follows. After speaking of some gigantic oaks he says: "But I scarce think either of them held so many, as the prodigious Witch-Elm that grew at Field in this county, and was felled within memory by Sir Harvey Bagot; which, according to an original paper put into my hands by the Right Worshipful Sir Walter Bagot, Bt., the present proprietor, and, as I had it from the mouth of Walter Dixon, yet living, who was a surveyor of the work, was so very great and tall, That 2 able workmen were 5 days in stocking and felling it down; That it fell 120 foot or 40 yards in length; That the stoole was 5 yards 2 foot diameter; That the tree at the butt end was 17 yards in circumference; That it was 8 yards and 18 inches, *i.e.* $25\frac{1}{2}$ foot about by girth measure in the middle; That 14 loads of firewood, each as much as 6 oxen could draw to the house at Field, being not above 300 yards distant, broke off in the fall; That there was 47 loads more of firewood (as large as the former) cut from the top; That they were forced to piece 2 saws together, and put 3 men to each end, to cut the body of it in sunder; That there was cut out of it 80 pair of nathes¹ for wheels, and 8000 feet of sawn timber in boards and planks, after 6 score per cent, which at 5s. per cent came to 12 pounds, All which is attested (as a thing, I suppose, they foresaw in a little while would otherwise become incredible) under the hands of

Sir Harvey Bagot.
William Cowper, Steward.
Roger Shaw, Baylif.
Walter Dixon, Surveyor.

Lawrence Grews } Cutters.
Humphrey Chetton }
Francis Marshall }
Thomas Marsh } Stockers.

¹ *Nathes* is an old word meaning *naves*.

And so as to the number of Tunns according to the scantlings first above mentioned, they computed it to contain (after their gross country way of measure) 96 tuns of timber, a vast quantity indeed for one tree. But whoever will take the pains to cast it nicely and more artificially, according to the above measured scantlings, will find that it must contain 100 tuns at least of neat timber, a fifth part (which is sufficient in such large butts) being allowed for wast of rind, chips, etc."

Now as one can hardly believe that eight persons would have signed their name to such a statement if they had not believed it to be true, we have dimensions which though they cannot be exact, seem to be unequalled by any hardwood tree on record out of the tropics; and though the quantity of firewood seems incredible, yet if the number of tons be estimated at only 40 ft. to the ton there is something like 4000 cubic ft. of timber, or if the firewood is estimated only at 50 ft. to the load, and the nathes and board at 1000 ft., the volume is 4050 ft., nearly double the contents of the largest tree now standing.

Aubrey,¹ *Natural History of Wilts*, 56 (1685), says:—"At Dunhead, St. Marie's, at the crosse is a wich-hazell not less worthy of remarque . . . for the large circumference of the shadowe that it causeth. When I was a boy, the bowyers did use them to make bowes, and they are the next best to yew."

In Scotland, though the tree is common I have not seen or heard of any of exceptional size. Hunter² mentions a good many, but rarely distinguishes between the wych and other elms. Among these the following may be noticed:—A tree at Moncreiffe House, which has layered itself in several places; and a tree at Kinfauns Castle, Perthshire, for which it is said that £50 was offered forty years ago though only computed to contain 460 feet of timber. It was in 1883 about 70 ft. high by 17 ft. in girth at the smallest place, seven feet from the ground. It was figured by Loudon, *Arb. et Frut. Brit.* iii. 1403, fig. 1244 (1838).

In the *Old and Remarkable Trees of Scotland* the same confusion has taken place, the Scotch elm being considered as a variety only and not distinguished in the returns given, but probably most of them relate to the wych elm. The largest of these was a tree then in a decaying condition at Myres in Fifeshire, stated to be 75 ft. by 20 ft. at 9 feet from the ground, dividing into two main stems 16 ft. and 9 ft. in girth. Loudon³ speaks of an elm near Roxburgh in Teviotdale, called "the Trysting Tree," which, when measured in 1796, was 30 ft. in girth at four feet from the ground. The tallest of which we have any record is a tree measured by Mr. Bean at Dalkeith⁴ which was 125 ft. high by 13 ft. 9 in. at four feet.

Strutt, in his *Sylva Scotica*, plate iv, figures a group of four wych elms at Pollok in Renfrewshire, the seat of Sir John Stirling Maxwell, Bart., which were then in extraordinary health and vigour, and of which the largest, measured⁵ in 1824, was 85 ft. by 11 ft. 10 in., and contained 669 cubic feet of timber. Mr. Renwick informed me that two of these which remained, were cut down in 1905 and were 90 to 96 ft. high and 12 ft. in girth. The other two were blown down about eleven years

¹ Quoted by Rev. T. A. Preston, in *Trans. Wilts. Arch. and Nat. Hist. Soc.* 1888, p. 269.

² *Woods of Perthshire*, 134, 486 (1883). ³ *Arb. et Frut. Brit.* iii. 1402 (1838). ⁴ *Gard. Chron.* xli. 168 (1907).

⁵ Loudon, *Gard. Mag.* xiii. 167 (1837) in an account of the trees at Pollok, states that the largest elm was, in 1836, 90 ft. high and 11 ft. 9 in. in girth close to the ground.

previously. The rings showed the age of the trees to be about 300 years, and there had been practically no growth during the last ten years of their life. Neither the plate in Strutt nor the photograph in *Ann. Anderson. Nat. Soc.* ii. pt. i, frontispiece (1896), show the habit of the wych elm, and I should have supposed these to be English elms except that they produced seed freely every year, even in old age.

Mr. Renwick sends us a list of wych elms, the most remarkable of which are: a hollow tree at Tullichewan Castle, Dumbartonshire, 20 ft. in girth at 2 ft. 5 in. from the ground, the stem being partly covered by burrs; at Woodbank, two trees, 105 ft. by 15 ft. and 100 ft. by 16 ft. 2 in., in 1910; at Strathleven, a tree 90 ft. by 16 ft. 10 in. in 1911; at Ancrum Park, Roxburghshire, a tree, 18 ft. 1 in. in 1893; at Newbattle Abbey, a tree 16 ft. 5 in. in 1896.

In Ireland, *U. montana* is common in the wild state, and is the only species that occurs in rocky and hilly situations in Donegal and Kerry. We have not seen any trees equalling in size those in England or Scotland, the finest specimen probably being one at Charleville, Co. Wicklow, which was 90 ft. high by 17 ft. 4 in. in girth in 1904. In a meadow by the river at Inistioge, Co. Kilkenny, there are two good wych elms, the larger measuring 90 ft. by 14 ft. 11 in. in 1904. At Adare Manor, Limerick, a tree, which had been damaged by a severe gale a short time previously, was 114 ft. by 15½ ft. in the same year.

The largest elm ever known in Ireland was probably one recorded by Hayes,¹ who considered it to be perhaps the finest tree of its species in the world. It grew at St. Wolstans, Co. Kildare, and was supposed to have been planted before the dissolution of the monastery in 1538. It lost two great limbs in 1762, and was blown down in the winter of 1776. Some time before this, the trunk had been carefully measured and was found to be 38 ft. 6 in. in circumference.

Hayes² quotes, as showing the extraordinary vigour of the elm in Ireland, a statement given him by Mr. Herbert of Cahirane, near Killarney:—Six "wyche or native Irish" elms, that were produced by layers from the stool of a tree felled in 1766, measured after twenty-six years' growth, from 3 ft. 11 in. to 5 ft. 1 in. in girth at 5 feet from the ground.

TIMBER, cf. p. 1922.

(H. J. E.)

ULMUS VEGETA, HUNTINGDON ELM, CHICHESTER ELM

Ulmus vegeta,³ Lindley, in Donn, *Hort. Cantab.* 96 (1826); Ley, in *Journ. Bot.* xlviii. 68 (1910).

Ulmus glabra, Miller, var. *vegeta*, Loudon, *Arb. et Frut. Brit.* iii. 1404 (1838).

Ulmus americana, W. Masters, *Hortus Duroverni*, 130 (1831) (not Linnæus).

A tree, attaining about 100 ft. in height and 15 ft. in girth, with a straight bole and long ascending straight branches. Bark similar to that of *U. montana*. Young branchlets stout, with a few scattered hairs, glabrous and occasionally striated in the

¹ *Practical Treatise on Planting*, 135 (1794).

² *Ibid.* 162 (1794).

³ There is no doubt that Lindley meant by this name the Huntingdon elm, although he erroneously gave its habitat as North America, relying on Masters, nurseryman at Canterbury, who called it the American elm, a name by which it is still known in some nurseries.

second year. Buds with minutely pubescent ciliate scales. Leaves (Plate 412, Fig. 16) oval, $3\frac{1}{2}$ to 5 in. long, $2\frac{1}{2}$ to 3 in. broad, very unequal at the base, abruptly contracted at the apex into a long serrated point; upper surface smooth, glabrous; lower surface with slight tufts of pubescence in the axils, glabrous elsewhere, but dotted with numerous minute brown glands; lateral nerves 14 to 18 pairs, often forked; margin coarsely biserrate, non-ciliate; petiole $\frac{1}{4}$ to $\frac{3}{8}$ in. long, more or less pubescent with scattered hairs.

Flowers, twenty to thirty in a cluster, on very short pedicels, very irregular in size and in the number of the sepals and stamens; calyx campanulate with a narrowed wrinkled tubular part at its base, or funnel-shaped, with four or five pink lobes; stamens, three, four, or five, with pale pink filaments and bright red anthers; stigmas bright red. Samaræ on very short pedicels, obovate-oval, about $\frac{7}{8}$ to 1 in. long and $\frac{3}{8}$ to $\frac{3}{4}$ in. broad, glabrous, non-ciliate, rounded at the apex with a short notch closed by the incurved stigmas; seed a little above the centre of the samara, with its apex extending nearly to the base of the notch; seed-cavity long and pointed at both ends.

The Huntingdon elm suckers very freely. Corky wings are never developed on the branchlets. It bears in favourable seasons a great abundance of seed, which is remarkably fertile. Sowings made at Cambridge in 1909, showed that this tree is a hybrid, one of the parents being *U. montana*, and the other uncertain, but probably *U. nitens*. I need not repeat here, the full account of the seedlings of the Huntingdon elm, which appeared in *Journ. Linn. Soc. (Bot.)* xxxix. 292-293 (1910). It is interesting to note that the fact that the Huntingdon elm does not come true from seed was established¹ at the Oxford assizes in 1847, when a nurseryman brought an action against Mr. Rivers of Sawbridgeworth, for supplying seedlings of the Huntingdon elm, which were expected to be the same as grafted plants, but which turned out to be very different.

The Huntingdon elm was raised in Wood and Ingram's nursery at Huntingdon about 1750, from seed, which is said² to have been gathered from some old trees in Hinchingsbrooke Park, near Huntingdon. Mr. John Ingram, who wrote an account² of its origin, in 1847, states that these trees were at that time still living, and were the true English or field elm; but as he wrote one hundred years after the original tree was raised, no reliance can be placed on his identification of the parent tree, which was more likely to have been *U. nitens*, which is still common in Hinchingsbrooke Park.

The name, Chichester elm, which was given to this tree as early³ as 1829, cannot be explained. It was also supposed to be of American origin, and is occasionally sold by some nurseries as *U. americana*. (A. H.)

I visited Hinchingsbrooke Park, the seat of the Earl of Sandwich, on 30th October 1911, with Mr. M. D. Barkley, agent for the estate, to find if possible the trees from

¹ Cf. *Gard. Chron.* 1847, p. 507. Elm seedlings with opposite and with alternate leaves were noticed and figured by Carrière, in *Rev. Hort.* xlvii. 286, figs. 47, 48 (1875); but he was unable to explain their significance.

² *Gard. Chron.* 1847, pp. 507, 526.

³ Lindley, *Syn. Brit. Flora*, 227 (1829). Cf. Loudon, *Arb. et Frut. Brit.* iii. 1404 (1838).

which the original Huntingdon elm was raised. I found four distinct forms of elm. The oldest, which appear to have been growing in hedgerows before the park was enclosed about 1750, are of no great height, though one of them near the north lodge is $20\frac{1}{2}$ ft. in girth. These are an inferior type of Huntingdon elm, and had shed most of their leaves without colouring well. Some taller and straighter trees which are true English elms grow near them, and had their leaves still on and quite green.

About one hundred yards north of the Japanese garden, there is an old tree 80 ft. by $16\frac{1}{2}$ ft. of the true Huntingdon character, having its trunk split to the ground and the leaves nearly all fallen. On the edge of the grove was a group of bushy ill-shaped trees with small glabrous leaves.

Near these, within the grove which is fenced off, are the tallest and finest elms which I saw in the park, one of them being 120 ft. by $17\frac{1}{2}$ ft., the leaves of which, differing from the Huntingdon type, were still on and quite green. Its tall straight trunk had a large wound where a branch had been torn out by the wind. A bed of suckers surrounded this group of trees, some of which have been transplanted to the Huntingdon nursery, in the hope of preserving a better type of Huntingdon elm than the trees now sold, which, as I am informed by Mr. Perkins, proprietor of this nursery, are usually budded on wych elm stocks. This fine elm is probably a seedling of the Huntingdon elm, and may be called the "Hinchingsbrooke" elm.

The Huntingdon elm, though a favourite tree among nurserymen on account of its very rapid growth, and often making an ornamental wide-spreading tree, should not, in my opinion, be planted as an avenue or park tree. Its habit of forking tends to split the trunk in a way that other elms do not show; and out of a large number of trees which I have felled at Colesborne, at about sixty years after planting, hardly one was free from defects caused by this bad habit. I calculated the loss in measurement of the timber on these trees was from 15 to 25 per cent, and the timber, though fit for tinsplate boxes, is pale in colour and soft in texture, compared with English or wych elm. It grows, however, with such rapidity, that it might pay to plant in woods, or if care is taken to prune all the branches when young, up to 40 or 50 ft. As a rule, it loses its leaves a month before the English elm and colours badly, but in the remarkable season of 1911, a row of elms of this variety growing at Colesborne on dry soil with a southern aspect, turned a brilliant yellow, just before the leaves fell in October.

The largest elm I have ever seen, and the largest tree of any kind in Great Britain, grew in the grove of Magdalen College, Oxford, but had never been noticed by arboriculturists,¹ until Mr. W. Baker, Curator of the Botanic Garden, showed it me in July 1905. Though generally supposed to be a wych elm, it was undoubtedly identical in habit and leaves with *U. vegeta*. On October 14th of the same year I saw it again, when its leaves had fallen, whilst the English elms in the same park were

¹ H. A. Wilson, in a *History of Magdalen College*, 286 (1899), states: "Most of the trees in the grove are English elms dating from the Restoration period. Two wych elms were planted probably about the same time as the others. The girth of one of these trees in 1831, at five feet, is stated to have been 21 ft., in 1866 23 ft. 9 in. In June 1899 it measured 26 ft. 5 in. and its height was approximately 130 feet. R. T. Günther, *Oxford Gardens*, 218 (1912), gives a reproduction of a photograph of the great Magdalen elm, which was taken in 1899. He states that there is an error in Wilson's account, as the measurement given of 21 ft. girth in 1831 was really that of another tree which fell in 1861. The latter was estimated to contain 1092 cubic feet.

still green. At my suggestion Mr. G. E. Baker, then Bursar of Magdalen College, removed a scrubby tree which stood near it, in order to allow a photograph (Plate 395) to be taken soon after by Mr. Foster of Burford. I took great pains to measure it accurately from four different positions, and found its height to be 140 ft., and its girth at five feet, 27 ft. I estimated its contents when standing at over 2000 cubic feet, but when I showed it later to some of the most experienced judges of timber in the English Arboricultural Society, their estimates were all lower than mine. On 5th April 1911 this splendid tree was blown down, and on hearing of this I went to Oxford at once with Mr. Foster to photograph and measure it on the ground. I made the total height 142 feet. With the help of my forester, J. Irvine, I made a series of thirty-three measurements of the various pieces and limbs as accurately as possible, Mr. Carter, Bursar of Magdalen, booking them as we measured; and found that if no allowance was made for bark, which was three to four inches thick on the trunk, or for the hollows caused by decay, the total contents were 2787 feet. Professor Somerville,¹ and Sir W. Schlich, F.R.S., afterwards measured the tree on the ground, and agree that my calculation of its cubic contents is nearly accurate. The timber of this tree was much redder than that of any tree of *U. montana* which I have ever seen. No suckers were noticed by me, and none have come up since the fall of the tree. I understand that the President and Fellows of Magdalen College have decided to allow the remains to lie undisturbed as a memorial of the fallen giant.

This tree was so rotten in the interior that the annual rings could not be counted. Judging from its great size, it was probably 200 to 300 years, and cannot be of the same origin as the ordinary Huntingdon elm, if the story of the origin of the latter in 1750 is correct. The independent origin of this hybrid at various times and in different places is not improbable.

Another tree, similar in habit and foliage, still survives in the Grove of Magdalen College, and in 1912 measured about 130 ft. in height, and 23 ft. in girth.

Elsewhere I have seen no old trees except in Hinchingsbrooke Park; but there is a fine specimen² in the Fellows' garden of Trinity College, Cambridge; and another in Victoria Park, Bath. There is at Cambridge, an avenue of Huntingdon elms, known as Brooklands Avenue, which is said to have been planted by Mr. Richard Foster about 1830. (H. J. E.)

¹ Cf. *Quart. Journ. Forestry*, v. 279, fig. (1911).

² Figured in *Journ. Linn. Soc. (Bot.)* xxxix. pl. 20 (1910). According to C. W. King, this tree was planted about 1814, in the presence of Adam Sedgwick. It is now often called Sedgwick's elm.

ULMUS MAJOR, DUTCH ELM

- Ulmus major*,¹ Smith, *Eng. Bot.* t. 2542 (excl. syn.) (1814); Lindley, *Syn. Brit. Flora*, 226 (1818); Loudon, *Arb. et Frut. Brit.* iii. 1396 (1838); Ley, in *Journ. Bot.* xviii. 71 (1910).
Ulmus hollandica,¹ Miller, *Gard. Dict.* ed. 8, No. 5 (1762) (?).
Ulmus hollandica, Moss, in *Gard. Chron.* li. 217 (1912).
Ulmus fungosa, Aiton, *Hort. Kew.* i. 319 (1789) (?).
Ulmus scabra, Miller, var. *major*, Gürke, in Richter and Gürke, *Plant. Europ.* ii. pt. i. p. 73 (1897); Schneider, *Laubholzkunde*, i. 218 (1904).

A tree, attaining in England over 100 ft. in height and 15 ft. in girth, but usually smaller, with a short bole and irregular wide-spreading branches. Bark of the trunk dark coloured, deeply fissured. Young branchlets glabrous or with a few scattered hairs; finely striated, glabrous and bright reddish-brown in the second year. Buds ovoid, with minutely pubescent ciliate scales. Leaves (Plate 412, Fig. 15) broadly oval, 3 to 5 in. long, 2 to 3 in. wide, very unequal at the base, contracted at the apex into a rather long serrated point; upper surface dark green, shining, nearly smooth, with a scattered minute pubescence; lower surface light green, with conspicuous white axil-tufts, prolonged along the midrib between the insertions of the lower lateral nerves, and with a scattered minute pubescence and numerous minute glands; nerves about twelve to fourteen pairs, mostly forked; margin deeply serrate, non-ciliate; petiole $\frac{1}{4}$ to $\frac{3}{8}$ in. long, pubescent.

Flowers, often very numerous (twenty to fifty) in the cluster, on extremely short pedicels, mostly tetramerous, with four calyx-lobes and four stamens (but often irregular with five calyx-lobes and four stamens, five calyx-lobes and five stamens, etc.): calyx, funnel-shaped, lobes pink and unequal; stamens with filaments tinged with pink and with red anthers; stigmas bright red. Samaræ, on very short pedicels, obovate-oval, when mature $\frac{3}{4}$ to 1 in. long, and $\frac{1}{16}$ to $\frac{3}{4}$ in. broad, full and rounded at the apex, which is emarginate, with a short notch usually closed by the incurved stigmas below the emargination; seed in the upper half of the samara, with its apex close to the base of the notch.

U. major may almost always be recognised by the large corky ridges, which are developed only on the epicormic branches of the trunk.² It produces suckers freely, the stems of which often have bright reddish-brown corky ridges, whilst their leaves and branchlets are more pubescent than those of the adult tree.

U. major rarely bears fertile seed; but in 1909, small lots of seed from trees at Brocklesby, Belton, Bayfordbury, and Cambridge produced in each case two seedlings. These eight seedlings are very variable in appearance, those raised from the

¹ *U. major* was described and figured by Smith from specimens gathered in England by E. Foster, and is the first certain name. We have not adopted Miller's name, *U. hollandica*, as his description is uncertain; moreover, it implies a foreign origin for a tree which is undoubtedly indigenous in England. Miller quotes as a synonym of his elm, *Ulmus major hollandica*, Plukenet, *Alm.* ii. 393 (1696), which is described as "*angustis et magis acuminatis samaris, folio latissimo scabro.*" Plukenet's elm cannot be determined, but his description excludes *U. major*. Cf. page 1869, note 2. The usage of "Dutch elm" as a name for *U. major* apparently began in error about 1730.

² In *U. nitens*, var. *suberosa*, which is the true cork-barked elm, the branchlets in the crown of the tree are all corky.

seed of the tree at Belton being exactly like *U. montana*; and I have little doubt that *U. major* is a hybrid, with *U. montana* and *U. nitens* as the parent species.

VARIETIES

The following varieties are assigned with some doubt to *U. major*:—

1. Var. *serpentina*, Henry.

Ulmus serpentina, Koch, *Dendrologie*, ii. pt. i. 417 (1872).

Ulmus montana, sub-species *major*, var. *serpentina*, Dippel, *Laubholzkunde*, ii. 29 (1892).

A small tree, with curved and twisted pendulous branches, forming a dense pyramidal or globose crown. Leaves and branchlets similar to those of *U. major*.

The origin of this variety is unknown. It is said by Koch to be known in nurseries as the parasol elm, and is represented at Kew by a good specimen about 15 ft. high, obtained from Späth in 1896. Another smaller tree at Kew is labelled *U. campestris pendula nova*.

2. Var. *Daveyi*,¹ Henry.

A wide-spreading tree, with irregular branches and pendulous branchlets, differing from *U. major* in the epicormic branches never developing corky ridges. Young branchlets more or less pubescent with long hairs. Leaves similar in shape to that species, but smaller, $2\frac{1}{2}$ in. long, 2 in. broad, and with 10 to 12 pairs of lateral nerves; upper surface shining, smooth, with a scattered minute pubescence; lower surface similar, covered with a dense soft pubescence, and with conspicuous white axil-tufts; petiole densely pubescent. Flowers with the sepals and stamens irregular in number, and the stigmas white or tinged with pink. Samaræ not seen.

This occurs as a rare tree in Cornwall, in the valleys mixed with *U. major*, which it resembles in its wide-spreading habit, but has very pendulous branchlets. It is apparently never very large in Cornwall, where I saw it at Coldrenick and near Perranporth; but in Norfolk and Cambridge, where it is also rare, it reaches 80 ft. in height.

3. A tree at Kew, about 25 ft. high, pyramidal in habit, with ascending branches, which was obtained from Späth in 1896 as *U. campestris*, var. *modiolina*,² has leaves like those of *U. major*, except that they are very scabrous above.

DISTRIBUTION

U. major is widely distributed throughout England, occurring from Cornwall to Essex and Norfolk, and extending as far north as Yorkshire. It ascends to about 1000 ft. altitude in mountain valleys in South Wales.³ In many districts it is the commonest tree in hedgerows; and in Cornwall, where it is associated with *U. nitens*, var. *stricta*, these two elms grow in every valley and are certainly indigenous.

U. major is said to occur in France, Germany, and Russia; but I have seen no

¹ Named after Mr. F. Hamilton Davey, whose researches into the flora of Cornwall are well known.

² This tree is different from *U. modiolina*, Dumont de Courset. See p. 1894.

³ Ley, in *Journ. Bot.* xlviii. 72 (1910).

specimens, and doubt if it is really known by Continental botanists, who apply the name to forms of *U. montana* with large leaves.¹

U. major is usually called "Dutch elm" by foresters and carpenters, and has been supposed by Miller and subsequent writers to have been introduced into England from Holland in the reign of William III. In all probability the elm which was then introduced was not *U. major*, but a vigorous form of *U. montana*. It is difficult to see how the latter could have been *U. major*, a tree which is apparently unknown in Holland.² (A. H.)

CULTIVATION

Though it is difficult to describe the habit of this elm, which is very inferior to that of the true English elm, yet it is easy to recognise, even at a distance, as I have repeatedly been able to foretell by the form alone before reaching a tree, that it would have corky twigs on the trunk. It has been largely planted in the neighbourhood of London, where, as elsewhere, it loses its leaves three weeks or a month earlier than the true English elm. In Kensington Gardens, where most of the elms appear to belong to this species, on 30th October 1911, there was hardly a leaf left on the majority of the elms, whereas throughout the Thames valley true English elms were still green in the hedgerows, and on my own place a week later, after 16° of frost, they were only beginning to turn golden, a colour which the Dutch elm seldom or never assumes. An immense deal of trouble and expense and obloquy has fallen on those responsible for the care of the London Parks because a wholesale lopping of the old elms was considered necessary for the safety of passers-by, after several accidents had occurred from falling branches. I am able through the courtesy of the Right Hon. Lewis Harcourt, who, in 1905, was the Minister responsible for the London Parks, to give an illustration (Plate 396) showing the effect of this lopping after a period of some years. I think it must be allowed that, however ugly they seem at first, they throw out young branches with great rapidity and soon improve in appearance.

This tree in some seasons produces a large quantity of seeds which are nearly always infertile. On 13th May 1906, I noticed three trees growing in a row near the North Lodge at Gatton Park, Surrey, their leaves being much more backward than those of *U. campestris*, but none of the samaræ which were sent me from these trees seemed to have any perfect seed.

¹ Cf. Mathieu, *Flore Forestière*, 302 (1897). *U. major*, Reichenbach, *Icon. Fl. Germ.* xii. 13, t. 665 (1850), is *U. montana*. Michaux, *N. Amer. Sylva*, ii. 224, plate 129, fig. 2 (1819), describes and figures ordinary *U. montana* under the name *U. suberosa* as the Dutch elm.

² In the large collection of specimens of wild and cultivated elms of Holland, which are preserved in the herbarium of the Dutch Botanical Society at Haarlem, I found none identical with *U. major* of England. Most of the supposed wild elms in Holland, as those on the dunes near Haarlem, are *U. nitens*, var. *suberosa*. Mr. Springer sent me a branch of a solitary large elm growing on these dunes, which he supposed to be *U. major*; but the leaves differ in being very scabrous on the upper surface, and belong to a hybrid intermediate between *U. montana* and *U. major*.

U. major may be expected to occur on the continent; but I have not seen any trees of the typical English form, either wild or cultivated, in France, Belgium, and Holland. I have, however, specimens from a wild tree in a wood, near Gray, Haute Saône, intermediate between *U. major* and *U. nitens*.

U. corylifolia, Host, *Fl. Austr.* i. 239 (1827), judging from the description and a type specimen in the Kew Herbarium, is allied to, but not identical with *U. major*. This is said to grow on the banks of streams in mountain woods in Austria.

One of the tallest I know which may be referred to *U. major* is a tree in the heronry at Dallam Tower, Westmoreland, which, being drawn up in a thick wood, has attained a height of about 130 ft., and is clear of branches for 60 or 70 ft.; but is only 10 ft. in girth. A very large tree grows by the lake at Dodington Park, Gloucestershire; the main trunk, 22 ft. in girth, is broken, but a branch remains which, in 1910, was 115 ft. high; the branchlets are very corky. A tree at Laverstoke Park, Hants, 113 ft. by 18 ft., is of a superior type to the common Dutch elm, and may be one of the hybrids. There are trees of *U. major* at Hampton Court, some of large size; at Syon; at Aldenham, a large tree on the east front of the house; at Beaulieu Abbey; and at many places in the south of England.

Many of the large elms in Kew Gardens belong to this species, and one, which was felled in December 1911, was 91 ft. high by 13 ft. 5 in. in girth. Mr. Bean counted on the stump about one hundred and fifty rings, so that this tree was probably planted about 1759, when the botanic garden was formed at Kew.

There are many Dutch elms at Boughton; and I was assured by Mr. Neil, the forester here, that their timber is as good as that of the English elm. It is generally believed by carpenters and wheelwrights to have much more brittle and less valuable timber than the redder wood of the English elm.

Many elms in the eastern counties belong to this species; and though there are some fine true English elms in Essex, yet near the coast of this county, and in Suffolk and Norfolk, we rarely see an elm of large size, which does not seem to be *U. major*. On light and sandy soils it is a scrubby tree, and does not carry its leaves so late or turn such a bright colour in autumn as the English elm.

The avenue of elm at Castle Howard in Yorkshire, which is perhaps the best I know so far north, appears to be, and is considered by Mr. Fell, the forester there, to be, of this type, which in some parts of England is often called by carpenters a "bastard" elm.

Boutcher says¹ that in order to get the true variety he imported it from Rotterdam, to make the mother plants of those he raised in his nursery; and adds that though inferior in beauty and elegance of form, to what he calls the French elm,² it is still a very valuable tree in the climate of Scotland, as "it will succeed in wet obstinate clay, where no tree I know of equal use, and few but aquatics, will grow freely; but in such places it will soon become a stately tree, and though the wood is not equal to the other mentioned kinds, it is still a useful wood, and is often indiscriminately sold to the carpenter with them from their near resemblance."

In all probability Boutcher here referred to the hybrid elm, *U. belgica*, which was cultivated then in Holland; but we have had no specimens from Scotland that can be referred to this. True *U. major* is rare in Scotland, where most of the elms which are not *U. montana* are *U. nitens* of French origin.²

In Ireland *U. major* is the common form in some parts of the country. Many of the elms in the Phoenix Park seem to be Dutch elms, but I have not examined them carefully. It occurs at Loughrea, Co. Galway, and is common at Lismore in the Blackwater valley, Co. Waterford. Here it is known to timber merchants as

¹ *Treatise on Forest Trees*, 19 (1775).

² Cf. p. 1897, last paragraph.

"Irish elm," and the wood is used by wheelwrights. The habit of the tree is generally branchy, and inferior to that of *U. nitens*, which is here erroneously called English elm. (H. J. E.)

ULMUS NITENS, SMOOTH-LEAVED ELM

Ulmus nitens, Moench, *Meth.* 333 (1794); Rehder, in *Mitt. Deut. Dend. Ges.* 1908, p. 157; Moss, in *Gard. Chron.* li. 217 (1912).

Ulmus glabra, Miller, *Gard. Dict.* ed. 8, No. 4 (1768) (not Hudson¹); Smith, *Eng. Bot.* t. 2248 (1811); Loudon, *Arb. et Frut. Brit.* iii. 1403 (1838); Reichenbach, *Icon. Fl. Germ.* xii. 13, t. 664 (1853); Willkomm, *Forst. Flora*, 553 (1887); Schneider, *Laubholzkunde*, i. 219 (1904) (in part); Ley, in *Journ. Bot.* xlviii. 69 (1910).

Ulmus foliacea,² Gilibert, *Exercit. Phyt.* ii. 395 (1792); Sargent, *Arnold Arboretum Bull. Pop. Inform.* No. 11 (1911), and in *Gard. Chron.* l. 202 (1911).

Ulmus campestris, var. *laevis*, Spach, in *Ann. Sc. Nat.* xv. 362 (1841); Planchon, in *Ann. Sc. Nat.* x. 273 (1848).

Ulmus campestris, var. *glabra*, Hartig, *Naturl. Forstl. Kulturpfl.* 458, 460 (1851); Planchon, in De Candolle, *Prod.* xvii. 157 (1873); Ascherson and Graebner, *Syn. Mitteleurop. Flora*, iv. 553 (1911).

A tree, with a straight bole, and wide-spreading branches, with usually pendulous branchlets. Bark grey, deeply fissured in old trunks. Young branchlets slender, glabrous or with a few scattered hairs, usually with the upper margin of the stipule-scars fringed with a tuft of hairs. Buds with minutely pubescent ciliate scales. Leaves (Plate 412, Fig. 23) oval or obovate, 2 to 3½ in. long, 1 to 2 in. broad, very unequal at the base, acuminate at the apex; upper surface dark green, shining, smooth to the touch, in spring pubescent with scattered minute hairs, in autumn glabrescent; lower surface, with conspicuous white axil-tufts, and covered with minute reddish brown glands, in spring pubescent with scattered minute hairs, in autumn glabrescent; margin biserrate, non-ciliate; lateral nerves about twelve pairs, often forked; petiole ¼ to ½ in. long, pubescent.

Flowers, twenty to thirty in a fascicle, on very short pedicels (less than ½ in. in length); tetramerous or pentamerous, but often irregular in the number of sepals and stamens; calyx funnel-shaped, about ¼ to ⅓ in. long, with four or five pink short lobes; stamens, four or five, occasionally three, with pink filaments and red anthers; stigmas white, or rarely pale pink. Samaræ, on very short pedicels, glabrous, non-ciliate, obovate with a cuneate base, about ¾ in. long, and ½ in. broad; broad and rounded at the slightly emarginate apex, with the notch closed by the incurved stigmas; seed in the upper part of the samara, with its apex nearly touching the base of the notch.

Seedling: The two cotyledons are raised above the ground on a short

¹ *U. glabra*, Hudson, *Fl. Angl.* 95 (1762), is the tree almost universally known as *U. montana*; and being earlier than Miller's name, renders the latter inapplicable to the smooth-leaved elm.

² *Ulmus foliacea*, Gilibert, *Exercit. Phyt.* ii. 395 (1792), was founded on a specimen of an elm, which was said to be frequent about Grodno in Lithuania. The description is very imperfect, but probably applies best to *U. nitens*, which occurs in Lithuania. There are no grounds for resuscitating a name like *U. foliacea*, which cannot be identified with certainty.

pubescent caulicle, which ends in a long tap-root; and are sub-orbicular to obovate, $\frac{1}{3}$ to $\frac{2}{5}$ in. long, broad and rounded at the apex, deeply cordate at the base, green above with scattered short bristles, whitish and glabrous beneath; indistinctly veined; margin entire and ciliate; stalklets very short, pubescent. Leaves, arising from the stiff erect pubescent stem in opposite pairs, ovate, sharply serrate or biserrate, scabrous above with papillæ and numerous short bristles, the latter being scattered on the under surface; ciliate in margin; petioles short, pubescent. Seedlings, sown in June, attain in October 6 to 12 in. in height, and bear six to eight pairs of leaves as a rule. The normal alternate foliage of the adult plant appears in the second year; but develops at once on any branch that may be formed in the first year. The pubescent twigs and rough hairy leaves are preserved for a considerable period, the normal foliage and branchlets not appearing till the trees are about ten years old.¹

VARIETIES

This species, being distributed over a wide area (cf. p. 1896), is variable in the wild state, in the amount of pubescence on the branchlets and leaves, and in the presence or absence of corky ridges on the twigs and branches. In the ordinary form in England, the twigs are not suberose.

1. Var. *suberosa*, Henry. Cork-barked Elm.

Ulmus hollandica, Pallas, *Fl. Ross.* 76 (1784) (not Miller).

Ulmus suberosa, Moench, *Verz. Weissenst.* 136 (1785); Reichenbach, *Icon. Fl. Germ.* xii. 13, t. 663 (1850); Hartig, *Naturges. Forst. Cult.* 459, t. 56 (1851) (not Ehrhart,² Smith, Lindley, or Loudon).

Ulmus tetrandra, Schkuhr, *Bot. Handb.* i. 178, t. 58 b (1791).

Ulmus campestris, var. *suberosa*, Wahlenberg, *Fl. Carpat.* 71 (1814).

Ulmus glabra, var. *suberosa*, Gürke, in Ritter and Gürke, *Pl. Europ.* ii. 72 (1897).

Branchlets of the second to the tenth year furnished with corky wings. Leaves and samaræ as in the type (Plate 412, Fig. 19).

This variety is occasionally seen in England, as on trees at Hatfield; and is represented at Kew by four trees of no great size, but of considerable age, which were long labelled erroneously *U. alata*.³ It appears to be a common variety in the forests of central Europe, as in the oak forests on the banks of the Save in Slavonia, where I saw it in 1909, and Elwes in 1910. Elwes also gathered a specimen at Gissselfelde in Denmark in 1910.

A form of var. *suberosa* with small leaves, about an inch in length, is cultivated at Kew, as var. *microphylla pendula*.⁴

2. Var. *stricta*, Aiton, *Hort. Kew.* i. 319 (1789); Schneider, *Laubholzkunde*, i. 220 (1904); Ley, in *Journ. Bot.* xlviii. 70 (1910). Cornish Elm.

¹ Cf. our account of French seedlings of this species, p. 1897. A young seedling is figured in *Journ. Linn. Soc. (Bot.)* xxxix. 292, pl. 22 (1910).

² *U. suberosa*, Ehrhart, *Beit.* vi. 87 (1790), was a general name, applied to all the elms in Europe that were not *U. montana* or *U. pedunculata*. Ehrhart's specimen of *U. suberosa* in Smith's herbarium at the Linnean Society is the "English elm," *U. campestris*, L.

³ Cf. *Gard. Chron.* xix. 453, fig. 66 (1896).

⁴ Distinguished as *U. glabra*, var. *propendens*, Schneider, *Laubholzkunde*, i. 220 (1904).

Ulmus campestris, var. *cornubiensis*, Loudon, *Arb. et Frut. Brit.* 1376 (1838).

Ulmus stricta, Lindley, *Syn. Brit. Flora*, 227 (1829); Moss, in *Gard. Chron.* li. 234 (1912).

A tree, attaining about 80 ft. in height and 15 ft. in girth, rather variable in habit, but usually with a narrow crown, with the upper branches short and ascending, the lower branches spreading and curving upwards at the ends. Bark light grey, fissuring into small plates. Young branchlets often densely pubescent at the insertions of the leaves, elsewhere with scattered hairs. Buds minute, with glabrous scales, slightly ciliate in margin. Leaves (Plate 412, Fig. 20) firm in texture, obovate to oval, 2 to 2½ in. long, 1 to 1½ in. broad, unequal at the base, acuminate at the apex; upper surface dark green, shining, glabrous, smooth to the touch, lower surface lighter green, with conspicuous tufts of pubescence at the junctions of the midrib and lateral nerves, and at the forks of the latter, and with slight tufts usually near the margin at the base of the teeth, elsewhere glabrous or with minute scattered pubescence; lateral nerves about twelve pairs, often forked; margin crenately biserrate, non-ciliate; petiole about $\frac{1}{3}$ in. long, pubescent.

Flowers, fifteen to twenty in small clusters, on very short pedicels, irregular in the number of sepals and stamens, but mostly tetramerous; calyx funnel-shaped, minute, about $\frac{1}{2}$ in. long, with pink lobes; stamens four or five, with pink filaments and dull red anthers; stigmas pink. Samaræ rarely ripening, but when mature, similar to those of typical *U. nitens*, but narrower, obovate, cuneate at the base, about $\frac{2}{3}$ in. long and $\frac{3}{8}$ in. wide; imperfect samaræ are usually broadly obovate, less than $\frac{1}{2}$ in. long.

From ten lots of seed, sent me from different localities in Cornwall, I raised in 1909, thirty-eight seedlings, all of which bore opposite leaves. These plants are now all uniform in appearance; and in all probability the Cornish elm is a pure species.

In Abbeyleix Park, Ireland, there are a few elms, growing with oak trees on the alluvial flat of the river Nore, which are probably indigenous. These are similar in foliage to the Cornish elm; and have similar small tetramerous flowers, few in a cluster, but differing in having white stigmas. These trees produced a few ripe samaræ in 1909, similar to those of *U. nitens*, but scarcely $\frac{1}{2}$ in. long. From these I raised two seedlings, with opposite leaves, which in 1912 resembled the seedlings of the Cornish elm.

The suckers of the Cornish elm, which are freely produced, have pubescent stems, and small leaves, scabrous above with scattered minute tubercles and short bristles. The epicormic branches are usually smooth, but occasionally develop corky ridges, which are, however, never seen on the normal branches in the crown of the tree.

In Cornwall, the tree is slow in growth, but it produces a remarkably tough wood, which is used by wheelwrights for naves, felloes, and framework of waggons; and was formerly utilised as staves for the casks in which cement and china clay were exported, and also for making boxes in which gunpowder was compressed by an hydraulic press, as no other wood was found to bear great pressure so well.

The Cornish elm is undoubtedly indigenous in Cornwall and south Devon,

where it grows abundantly in the hedge rows, reproducing itself regularly by suckers, and possibly by seed in rare years as in 1909. Mr. F. Hamilton Davey tells me that it is plentiful also in parts of Somerset, and says regarding its distribution in Cornwall, that it is fairly common from the Tamar to a little to the west of Penzance. From the extreme north-east of the county to Land's End, it does not approach the coast nearer than a mile or two. It is also rare along the Lizard peninsula, and near the range of granite hills, which run from east to west through the centre of the county. It is a tree of low altitudes, the finest specimens being always found in sheltered valleys, especially in those which run to the south coast.

The Cornish elm was reported¹ by the late Rev. A. Ley to be common in Brittany, and this is confirmed by Dr. C. E. Moss, who observed it in most parts of Brittany, though good specimens were rare on account of the local practice of lopping. (A. H.)

I measured two large trees (Plate 397) of characteristic habit in the lower part of the entrance drive at Coldrenick in Cornwall, the suckers of which were of precisely similar habit. One was 100 ft. by 11 ft. 4 in., the other 92 ft. by 13 ft. 5 in. On the approach to Menabilly House from Fowey, I also saw fine Cornish elms, some over 100 ft. high. I measured one, 95 ft. by 6 ft. 2 in. At Scorrier, near Truro, there are many of these elms, though I saw none of great size; and Mr. John Williams told me that they resist the sea wind, which is here very strong, better than any other tree; and that he plants suckers, which are abundant. The Cornish elm seldom attains a great girth; but a tree at Enys, which Henry saw in 1911, measured 24 ft. in girth at the ground, 17 ft. at five feet up, and 16 ft. at seven feet up; but it was only about 65 ft. high. In the vicarage garden at Perranar-worthal, Henry saw a fine specimen 80 ft. by 11 ft.

In Devonshire I have seen no Cornish elm remarkable for size.

At Shawford, near Winchester, there are four fine trees, not quite of the typical Cornish form, the largest of which measured 125 ft. by 10 ft. 10 in. in 1907. At Bisterne Park, near Ringwood, I saw in 1896 three trees, differing somewhat in habit. One had a very erect trunk and pointed top; and measured 86 ft. by 13 ft. The second was more rounded at the top, and was 90 ft. by 14 ft. The third tree could scarcely be called a true Cornish elm, as it had the pendulous branches of an American elm, and measured 98 ft. by 13½ ft.

At Cowdray, near the ruins, there are three fine trees, of the same habit as the second tree at Bisterne, and not so regular as the Wheatley elm. These measured in 1906, 113 ft. by 13 ft., 113 ft. by 13½ ft., and 110 ft. by 11 ft. 9 in. respectively.

At Bagshot Park, on May 20, 1907, I measured a very fine tree, which had not yet come into leaf, though some seeds were nearly ripe. It measured 98 ft. by 11½ ft. At Arley Castle, there is a tree, No. 351 in the catalogue, which measured 75 ft. by 8 ft. 8 in. in 1907.

In Wales the Cornish elm grows well on the south coast; and at Singleton, the property of Lord Swansea, there is an avenue of them. Mr. Harris, formerly

¹ In *Journ. Bot.* xlviii. 70 (1910).

gardener here, considered this to be the best variety for seaside planting, as it bears the wind well.

In the Edinburgh Botanic Garden there are two trees, nearly equal in size, about 65 ft. by 5 ft. 4 in. in 1908, with small leaves, which seem to be a variety of the Cornish elm.

In Ireland, especially in the south, this tree comes to great perfection. In the Blackwater valley, I measured in 1910, in a meadow two miles east of Lismore, a splendid tree, about 100 ft. by 15 ft. In the avenue to the castle, there are some very tall and slender elms, one of which was 110 ft. by 10 ft. At Mallow Park, the seat of Mrs. Norris, I saw in 1909, some fine elms of similar type, one of which measured 95 ft. by 12 ft. 10 in.; another 95 ft. by 10 ft.; and a third, a very straight tree, about 90 ft. by 6 ft. The Cornish elm is probably native in the south of Ireland, where there are very many old trees of this variety. (H. J. E.)

3. Var. *Wheatleyi*, Simon-Louis, *Cat.* 1869, p. 98. Wheatley or Jersey Elm.

(?) *Ulmus sarniensis*, Loddiges, *ex Loudon, Arb. et Frut. Brit.* iii. 1376 (1838).

A pyramidal tree with stiff ascending long branches, and a narrow pointed crown. Leaves (Plate 412, Fig. 21) similar to those of the Cornish elm, but broader in proportion to their length, and glandular on the petiole and on the midrib, veins, and surface beneath, with less conspicuous axil-tufts. Flowers as in var. *stricta*, but with white stigmas. Fruit rarely ripening, but when mature similar to that of *U. nitens*, with the apex of the seed touching the small circular closed notch. From seed collected by Mr. J. F. Rayner from a tree in Southampton Cemetery, I raised forty-three plants in 1909, half with opposite, and half with alternate leaves. These now look a mixed lot, differing in the size of the leaves and in the presence or absence of corky ridges on the stem; and are not uniform like the seedlings of the Cornish elm.

This tree is generally regarded as a form of the Cornish elm, of which it is probably a seedling; but it differs in the characters noted. It is now generally sold in nurseries as the Wheatley elm; and is occasionally known in Germany and Holland under the erroneous name, *U. campestris*, var. *monumentalis*.¹ The Wheatley elm is so commonly known as the Jersey or Guernsey elm, that in all probability it is identical with the tree propagated by Loddiges as *U. sarniensis*, but Loudon's description of this is inadequate, and points rather to some form of the English elm.

A form of the Wheatley elm with leaves of a fine yellow colour, said to last till autumn, originated in 1900 in the Chester nurseries, and is now sold by Messrs. Dicksons as the "golden Cornish elm." (A. H.)

The finest Wheatley elm² is probably one growing in the public garden on

¹ The Wheatley elm is well figured by Springer in *Mitt. Deut. Dend. Ges.* 1910, p. 271, fig. 273; where Beissner points out that the true var. *monumentalis*, Rinz, *ex Petzold and Kirchner, Arb. Musc.* 554 (1864), is a columnar tree, with a few upright main branches and numerous short twigs bearing dense crowded dark green leaves, which was propagated by Rinz at Frankfort from a sucker of *U. nitens*, var. *suberosa*. A beautiful narrow pyramidal tree in Späth's nursery, called *U. campestris cornubiensis*, bears leaves similar in size and appearance to a common form of *U. nitens*, and differs from the Wheatley or the true Cornish elm.

² A good specimen at Kew is figured in *Card. Chron.* xli. 150, fig. 67 (1907).

the terrace at Richmond, overlooking the Thames, which is over 90 ft. in height (Plate 398).

In Messrs. Rogers' nursery at Southampton, large numbers of this elm are propagated; and I noticed that the grafts have rough leaves at first, and do not produce the typical smooth leaves until they are older. Trees of this variety retain their leaves till late in the season; and at Colesborne, colour well in the autumn. In the Isle of Wight, there are many trees of this type, and an avenue of small ones at Barton Farm, Osborne.

At Stowe, near Buckingham, there are some fine trees of this variety, here called Jersey elm, which produce many suckers. The best that I measured was 85 ft. by 8 ft. 2 in. in 1905. At Merton Hall, Norfolk, Henry measured a fine tree, 86 ft. by 8 ft. 10 in.; and there is a good specimen in Sir Hugh Beevor's grounds at Hargham.

At Monreith, Sir Herbert Maxwell has a number, which are called Southampton elms. These are from 52 to 57 ft. high, fifty-six years after planting, and are nearly as tall as some English elms planted about 100 years ago. These trees, however, are not so well-shaped as in the south of England, and looked as if the climate was too damp for them. In Queen's Park, Glasgow, there are twenty Wheatley elms, which were planted about 1859; they are 46 to 61 ft. in height, and average 6 ft. in girth.

(H. J. E.)

4. Var. *italica*, Henry (*var. nova*). Mediterranean Elm.

Leaves (Plate 411, Fig. 9) coriaceous, similar to those of *U. nitens* in shape and size, mainly differing in the numerous lateral nerves, which are never less than fourteen pairs, and often as many as eighteen pairs. Branchlets and samaræ as in the type. This variety usually has leaves smooth and glabrous above, and glabrescent beneath in autumn, with conspicuous axil-tufts; petiole $\frac{1}{4}$ in. long, pubescent.

This elm appears to be common in Italy, Spain, and Portugal, and also in Algeria. I observed it wild on Montserrat and in the Guadarrama mountains in Spain, where at 3000 to 4000 ft. elevation it attains a height of 70 to 80 ft. Dr. Henriquez sent to Kew on loan a specimen of this elm from Coimbra, in Portugal.

The small elms on which the vines are trained in Italy, north of the Apennines from Parma to Ravenna, are probably a form of *U. nitens*; but as these trees are lopped annually and kept low in stature, their leaves are irregular in size, have usually few nerves, and show a varying amount of roughness and pubescence on different individuals. Near Parma these elms produced good seed in 1911, from which I raised seedlings at Cambridge.

In the courtyard of the Villa Paveri-Fontana at Collecchio, near Parma, there is a remarkable old elm of this variety, about 60 ft. high, with a short, very burry, and rugged bole, 20 ft. in girth, and dividing above into three or four stems. Between Turin and the ancient royal palace at Stupinigi there is an avenue of elms, about six miles long, which was planted in 1781. Prof. Mattivoli, who kindly sent me specimens, tells me that the trees have been badly lopped during the last fifty years, and are not so large or so old as those in the gardens of the palace. The

largest which he measured in this avenue varied from 50 to 70 ft. in height, with a girth ranging from 7 to 11 ft. The largest elms in Turin are in the La Marmora garden, and measure about 100 ft. in height and 12 $\frac{1}{2}$ ft. in girth. These are said to have been planted in 1706.

5. Var. *umbraculifera*, Trautvetter, in *Act. Hort. Petrop.* ii. 590 (1873).

A tree with a dense globose crown of foliage, which is commonly cultivated in Persia, and only differs from ordinary *U. nitens* in its peculiar habit. This elm attains occasionally an enormous size, and is much prized on account of its dense shade and beautiful form. It is said to have been known in Persia for centuries, and has been introduced into the Caucasus and Armenia.¹ Regel, in *Gartenflora*, xxx. 3. t. 1034 (1881), figures a beautiful specimen, apparently of great age and size, which was then growing near Erivan in Russian Armenia. This peculiar elm is known to the Persians as the *narwan*,² and is always propagated by grafting. It was introduced in 1878 by Späth, who received it from a German gardener in the employment of the Shah, and is said to be planted in some of the streets in Berlin.³ There is a fine specimen about twenty years old, grafted at 6 ft. from the ground, in Desfossé's nursery at Orleans.

Var. *umbraculifera gracilis*, Späth, *Cat.* No. 100, p. 121 (1897-1898).

This originated in Späth's nursery from a shoot of the preceding variety, which had been grafted on a standard, and is said to differ only in forming a long oval and not a globose crown. At Kew, a shrub, labelled var. *umbraculifera*, obtained from Simon-Louis in 1904, has numerous ascending branches from the base, no main stem being developed, and forms a globose bush about 6 ft. high.

6. Var. *Rueppellii*,⁴ Späth, *Cat.* No. 73, p. 124 (1888-1889).

A pyramidal tree, with a distinct stem and numerous ascending branches, forming a globose or ovoid crown, and closely resembling var. *umbraculifera* in habit. Branches slightly corky, branchlets pubescent. Leaves similar to those of the Cornish elm in size and shape, but scabrous above. This is represented at Kew by two trees, about 10 ft. high, that were obtained from Barbier in 1902.

7. Var. *pendula*,⁵ Rehder, in Bailey, *Cycl. Amer. Hort.* 1882 (1902).

Branches and branchlets very pendulous. There is a good specimen⁶ of this

¹ Radde, *Pflanzenverbr. Kaukasus*, 305 (1899). A fine tree in the city of Bokhara is figured in *Mitt. Deut. Dend. Ges.* 1910, p. 73. *Ulmus densa*, Litwinow, in *Schede Herb. Fl. Ross.* vi. 163 (1908), is the name given to the wild elm with a dense crown of foliage, which grows in the mountains of Turkestan and Ferghana. Litwinow considers var. *umbraculifera* to be probably a graft of *U. densa*.

² This Persian word is also transcribed *narwand*, *narband*, and *narbum*, and primarily means a pomegranate tree. Probably it has been transferred to this peculiar elm on account of the fancied resemblance of the globose crown to a pomegranate.

³ *Garden and Forest*, ii. 516 (1889). Cf. also *Gartenflora*, xxxvi. 643 (1887). E. Morren, in *Belg. Hort.* 1879, p. 269, states that Späth received this variety from M. Scharrer at Tiflis.

⁴ The origin of this variety is unknown; but it was probably named after T. Rueppell, owner of P. Smith and Co.'s nursery at Hamburg from 1862 to 1899.

⁵ A tree cultivated at Kew as *U. glabra pendula nova* is a common form of the species with drooping branches, which do not form a dense crown of foliage as in true var. *pendula*.

⁶ The outer lower branches of this tree bear abnormal leaves, some of which have one or two small supernumerary leaflets at the base. Other leaves are large and broad, as if composed of two ordinary leaves, and are often cleft from the apex to the base. Some leaves form ascidia. Similar leaves occur on a single lower branch of a tree of *U. nitens* in the Cambridge Botanic Garden. Cf. Worsdell, in *Gard. Chron.* l. 285 (1911), and in *Journ. Roy. Hort. Soc.* xxxvii., *Proc.* cxxiii. (1912). Similar abnormal leaves are present on a specimen at Kew of *U. nitens*, gathered from a large tree in Persia by Dr. Stapf. Delavaud, in *Bull. Soc. Bot. France*, viii. 144 (1861), gives an explanation of the same kind of malformation, which he had observed on an elm at Rochefort.

variety on the lawn in front of the palace at Kew. It is grafted high, and resembles in appearance the weeping form of *U. montana*.

A weeping form of *U. nitens* in Victoria Park, Bath, is known as the Scampston elm, var. *scampstoniensis*, Petzold and Kirchner, *Arb. Musc.* 560 (1864). Schneider states that what he has seen under this name is ordinary *U. nitens*. Loudon says that the Scampston elm came from a place of that name in Yorkshire, and that a tree, 18 ft. high in 1834, which bore this name in the Chiswick garden, was clearly some variety of the glabrous elm, and differed little from the species. Elwes saw the decayed stump of the original tree at Scampston Hall in Yorkshire; and so far as we can ascertain, this weeping variety, if it ever was distinct, is no longer known in nurseries in England.

8. Var. *Dampieri*, Henry.

Ulmus Dampieri and *Ulmus montana Dampieri*, Petzold and Kirchner, *Arb. Musc.* 563 (1864).

Ulmus campestris Dampieri, Späth, *Cat.*

Ulmus campestris, var. *plumosa*, Lavallée, *Arb. Segrez.* 236 (1877).

A tree, fastigate in habit, forming a narrow pyramidal crown. Branches curved. Leaves, crowded on short glabrous branchlets, broadly ovate, 2 to 2½ in. long, 1½ to 1¾ in. broad, smooth and glabrous above, glabrous beneath except for conspicuous axil-tufts; margin incised with serrated teeth.

This beautiful tree, which has been much confused with Ford's elm (the similar variety of *U. montana*), is probably of continental origin.¹ The finest specimens which I have seen are two trees in Antwerp Park, about 45 ft. high, and one in the Leyden Botanic Garden, which was 40 ft. by 4½ ft. in 1912.

A sub-variety of this with yellowish leaves is occasionally seen in botanic gardens, where it is known as *U. Dampieri aurea* or *U. Dampieri Wredei*.²

9. Var. *modiolina*, Henry.

Ulmus modiolina, Dumont de Courset,³ *Bot. Cult.* vi. 384 (1811).

Ulmus tortuosa, Loddiges, *Cat.* 1836, ex Loudon, *Arb. et Frut. Brit.* iii. 1376, 1379 (1838) (not Host).

This is *l'orme tortillard* of the French,⁴ described as a tree with a twisted

¹ Nothing is known of Dampier, after whom this elm is named.

² Named after Wrede, curator of the Arboretum at Alt-Geltow, near Potsdam, where the yellow form originated in 1875 as a branch on a tree of *U. Dampieri*. It received a certificate from the Royal Horticultural Society in 1893, as *U. Wredei aurea*.

³ Dumont de Courset described *U. modiolina* as a pyramidal tree with crowded branches and small leaves. Du Roi, *Harbk. Baumz.* ii. 501 (1772), identified *l'orme tortillard*, which was then much valued in France, with *U. glabra*, Miller (*U. nitens*, Moench). Michaux, *Arb. Amer.* iii. 274 (1813), who advocated its introduction into the United States, said that it could be propagated by layering. Loudon states that it was reported to come true from seed frequently. M. de Vilmorin tells me that his grandfather planted several lines of this variety at Les Barres, which still exist but are growing in poor soil. His specimens include two different trees, one being ordinary *U. pedunculata*, while the other is a peculiar elm with moderately sized leaves, scabrous on both surfaces. The tree in the Jardin des Plantes, Paris, which is now labelled *U. campestris modiolina*, is probably not the original tree, as it is identical with the hybrid elm (*U. belgica*) of Holland and Belgium. The elm cultivated as var. *modiolina* by Späth is closely allied to *U. major* (see p. 1884). Huberty, in *Bull. Soc. Cent. Forest. Belg.* xi. 492 (1904) and xv. 788 (1908), considers this elm to be a special variety with small leaves, which grows slowly even in good soil, but produces the most suitable wood for making naves of wheels; but I have seen no specimens in Belgium. Aigret, in *Ann. Trav. Public. Belg.* x. 1225 (1905), assigns to var. *tortuosa* some hybrid elms with large leaves, which are growing with twisted trunks at Louveigné in the province of Liège.

⁴ The earliest account is by Duhamel, *Exploit. des Bois*, i. 294 (1764), who says that *le tortillard* has not only the most useful wood of all the elms, but has also fine foliage; and adds that it can be raised by seeds, grafts, or layers. Poederlé, *Man. de l'Arbor.* i. 116 (1792) identifies Duhamel's *l'orme tortillard* with the elm called *orme maigre* in Belgium, which is *U. nitens*.

arrangement of the bark and of the fibres of the wood, the stem when old being covered with burrs. This is stated by old writers to be a distinct variety, which produced wood valued by wheelwrights. Koch¹ states that it is a fine tree, with burry excrescences on the trunk, much planted in avenues in the north of France.

It is somewhat doubtful, however, whether this elm was really a distinct variety, as the description points to abnormal growth, which might occur in any kind of elm. M. Hickel informs me that the term *l'orme tortillard* is now applied to small elms of *U. nitens* with twisted and knotty stems, growing as a rule in poor soil.²

10. Var. *variegata*, Dumont de Courset, *Bot. Cult.* vi. 384 (1811); Loudon, *Arb. et Frut. Brit.* iii. 1405 (1838).

Leaves variegated with white, elliptic, 1 to 3 in. long, long-acuminate at the apex, smooth to the touch above, on long petioles. Branchlets glabrous. This occasionally bears branches with green leaves, similar to the ordinary form of *U. nitens*.

This³ was cultivated in 1838 in the Chiswick garden, and differs from the variegated form of the English elm. Elwes saw a very fine variegated smooth-leaved elm at The Mote, Maidstone, 90 ft. by 9 ft. in 1911; another at Leaton Knolls, Shrewsbury, 62 ft. by 5 ft. 8 in. in 1910; one at Woburn, 60 ft. by 5 ft. in 1908; and a fine tree by the roadside at Little Parndon rectory, Essex, which was 85 ft. by 10 ft. in 1907. This was said by the Rev. P. Deedes to be at its best in July, when the leaves are of a golden colour; but they are shed early in autumn. There are also specimens at Beauport, at Stanway, and in Victoria Park, Bath.

Another variegated variety, which is probably derived from *U. nitens*, is in cultivation at Kew, where it forms a wide-spreading tree about 20 ft. high, obtained from Smith of Darley Dale in 1879 under the name *U. campestris variegata nova*. It bears leaves, which are often much reduced in size and entirely whitish. Occasionally branches are produced bearing leaves of normal size, with the variegation confined to the margin, while one or two other branches bear pure green leaves larger than is usual in typical *U. nitens*.

11. Var. *Webbiana*, Lee, ex Simon-Louis, *Cat.* 1869, p. 97.

A tree, pyramidal in habit, with ascending branches and sparse foliage. Leaves folded longitudinally, so that most of the upper surface is concealed; in other respects similar to those of var. *stricta*. There are two good specimens at Kew, about 35 ft. high, which were planted in 1871.

This variety is said⁴ to have been raised in Lee's nursery about 1868; but it seems to be identical with *U. campestris*, var. *concavæfolia*, Loudon, *Arb. et Frut. Brit.* iii. 1378 (1838), which is insufficiently described.

¹ *Dendrologie*, ii. pt. i. 410, where it is referred to *U. montana*. Koch's description possibly refers to *U. Klemerei*. See p. 1872.

² This was the view taken by Planchon, in De Candolle, *Prod.* xvii. 158 (1873). M. Jouin showed me in the nursery of Simon-Louis at Metz, an avenue of what he called "*orme tortillard*," which he said were much liked by wheelwrights. They seemed to be a bad stunted elm, with swellings on the crooked trunks, and are propagated by grafting on stocks of *U. nitens*.—H. J. E.

³ This is probably identical with var. *argenteo-variegata*, Rehder, in Bailey, *Cycl. Amer. Hort.* 1882 (1902), which is the same as var. *folio argenteo-marginata*, Petzold and Kirchner, *Arb. Musc.* 557 (1864). It appears to have been first mentioned by Miller, *Cat. Plant.* 86 (1730), and *Gard. Dict.* ed. 1, No. 7 (1731), as *Ulmus folio glabro eleganter variegata*, the striped witch elm.

⁴ *Gard. Chron.* 1868, p. 918.

Ulmus viscosa, Koch, *Dendrologie*, ii. pt. i. 416 (1872), appears to differ very little from var. *Webbiana*. It is represented at Kew by a stunted specimen, obtained from Booth in 1871.

12. Var. *virens*, Henry. Kidbrook Elm.

Ulmus campestris, var. *virens*, Loudon, *Arb. et Frut. Brit.* iii. 1376 (1838).

A tree, narrowly pyramidal in habit, with long ascending branches, retaining its foliage till December. Branchlets slender, glabrous. Leaves oval, about 3 to 4 in. long, and $1\frac{1}{2}$ to 2 in. wide, long-acuminate at the apex, coarsely biserrate, glabrous and smooth above, slightly scabrous beneath, with numerous glands; lateral nerves, about twelve pairs, remote, often forked. Flowers similar to those of the Huntingdon elm. Samaræ similar, but smaller.

The only specimen of this tree which I have seen is one about 40 ft. high at Ashwell Bury, near Baldock. In habit it somewhat resembles the Huntingdon elm, but is more narrowly pyramidal. It retained its leaves in 1910 till the first week in December. It is probably identical with Loudon's tree, of which he says: "Notwithstanding its name of Kidbrook elm, a place in Sussex, it is a Cornish variety," probably on account of its pyramidal habit. Var. *virens* appears to be unknown in nurseries at the present day.

13. Var. *betulaefolia*, Loudon, *Arb. et Frut. Brit.* iii. 1376 (1838).

Ulmus betulaefolia, Loddiges, *Cat.* 1836.

A tree, pyramidal in habit, with ascending branches. Leaves ovate-oblong, up to $3\frac{1}{2}$ to 4 in. long and $1\frac{1}{2}$ in. broad, long-acuminate at the apex, tapering to a cuneate but unequal base, coarsely biserrate; lateral nerves 12 to 14 pairs.

This tree, which is readily distinguished by its foliage and habit, is represented by a good specimen in the Cambridge Botanic Garden. It is occasionally seen in hedgerows in Herts and Huntingdonshire.

DISTRIBUTION

U. nitens is a native of central, western, and southern Europe, Algeria, Asia Minor, Caucasus, Armenia, Persia, and Turkestan. In eastern Asia it is replaced in Manchuria, Korea, and Japan by the closely allied species, *U. japonica*.

In Europe, this species has a more southerly distribution than *U. montana*, and is unknown in Denmark, Sweden, and Norway as a wild tree, though it is said to occur, possibly planted, on the island of Gothland, in the Baltic. In Russia, it is limited to the southern provinces, its northern limit passing through Grodno, Volhynia, Chernikof, Tambof, Saratof, Samara, and Orenburg. It is especially common in the south-west, occasionally forming pure woods, one of which is said by Köppen¹ to extend for fifteen versts in the valley of a tributary of the river Ingul in Kherson. It occurs in the Crimea, and in the Caucasus, where it grows from sea-level to an altitude of 6000 feet.

¹ *Holgerwächse Europ. Russlands*, ii. 34 (1889).

In Germany the northern limit of this species is not accurately known; but it is a rare tree in the north, except in the river valleys.¹ It is widely spread through Austria-Hungary, the Balkan States, Greece, Italy, Spain, and Portugal.

U. nitens is rare, either wild or cultivated, in Belgium and Holland; but it grows on the dunes near Haarlem. I saw no trees of it in the Ardennes,² where the wild elms are *U. pedunculata* and *U. montana*.³ I found it in a nursery at Malines, where it was called *orme maigre*.

In France it is widely distributed, except in Provence, where it is replaced by the southern variety of *U. campestris*. It is common, however, only in some parts, and rarely if ever forms a prominent feature in the landscape, such as it does in East Anglia. It is apparently wild in Normandy, where it grows often in hedges as a small tree with corky branches and numerous suckers. It is indigenous in certain forests, mixed with oak, notably in the Bois de Vincennes near Paris, where it is associated with *Quercus lanuginosa*. I noticed a few trees growing in the forest of Marly. It constitutes a small percentage of the forest of Thétieu, through which the Adour flows near Dax. The soil here is liable to inundation once or twice a year, and the main species is the pedunculate oak. I estimated many elms in this remarkable forest to be about 70 ft. in height and 5 to 6 ft. in girth. Near Angoulême I noticed this elm in hedges on the road to the forest of La Braconne, one fine tree being 90 ft. in height and 7 ft. in girth. It is also common on the outskirts of the forest of Orleans, where it grows in hedgerows around cultivated fields in better soil than that of the interior of the existing woodland. M. Mathey gives an interesting account⁴ of the remarkable woods, known as *vaiivres*, which occur on the banks of the Saône from Port-sur-Saône near Vesoul to twenty-eight kilometres north of Macon. These moist woods, with an alluvial soil which is frequently flooded, are mainly composed of oak, ash, and glabrous elm, with a sprinkling of aspen, alder, hornbeam, maple, and blackthorn. The herbaceous vegetation is characterised by moisture-loving plants like *Carex brizoides*, *Panicum Crus-Galli*, and *Iris Pseudacorus*. Most of these woods are treated as coppice with standards, the number of the latter that are reserved being often in the proportion of 15 oaks, 2 ashes, and 1 elm; but as the elm is the least valuable, it is not maintained in the overwood, although it increases by suckering in the underwood. The late M. Broilliard stated⁵ that the woods richest in elms are near Gray (Haute Saône), Pontailler, Heuilley (Côte d'Or), Ecuelles, Boyer (Saône-et-Loire), and Truchère (Ain).

The seedling elms⁶ that are imported into England, under the name

¹ Willkomm, *Forst. Flora*, 554 (1887), states that, on the alluvial land along the Elbe in north Germany, small pure woods of this species are not uncommon.

² Reputed wild trees of small size on the side of the river near Rochefort were, I found on enquiry in 1912, elms that had been imported as seedlings twenty-five years previously from a French nursery in Calvados.

³ Specimens of wild elm in the Bois de Colfontaine near Mons, sent me as "*U. campestris*" by M. Quievy, are also *U. montana*.

⁴ *Bull. Soc. Forest. Frauche-Comté*, iv. 494 (1898), and *Bull. Soc. Cent. Forest. Belg.* vi. 87 (1899). I am indebted for specimens of this elm to M. Mourlot, Inspector of Forests at Gray, and to M^{me}. Broilliard.

⁵ *Bull. Soc. Cent. Forest. Belg.* xii. 53 (1905).

⁶ On account of their rough pubescent leaves and branchlets, these seedlings have been much confused with *U. campestris*, the true English elm; but they are undoubtedly *U. nitens*, and agree perfectly with seedlings that I have raised from seed of the latter species gathered in England. Sargent sent me in 1911 seedlings of his "*U. foliacea*," raised from seed gathered in Hungary in 1905; these have corky pubescent twigs and rough hairy leaves and are also *U. nitens*.

U. campestris, from French nurseries at Orleans, Ussy, and elsewhere, are raised from the seed¹ of *U. nitens*. This importation has continued probably without interruption from the time of Evelyn, who refers² to the French elm as having "glabrous and smooth" leaves, and mentions in 1664 "a cloyster of the right French elm in the little garden near to her Majesties the Queen Mothers Chapel at Somerset-house, which were (I suppose) planted there by the industry of the F.F. Capuchines." In all probability many of the glabrous elms that are now growing in parks and pleasure grounds in England and Scotland are of French origin.

In England, *U. nitens* is limited to the southern, midland, and eastern counties. Throughout the east of England, where it is much commoner than *U. montana*, it is usually known, when of wide-spreading habit, as the wych elm. *U. nitens* is unknown, except as a planted tree, in Scotland; but it is probably wild in the south of Ireland, where it is frequent in hedge-rows; and at Abbeyleix, var. *stricta* is scattered amidst oaks on the alluvial flat of the river Nore. Cf. p. 1889.

Many elms may be found in the south and west of England, which differ somewhat in foliage and habit, both from typical *U. nitens*, and its well-marked varieties, described above. It seems unnecessary to describe these in detail or to give them special names. In several cases, in which I sowed seeds of trees, slightly abnormal in foliage and habit, the seedlings produced are not uniform, and show the characters of opposite and alternate leaves in the first year in Mendelian proportions; and are presumably of hybrid origin. Some of these elms have leaves thicker in texture, larger in size, often longer with more numerous nerves; whilst others show peculiar serrations, less obliquity at the base, etc. A tree at Colesborne, from which numerous seedlings were raised in 1909, is a typical instance of this class of elm.³ (A. H.).

REMARKABLE TREES

Among the most remarkable trees of this species is an elm (Plate 399) at Sharpham, near Totnes, the seat of O. Durant Parker, Esq., which was figured as a wych elm in *Gard. Chron.* xxxix. 152 (1906). I found this tree to be a glabrous-leaved elm of unusual habit, with immense branches spreading to a distance on one side of 104 ft., and covering a total area of a quarter acre. Its height when I saw it in 1906 was 80 to 90 ft., and its girth 17 ft. The lateral branches were covered with small spray and ferns, which are favoured by the damp climate.

In Dyrham Park, Gloucestershire, there is an old and decayed glabrous-leaved elm, which in 1906 measured 19½ ft. in girth, but was throwing out much young spray on the live branches.

From West Dean, in Sussex, Mr. F. Arthur sent me specimens of this elm, which is there known as wych elm; its timber sells locally for 1s. per foot.

At Godinton, Kent, a fine tree which has the habit of the weeping Hertfordshire elm, measured in 1907 about 100 ft. by 12 ft.

¹ M. de Vilmorin informs me that the seeds of this elm, which are sold by him as "*U. campestris*," are usually gathered in the neighbourhood of Soissons (Aisne) and Le Mans (Sarthe).

² *Sylva*, 19 (1664).

³ Referred to in *Journ. Linn. Soc. (Bot.)* xxxix. 294 (1910).

Some trees of the same habit, which possibly originated in the nursery at Canterbury, where Masters raised elms of this type, are at Betteshanger, near the church, and in 1907 were 70 to 80 ft. by 7 to 8 ft. in girth.

At Boughton Park, in the broad avenue, which is a hundred yards wide and stretches for a mile in front of the house, are a number of elms, which like those at Cassiobury, and some of those at Hinchingsbrooke, are remarkable for their burry growths and stunted habit. Whether this is due to their having been propagated from suckers of trees having this peculiarity I cannot say, but there are much better-shaped trees in the same avenue which are free from burrs, and have attained a much greater height. Two which I measured were 107 ft. by 18 ft. 4 in., and 104 ft. by 18½ ft. in 1908. Boughton is celebrated for its extensive avenues of elms, planted by "John the Planter," Duke of Montagu, who died in 1749. Most of them are true English elms, and one which I saw in the timber yard had 170 rings, of which only twenty were sapwood, in a diameter of 3 ft. Elm timber at Boughton averages about 1s. per foot, though in an exceptional case it has realised 2s. 6d. per foot. It is much liked for chair seats, on account of its rich colour.

In Hertfordshire and on the western borders of Essex, the most graceful form of this tree may be seen in perfection. Among the largest in this district are the following:—At Bayford Lodge, Bayfordbury, a fine weeping tree, very distinct from an English elm growing beside it, in 1909 was 92 ft. by 11 ft. 9 in. At Amwell Bury, near Ware, Herts, there is a magnificent tree of *U. nitens*, of which Mr. H. Clinton-Baker sends us the following particulars. It is situated on Mr. E. S. Hanbury's property, and in November 1911 measured 133 ft. in height, with a trunk 23½ ft. in girth at five feet, above which it divides into two stems, 15 ft. 2 in. and 14 ft. 6 in. in girth respectively.

At Eastwick rectory, in the Stort valley, the best of a group of four trees near the church was 119 ft. by 10 ft. in 1909; while another was 116 ft. by 6½ ft. A little higher up in a narrow grass field there is a fine tree of the same habit, 113 ft. by 13½ ft. Suckers from these trees are numerous; and Mr. Rivers, of the Sawbridge-worth nurseries, has propagated a number of this type. At Briggins Park, the seat of the Hon. H. C. Gibbs, two splendid trees (Plate 401) stand together by a small lake; the larger was 128 ft. by 12 ft. 10 in. in 1909. On the road from Dunmow to Easton Park, there are a number of weeping elms, which vary a good deal in habit, and appear to belong to this species, but I have not seen them in leaf. At Aldenham, in Sawyer's Lane, there are good trees of this type which, as usual, have rough-leaved suckers; the best measured in 1908 about 108 ft. by 7 ft. 11 in.

At Great Saling, Essex, on the village green, there is a handsome weeping tree (Plate 402), with an immense witches' broom near the top, which in 1907 measured 110 ft. by 20 ft. 9 in. Loudon says¹ that Mr. Jukes, who made drawings of the large elms at Studley Royal, pronounced this elm to be the most handsome that he had seen. It measured, in 1841, 114 ft. in height and 17½ in girth at five feet from the ground.

¹ *Gard. Mag.* xvii. 356 (1841).

At Ryston, near Downham, Norfolk, in 1908, I measured one in a hedgerow which was 95 ft. by 16 ft. 9 in.

At Belton, Grantham, there are large glabrous elms in the grounds; and at Barholm, not far from Stamford, there are two remarkable trees, very wide spreading, with a rounded crown of foliage, of no great height, but 16 ft. 3 in., and 17½ ft. in girth in 1910.

In Gloucestershire there are several old elms on my own property which have similar leaves to *U. nitens*, but which keep their leaves green later in autumn and turn to a brighter colour, which may be due to the locality, for I have noticed that beech, oak, elm, and other trees colour better in the Cotswold hills than in the eastern counties. The timber, though hard and tough, is not so red as that of the English elm, and their habit is more spreading owing probably to their hybrid origin. From one of these just outside my park, which does not lose its leaves till late in November, I have raised numerous seedlings, which vary extremely in habit and vigour, but all have rough leaves at four years old like the suckers of the parent tree. At Toddington Manor there is a fine spreading tree near the house, which in 1910 measured 100 ft. by 15 ft. 2 in.; but most of the elms here and generally in the Vale of Gloucester are true English elms.

In Scotland I have not noticed any large trees of this species; but Mr. Renwick measured a tree at Loudon Castle, 107 ft. by 15 ft. 4 in. in 1910.

In Ireland, Mr. R. A. Phillips informs us that it is common in hedgerows between New Ross and Waterford, and along the river Barrow. At Killarney, Henry measured one in Lord Kenmare's grounds, which was 91 ft. by 12 ft. in 1903.

On the Continent there are many large elms, referred by Continental botanists to *U. campestris*, which are often *U. nitens*. The most famous elm in Germany is a tree standing in the market-place of Schimsheim, near Worstadt in Hesse, which is figured by Seidel in *Woods and Forests*, 1884, p. 577. Willkomm¹ states that this tree is 500 or 600 years old, about 100 ft. high, and 44 ft. in girth at 3 ft. 4 in. above the ground. The trunk is hollow, but otherwise the tree is quite healthy, with abundance of foliage. Neither Seidel nor Willkomm identify the species of this elm. The elm at Worms under which Luther preached is said by Willkomm¹ to be probably *U. nitens*, and is reported by Seidel to be much taller than the Schimsheim elm, and 25 ft. in girth at 8 ft. above the ground. Mr. Springer has sent me a photograph of a wide-spreading smooth-leaved elm at Windesheim Castle, near Zwolle in Holland. This tree measured, in February 1913, 75 ft. in height and 23 ft. 9 in. in girth, with a crown of foliage 106 feet in diameter.

(H. J. E.)

¹ *Forstliche Flora*, 550, note (1887).

ULMUS MINOR, GOODYER'S ELM

Ulmus minor, Miller,¹ *Gard. Dict.* ed. 8, No. 6 (1768); Reichenbach,² *Icon. Fl. Germ.* xii. 12, t. 660 (1850).

Ulmus glabra, Miller, var. *minor*, Ley, in *Journ. Bot.* xlviii. 70 (1910).

Ulmus campestris, Smith, *Eng. Bot.* t. 1886 (1808) (not Linnæus); Lindley, in Rees, *Cyclopædia*, xxxvii. No. 1 (1819).

Ulmus sativa, Moss, in *Gard. Chron.* li. 216 (1912) (not Miller).

Ulmus sativa, Miller, var. *Lockii*, Druce, *List of British Plants*, 63 (1908).

Ulmus Plotii,³ Druce, in *Northampton Nat. Hist. Journ.* 1911, p. 88, and in *Gard. Chron.* l. 408 (1911).

A small tree, 40 to 90 ft. in height, with the stem usually curving at the summit, and a few short stout ascending branches, and pendulous branchlets, forming a narrow crown of peculiar appearance. Young branchlets slender, with a scattered minute pubescence, glabrous and finely striate in the second year. Leaves (Plate 411, Fig. 3) firm in texture, obovate or elliptical, about 1½ to 2½ in. long and ¾ to 1½ in. broad, unequal and often cordate at the base; acute, acuminate, or occasionally rounded at the apex; upper surface dull, scabrous with scattered minute tubercles and minute hairs; lower surface scabrous and densely pubescent with short hairs in spring, later glabrescent, but with conspicuous axil-tufts; biserrate; lateral nerves, eight to ten pairs, often forked; petiole ½ in. long, pubescent.

Flowers, twenty to twenty-five, in small clusters, on very short pedicels, irregular in the number of sepals and stamens; calyx funnel-shaped, about ⅛ in. long, with four, five, or six pink lobes; stamens, three, four, or five, with deep pink filaments and red anthers; stigmas pink. Samaræ rarely ripening, but in 1909 a few were produced, narrowly obovate, ½ in. long, emarginate at the apex, with a triangular open notch; seed in the upper half of the samara.

This tree produces suckers freely. It is possibly a hybrid, as a small packet of seed produced in 1909 fifty-seven alternate-leaved and twenty-eight opposite-leaved seedlings.

¹ Miller, *Gard. Dict.* ed. 8, No. 6 (1768), describes *U. minor* as "the smooth narrow-leaved elm, by some called the upright elm," and adds that "the leaves are narrower and more pointed than the English elm and are smoother; they are later in coming out in the spring than these, but continue later in autumn." He identifies it with *Ulmus minor folio angusto glabro*, which is the elm described by him in *Gard. Dict.* ed. 3, No. 6 (1737) and in ed. 6, No. 10 (1752), as "very common in some parts of Hertfordshire and in Cambridgeshire, where there is scarce any other sort of elm to be seen. This makes a very handsome upright tree, and retains its leaves as late in the autumn as the common small-leaved elm, which is called the English elm by the nurserymen near London; but it doth not come out so early in the spring." As Miller's *U. sativa* is undoubtedly the English elm (our *U. campestris*, L.), there is little doubt that Miller's *U. minor* is Goodyer's elm. The latter was called *U. minor* by Parkinson, *Theat. Bot.* 1405 (1640). Plot's *Ulmus folio angusto glabro* was not cited by Miller, and is *U. campestris*, var. *viminalis*. If *U. minor*, Miller, is objected to, on account of the uncertainty of the description, the tree may be styled *U. minor*, Reichenbach.

² Reichenbach's figure agrees, as regards leaves, flowers, and samare with English specimens of *U. minor*, and he cites correctly Smith, *Eng. Bot.* t. 1886. It is probable that *U. tortuosa*, Host, *Fl. Austr.* i. 330 (1827), is identical with *U. minor*, although Host's specimen in the Kew herbarium is *U. nitens*. *U. tortuosa* was said to be a low tree with a twisted trunk and small leaves, which grew in hilly districts in Hungary.

³ This is not, as Druce supposes, the elm described by Plot, *Nat. Hist. Oxfordshire*, 158 (1677), which is identical with *U. campestris*, var. *viminalis*. See p. 1906. I have examined specimens of the tree at Banbury referred to *U. Plotii* by Druce, and they agree exactly with *U. minor*, as here described. Cf. Moss, in *Gard. Chron.* li. 234, figs. 104, 105, and 106 (1912).

This elm was first described by Goodyer, in Johnson's edition of *Gerarde's Herball*, 1478 (1633), as *Ulmus minor folio angusto scabro*. He says that he saw it once, growing in hedgerows between Lymington and Christchurch, where it has been lately found by Dr. Moss. There are specimens in the British Museum, collected by Buddle and other early botanists; but it has apparently escaped the notice of later writers. So far as I know, it has never been cultivated in nurseries; and nearly all the trees which we have seen, grow in hedgerows and similar situations, where they may be looked upon as indigenous.

U. minor occurs on the Continent, as it is recorded by Reichenbach for Hungary; and there are specimens of it in the Haarlem herbarium from trees growing in Holland; but its distribution has not been worked out—French, German, and Russian botanists having paid little attention to the different kinds of wild elms.

This elm, which is of a remarkably distinct appearance, is common on the Madingley road, Cambridge, where the trees grow, from which I have drawn up my description. It is widely spread in the eastern counties, from Lincoln¹ through Norfolk and Suffolk to Essex, and occurs also in Northamptonshire, Huntingdonshire, Bedfordshire, Oxfordshire, and Hampshire. The usual habit of the tree is well shown in a photograph,² taken by Mr. Druce, of a tree growing near Fine-shade Abbey, Northamptonshire. He has also photographed³ a tree near Banbury, which is over 80 ft. in height.

(A. H.)

There are many elms of this variety in the eastern and midland counties, which are readily known by their smaller leaves, inferior size, and irregular habit. They are known sometimes in these districts as "lock" elms.³ A great many elms on the sandy land of west Norfolk are of this character, and, generally speaking, the hedgerow elms of this county are very inferior in size and shape to those of Essex, Herts, and the south generally. Similar trees grow in the hedges between Grantham and Belvoir Castle.

The finest specimen which we know of *U. minor* is a tree growing in the park at Weston Birt (Plate 403), which was 97 ft. high and 7 ft. in girth in June 1912. At Studley College, Warwickshire, there are about a dozen trees in a field, which are 70 to 80 ft. high, the three largest being 9 ft. 4 in., 9 ft. 6 in., and 9 ft. 9 in. in girth. Mr. C. C. Rogers, who has kindly sent specimens, tells us of a tree at Hagnaby Priory, Spilsby, Lincolnshire, nearly 90 ft. in height and 7 ft. 7 in. in girth.

(H. J. E.)

¹ Ley mentions a tree at Skellingthorpe in south Lincoln.

² Reproduced in *Gard. Chron.* l. 408, figs. 165, 166 (1911).

³ This name indicates the toughness of the wood of this elm, which is difficult to work with tools like the saw or plane, which become "locked," as carpenters say. Sir J. E. Smith, *Eng. Flora*, ii. 20, 23 (1824), states that the wood of this species "is greatly preferred in Norfolk to any other, and sells for nearly double the price, serving more especially for the naves of wheels."

ULMUS CAMPESTRIS, ENGLISH ELM

Ulmus campestris, Linnæus, *Sp. Pl.* 225 (1753) (in part), and *Flora Anglica*,¹ 11 (1754) (not Smith²); Loudon,³ *Arb. et Frut. Brit.* iii. 1374 (1838) (in part); Planchon, in De Candolle, *Prod.* xvii. 156 (1873) (in part); Moss, in *Gard. Chron.* li. 199 (1912).

Ulmus sativa,⁴ Miller, *Gard. Dict.* ed. 8, No. 3 (1768).

Ulmus suberosa, Smith, *Eng. Bot.* t. 2161 (1810) (not Moench or Ehrhart); Loudon, *Arb. et Frut. Brit.* iii. 1395 (1838) (in part); Lindley, *Syn. Brit. Flora*, 226 (1829).

Ulmus atinia, Walker, *Essays Nat. Hist.* 70 (1812).

Ulmus sarculosa, Stokes, var. *latifolia*, Stokes, *Bot. Mat. Med.* ii. 35 (1812); Ley, in *Journ. Bot.* xlviii. 72 (1910).

A tree attaining 130 ft. in height and 20 ft. in girth, with a tall straight stem, and spreading or ascending branches, rather variable in habit, but usually forming in the open a broad or narrow oval crown. Bark dark-coloured, deeply fissured. Young branchlets densely pubescent with short erect white hairs, more or less retained in the second year, when the twigs become finely striate. Buds ovoid, with minutely pubescent ciliate scales. Leaves (Plate 412, Fig. 14) broadly oval or ovate, about 2 to 3 in. long, and 1½ to 2 in. wide, very oblique at the base, shortly acuminate at the apex; upper surface dark green, scabrous, with a scattered minute pubescence, conspicuous on the midrib; lower surface pale green, with broad⁵ conspicuous white axil-tufts prolonged along the sides of the midrib, and covered between the nerves

¹ Linnæus, *Flora Anglica*, 11 (1754), identifies his *U. campestris* with one of the four elms mentioned by Ray, *Syn. Meth.* 468 (1724), namely, No. 1, *U. vulgarissima folio lato scabro*, Gerarde, *Emac.* 1480, which is the English elm. According to the rules of the Vienna Congress, the correct name, as it is the earliest, of the English elm must then be *U. campestris*, Linnæus, which cannot be applied to any other species. Continental botanists usually mean by *U. campestris*, all the European elms, except *U. montana* and *U. pedunculata*. *U. campestris*, Miller, *Gard. Dict.* ed. 8, No. 1 (1768), described as "the common rough or broad-leaved wild elm . . . very common in the north-west counties of England, where it is generally believed to grow naturally in the woods," is *U. montana*, and not the English elm, as asserted in *Gard. Chron.* li. 199 (1912).

² Smith, *Eng. Bot.* t. 1886 (1808), is *U. minor*. See p. 1901.

³ Loudon's account of the English elm is very confused, and his reference to Smith, *Eng. Bot.* t. 1886, is erroneous. He also fails to recognise that *U. suberosa*, Smith, *Eng. Bot.* t. 2161, is the English elm, and is quite different from *U. suberosa*, Moench, which is the corky-twigged variety of *U. nitens*.

⁴ Miller's *U. sativa*, which he calls "the small-leaved or English elm," is in my opinion the tree which is still named English elm and which is described above as *U. campestris*, L. The name "*sativa*" implies that it was commonly cultivated; and Miller states that it was planted near London. No other elm can have been meant, as it is certain that *U. campestris* was known near London under the name of English elm in Miller's time. The Society for the Encouragement of Arts offered a gold medal in 1765 (and also in subsequent years) "for properly planting the greatest number of the small-leaved English elms for raising timber, commonly used for keels of ships and water-works." [Cf. *Museum Rusticum*, iv. 380 (1765).] The elm that was used for making water-pipes was *U. campestris*, L., as is shown by T. H. W.'s clear account of the species around London, in *Gentleman's Magazine*, lv. 453 (1785). John Harrison, nurseryman at Cambridge, plainly means *U. campestris* by the English elm, in his *New Method*, 33 (1766): "That which we call the English elm, is peculiar only to the southern part of this island, where it grows wild in hedgerows; there is not a tree of that kind to be seen in the northern counties, but what has been planted within seventy or eighty years; and these are either in avenues or some plantations near gentlemen's seats." Cf. also Hunter, *Evelyn's Sylva*, 124 (1776). Miller quotes as a synonym Gerarde's *Ulmus minor folio angusto scabro*, of which he took a different view from Ray, as is clearly shown in his *Gard. Dict.* ed. 1, No. 3 (1731), where this elm of Gerarde's is identified with "the common English elm, the timber of which is generally preferred to the rest, and is the largest tree when planted on a kindly soil." It is impossible to suppose that *U. sativa*, Miller, can be the tree which is called by us *U. minor*, as the latter has never been called English elm, has never, so far as we know, been planted anywhere, and never attains a great size. Sir J. E. Smith, *Eng. Flora*, ii. 21 (1824), took the same view as I do regarding Miller's *U. sativa*.

⁵ The axil-tufts are peculiar, broad, and diffused in this species.

with a dense soft pubescence and numerous minute glands; lateral nerves ten to twelve pairs, often forked; petiole $\frac{1}{2}$ in. long, densely pubescent.

Flowers, about twenty in a cluster, on very short pedicels, irregular in the number of stamens and sepals; calyx funnel-shaped, with four or five or six red sepals; stamens three, four, or five, with red filaments and red anthers; stigmas white. Samaræ on very short pedicels, nearly orbicular, $\frac{1}{2}$ in. in diameter, glabrous, non-ciliate, emarginate at the apex, with a short notch closed by the incurved stigmas; seed in the upper part of the samara, with its apex touching the base of the notch.

The English elm occasionally, but rarely, produces epicormic branches with corky wings; but, as a rule, the branches of all parts of the tree, as well as the suckers, are not suberose. The suckers are produced very freely, with leaves and twigs more pubescent than those of adult trees. It rarely bears¹ good seed in England; but in 1909, out of about twenty lots of seed gathered in different places in the south of England, I raised one seedling from a tree at Cambridge, two seedlings from a tree at Bayfordbury, and one seedling from a tree in the Isle of Wight.²

VARIETIES

1. Var. *australis*, Henry.

A tree, often pyramidal in habit, with short branches. Branchlets similar in pubescence to the type. Leaves (Plate 412, Fig. 17) thick and firm in texture, oval, 2 to 3 in. long, $1\frac{1}{4}$ to $1\frac{3}{4}$ in. broad, with a longer and more cuspidate acuminate apex than in the type; scabrous and pubescent above; lower surface densely pubescent, the pubescence conspicuous on the midrib and nerves, with axil-tufts not so well developed as in the typical form of the species; lateral nerves about twelve pairs, very prominent beneath; coarsely biserrate in margin; petiole up to $\frac{1}{2}$ in. long, pubescent. Flowers similar to those of the English elm, but with pale pink sepals, anthers, filaments, and stigmas. Samaræ more obovate than orbicular, but rounded at the base and otherwise similar to the typical form.

This elm differs mainly from the English elm in the thicker texture of the leaves, which have more prominent nerves beneath. It appears to be distributed in the wild state in south-eastern France, Switzerland, and the Riviera. The small elms along the stream on the golf course at Cannes, some on the hills above La Mortola, and others of which I gathered specimens at Pertuis, in Provence, more closely resemble the English elm than any others which I have seen, in branchlets, leaves, and samaræ, but still are not identical. I have also received from Lord Walsingham specimens of this variety from trees growing at Venice;

¹ The English elm has long been known to produce unfertile seed. W. Watkins, *Forest Trees*, 24 (1753), says "I could never find any seed worth gathering on the English elm"; and proceeds to give directions for layering, which he preferred to propagation by root-suckers.

² Loudon, *Arb. et Frut. Brit.* iii. 1384 (1838), states that Masters raised in 1817, from the seed of a common English elm at Lea Park, near Canterbury, a considerable number of seedlings, which comprised about twenty distinct varieties. In all probability this tree was a hybrid. All the elms, however, now standing in Lea Park, judging from copious specimens which I received in 1910, appear to be English elms.

and it probably exists farther to the south and east, as it seems similar to an elm¹ found by Baldacci in mountain woods near Spizza in the extreme south of Dalmatia.

Var. *australis* is occasionally planted in botanic gardens in France, as at Le Mans and Bordeaux; but it seems rare in cultivation. I refer to this variety the elms in the avenue of the Cours-la-Reine, Rouen, which is said to have been planted in 1649 by the Duke de Longueville. The best of these trees still remaining were about 90 ft. by 9 ft. in 1912.

2. Var. *variegata*, Dippel, *Laubholzkunde*, ii. 25 (1892).

Ulmus campestris, var. *foliis variegatis*, Loddiges, *Cat.* 1836, ex Loudon, *Arb. et Frut. Brit.* iii. 1376 (1838).

Leaves striped and spotted with white. This is a very ornamental tree, no doubt of English origin,² as it agrees with the English elm in all its essential characters. So far as I know it never produces fruit. There are two good trees about 50 ft. high at Kew. A fine specimen at Moor Park, Rickmansworth, which was 65 ft. by $7\frac{1}{2}$ ft. in 1910, produces suckers with variegated leaves. Elwes saw, in 1909, a tree 83 ft. by $7\frac{1}{2}$ ft. at Campsea Ashe in Suffolk, also with variegated suckers. These are said to lose their colour if transplanted. Another at Kenwood, without suckers, was 75 ft. by 7 ft. 2 in. in 1909.

U. picturata, Cripps, ex Simon-Louis, *Cat.* 1880, p. 66, of which there is a small tree at Kew, does not appear to differ much from the preceding variety; but has larger leaves.

3. Var. *Van Houttei*, Schneider, *Laubholzkunde*, i. 220 (1904).

Leaves scabrous above and beneath, tinged with yellow. Branchlets pubescent with long hairs.³ The variety,⁴ which is known in catalogues as *U. campestris*, "*Louis van Houtte*," is represented at Kew by several trees about 20 ft. high, obtained from Waterer in 1894.

4. Var. *purpurea*, Petzold and Kirchner, *Arb. Musc.* 558 (1864).

Leaves 2 to $2\frac{1}{2}$ in. long, tinged purple, often folded, irregularly serrate. This is probably of hybrid origin, as it resembles *U. montana* in texture and roughness of surface, but has slender twigs and small leaves. It is grown at Kew under the name *U. montana*, var. *purpurea*.

5. Var. *purpurascens*, Schneider, *Laubholzkunde*, i. 220 (1894).

U. campestris myrtifolia purpurea, Louis de Smet, *Cat. No.* 10, p. 59 (1877).

Leaves small, about an inch long, scabrous above, pubescent beneath, tinged with a purple colour. Branchlets pubescent with long hairs. This is represented at Kew by a grafted tree, about 20 ft. high, obtained from Waterer in 1885.

¹ Var. *dalmatica*, Baldacci, in *Malpighia*, v. 79 (1891).

² Plot, *Nat. Hist. Oxfordshire*, 172 (1677), mentions a striped elm in Dorsetshire.

³ In *Gard. Chron.* xi. 368, fig. 77 (1887), an instance is given of the influence of scion upon stock, where this variety was grafted on *U. campestris* with ordinary green leaves, and the stock subsequently produced a variegated shoot below the graft.

⁴ The origin of this elm is unknown; but it may be the "yellow-leaved elm" referred to by Miller, *Cat. Plant.* 86 (1730), and *Gard. Dict.* ed. 1, No. 8, as "*Ulmus minor foliis flavescensibus*."

6. Var. *Berardii*, Simon-Louis. *Cat.* 1869, p. 96.

A small tree or shrub, with minute leaves, $\frac{1}{2}$ to $\frac{3}{4}$ in. long, firm in texture, deeply incised with a few teeth, almost glabrous; petioles, as well as the young branchlets, pubescent. This peculiar variety, with leaves somewhat resembling those of *Zelkova Verschaffeltii*, but smaller, was raised by Simon-Louis from seeds gathered in 1863 from the large elms growing on the ramparts at Metz. There is a specimen at Kew, about 10 ft. high, which was obtained from Späth in 1902.

At Kew there is a small tree raised from seed collected by me off a tree at Nancy in 1903, which has similar minute leaves, but scabrous above and pubescent beneath, and biserrate in margin. This is one of a number of seedlings raised from the same lot of seed, which differed extraordinarily in the size and other characters of the leaves, showing that the parent tree was a hybrid.

In the Kew herbarium there are remarkable specimens of an elm with minute foliage, which were gathered in Jersey by Oliver in 1874 and 1880, but of which I can learn no particulars. Mr. Miller Christy sent me in 1911 a branch with minute leaves of an elm, like a bush and only 4 ft. high, which grows close to the shore at the foot of the cliff at West Mersea, Essex. Elwes collected a similar specimen in a hedgerow between Bisterne and Ringwood.

7. Var. *viminialis*, Loudon, *Arb. et Frut. Brit.* iii. 1376 (1838).

Ulmus viminialis, Loddiges, *Cat.* 1836.

Ulmus antarctica, Petzold and Kirchner, *Arb. Musc.* 552 (1864).

A tree, with ascending branches, pendulous branchlets, and sparse foliage. Leaves (Plate 412, Fig. 22) incised on the margin with deep serrated teeth: about $1\frac{1}{2}$ to $2\frac{1}{2}$ in. long, obovate-elliptic or narrowly elliptic, often nearly equal at the base, long-acuminate at the apex, scabrous above, slightly pubescent beneath, with conspicuous axil-tufts. Young branchlets slightly pubescent.

This variety is said by Loudon to have been raised by Masters in 1817 from seeds of the common English elm; but it appears to me to be identical with the elm described by Plot¹ in 1677 as occurring in avenues at Hanwell, "where there is a whole walk of them planted in order, besides others that grow wild in the coppices of the park." Plot describes this elm as having a narrow leaf with a peculiar kind of pointed ending, and his figure is unmistakably that of var. *viminialis*. Mr. Druce states² that the avenue at Hanwell is now composed of English elm.

The best tree of this variety that we know of is at Milton Abbey, Dorsetshire, the seat of Sir A. E. Hambro. It measured in 1906 71 ft. by 6 ft. 4 in., and resembled in habit the Cornish elm. A tree in the Cambridge Botanic Garden is about 70 ft. high. There are three trees³ at Kew, two about 35 ft. high, which are labelled var. *viminialis*, and are of unknown origin, but evidently of considerable age; and one precisely alike in foliage, but labelled *U. campestris antarctica*, which was obtained

¹ *Nat. Hist. Oxfordshire*, 158, plate x. fig. 1 (1677).

² In *Gard. Chron.* 1. 408 (1911). Druce's identification of Plot's elms with the tree (which he calls *U. Plotii*) now growing at Banbury and elsewhere is, in my opinion, erroneous. Cf. Moss, in *Gard. Chron.* li. 234, figs. 104-106 (1912). Cf. also p. 1901, note 3.

³ Another tree at Kew, 18 ft. high, which was obtained from Osborne in 1879 and is labelled var. *betulaefolia*, scarcely differs from var. *viminialis*.

from Volxem in 1879, and is now about 35 ft. high. There are also fair specimens at Bradwell Grove (Oxon), Highnam, Tortworth, and Weston Birt. At Gissselfelde, Denmark, a fine tree is about 60 ft. high.

8. Var. *viminialis aurea*, Henry.

Ulmus Rosseelsii, Koch, *Dendrologie*, ii. pt. i. 412 (1872).

Ulmus campestris, var. *aurea*, Morren, *Belg. Hort.* 1866, p. 356, coloured plate; Lemaire, *Illust. Hort.* 1867, t. 513.

Ulmus campestris, var. *antarctica aurea*, Nicholson, in *Kew Handlist Trees*, ii. 135 (1896).

This is a sub-variety¹ of var. *viminialis*, in which the leaves are variegated with yellow. It appears to have originated about 1865 in Rosseel's nursery at Louvain; and is represented at Kew by a grafted tree about 20 ft. high.

9. Var. *viminialis marginata*,² Petzold and Kirchner, *Arb. Musc.* 556 (1864).

Var. *viminialis variegata*, Nicholson, in *Kew Handlist Trees*, ii. 137 (1896).

This is similar to var. *viminialis*, but the leaves are variegated with white. There are good specimens at Bayfordbury and Beauport, and a shrub at Kew about 10 ft. high. At Hamwood, Co. Meath, Elwes saw a tree about 30 ft. high in 1910.

DISTRIBUTION

The "English elm," by which name this species is usually known, is a native of southern England, growing in hedgerows, where it reproduces itself only by suckers. It is common in the Thames valley, extending southwards to the Isle of Wight, where it is abundant, and westwards to Devonshire, whence it ascends the Severn valley through Somerset and Gloucester to Worcester and Warwickshire, and the Wye valley to Herefordshire. It is unknown, except as a planted tree in the east of England, where it is replaced mainly by *U. nitens*; and is totally absent from Cornwall, where it is replaced by the Cornish elm.

This tree on account of the rarity with which it produces fertile seed, has been supposed to be not indigenous; and some writers, without any evidence, have asserted that it was introduced by the Romans. It is unknown in Italy, where the elm on which the vines are trained is quite a distinct variety.³ So far as I can ascertain, it has not been seen in the wild state anywhere but in England; though an allied form occurs in the south-east of France.

The English elm has been largely planted in royal parks and public gardens in Spain. Evelyn,⁴ speaking of this tree, states: "Those incomparable walks and vistas of them at Aranjuez, Casa del Campo, Madrid, the Escorial, and other places of delight belonging to the King and grandees of Spain, are planted with such, as they report Philip the Second to be brought out of England; before which (as that most honourable person the Earl of Sandwich, lately his Majesty's Ambassador

¹ It was exhibited at the London Horticultural Society in 1868 by Lee (*Gard. Chron.* 1868, pp. 914, 1038).

² A specimen of this in the Sherard Herbarium, Oxford, was gathered in the Chelsea Physic Garden in 1713.

³ Cf. *U. nitens*, var. *italica*, p. 1892.

⁴ *Sylva*, 33 (1679). The plantation of elms at Aranjuez is further described by Evelyn, *Sylva*, 303 (1706).

Extraordinary at that Court writ to me) it does not appear that there were any of those trees in all Spain. In that Princely Seat it is, that double rows of them are planted in many places for a league together in length, and some of them forty yards high." Philip II. created Aranjuez a royal residence in 1575, and probably planted the elms about this date.

I visited the Royal Park at Aranjuez in 1911, and found many fine avenues of elms, the largest trees measuring 100 to 120 ft. in height, and 12 to 16 ft. in girth. These differed in no respects from the English elms in Windsor Park or other places in England; and their deeply-furrowed dark-coloured bark has caused this species to be known in Spain as *olmo negro*. None of the trees which I saw looked old enough to date back to the reign of Philip II.; but I was informed that a very old tree which died and was removed in 1910, had a trunk 30 ft. in girth. This was probably one of the three ancient elms¹ noticed here by Lady Holland in 1803.

At Aranjuez, situated at a low altitude in a warm climate, on the banks of the Tagus, the English elm produces every year fertile seed in great abundance; and numerous seedlings were observed by me in a nursery in the park. At Madrid, on a plateau, 500 feet higher, with a cold temperature in spring, there are extensive groves of these elms in the Retiro Park; but the samaræ were empty and contained no seed, as is almost invariably the case in England; and M. Hickel noticed the poor seed on the elms of the same species at Toledo. Farther south in Spain, the English elm probably produces as good seed as at Aranjuez; and the prevalence of this tree in Spain must be due to the ease with which seedlings can be raised.

A large quantity of seed from the English elms in the Royal Park at Aranjuez was sent to me in May 1911, and sown immediately at Cambridge. In spite of the great drought, I raised numerous seedlings, which are very uniform in character, all having opposite leaves, indicating a pure species.

It is possible that the tradition of the introduction of the English elm into Spain from England is incorrect; and that this tree may be a true native of Spain, indigenous in the alluvial plains of the great rivers, now almost completely deforested. As explained under *U. nitens*, var. *italica*, the elm, which occurs wild in the mountains of Spain has different foliage, and it is readily distinguished by its light grey-coloured bark.

(A. H.)

CULTIVATION

The English elm is, so far as we are able to judge after careful study of the genus at home and abroad, a variety peculiar to the southern parts of England,² where it

¹ Cf. Earl of Ilchester, *Spanish Journal of Elizabeth*, *Lady Holland*, 73 (1910), where mention is made of three venerable trees ("either elms or oaks") in front of a small hunting villa built by Charles V. in the garden at Aranjuez. These, according to oral traditions, were said to have been planted by the Emperor Francis I. during his captivity, and by Philip II. Two were flourishing, but one was in a piteous state in 1803.

² We have never seen any specimens from the Continent which are identical with this species, except those planted in Spain which are mentioned above.

has grown in hedgerows from the earliest historical times in great abundance, and has propagated itself by suckers only. We can distinguish it from the other elms by its erect habit, by the rarity of suberose branches, by its dark red heartwood, and especially by the late period to which it holds its leaves, and by the bright golden colour which they assume, in seasons when the elms of all other varieties are comparatively dull in colour. This latter character is constant on all soils and, so far back as I can remember, in all seasons. Two reasons may be suggested to account for its rarely producing seed. One is that reproduction by suckers during a very long period has diminished its floral fertility.¹ The other that being here at the northern limit of its range (if it is a true native of Spain), the seasons are rarely warm enough. Whatever may be its origin, it is one of the finest and most characteristic trees of those parts of England where it thrives; and both from its economic and ornamental value deserves to be propagated in the only way it can be kept true, either by suckers or by layers from stocks of the best type.

So far as we know there is no nursery in this country which has so produced it for many years past, and the results are only too evident in the elms which are now growing in almost all modern places. Soil no doubt has a material influence on the growth of this as of other trees, and a rather heavy and deep soil is necessary to bring it to perfection, but even on the thin dry oolite of the Cotswold hills, the true English elm retains its characteristics, and though slower in growth attains a greater height and bulk than any other tree, except perhaps the beech and the wych elm.

Its true value as a landscape tree may be best estimated by looking down from an eminence in almost any part of the valley of the Thames, or of the Severn below Worcester, during the latter half of November, when the bright golden colour of the lines of elms in the hedgerows, is one of the most striking scenes that England can produce.

Its economic value is also much greater than has been generally realised, for a tree that will, on grassland, of only moderate quality, without detriment to the adjoining pasture, and without any outlay but a moderate attention in trimming the lower branches, produce a log worth from £4 to £5 in a hundred years or less, cannot be ignored as an important element in the value of all grazing districts.

No author that I know has written on the propagation of the elm with so much personal knowledge as William Boutcher, nurseryman at Comely Garden, Edinburgh (now Comely Bank Nursery), whose *Treatise on Forest Trees*, first published in 1775, contains more exact observation on nursery work than most recent books. The elm was a great favourite of his, and I believe that if his advice had been more generally followed, the elms produced during the last century by nurserymen would be much finer than they generally are. Though observant woodmen know that the best and

¹ This is very unlikely, as the English elm in Spain produces ripe and fertile seed in abundance, yet suckers there very freely. Moreover, *U. nitens*, which suckers quite as much as the English elm, produces good seed in abundance in favourable years.

straightest timber trees are those naturally produced in hedges from suckers, yet the practice of budding or grafting elms on the stock of the wych elm has become so general, that I do not know a single commercial nursery in England to-day where true layered English elms can be procured; and though nurserymen assert that the budded trees will produce equally fine specimens, yet one has only to compare the younger trees planted in the last hundred years with the older ones, to see how inferior they generally are.

This practice, however, was recommended as long ago as Miller's time on the grounds mentioned by Hunter, in Evelyn's *Silva* 124 (1776), as follows:—"The practice of grafting will be found a valuable improvement of the English elm, if we consider the nature of the wych elm on which it is grafted. First the wych elm will not only grow to the largest size of all the sorts, but will grow the fastest. This is not to be wondered at, if we examine the root, which we shall find more fibrous than in any of the other elms. Now as all roots are of a spongy nature to receive the juices of the earth for the nourishment and growth of the tree, that tree must necessarily grow the fastest, whose root is most spongy and porous; and therefore the English elm being set upon the root of the wych will draw from the earth a greater quantity of nutriment. The English elm on this basis, will arrive at timber many years sooner than those raised by layers, and be also forced to a greater size."

Boutcher says:¹ "The English elm grafted on the Scots makes both a beautiful and valuable tree, yet it is still inferior in regularity of form, and loftiness of stature, to those raised from their own mother, and as every tree must in some measure partake of the stock on which it is grafted, so this has a near resemblance of the Scots elm in its bark even when young, and when old, like them, grows more loose spreading and less erect than the true English, though when young they are extremely beautiful. Here it may be necessary to observe a practice extremely common among ignorant nurserymen, which is cutting their English elm grafts from those on Scotch stocks, and which, indeed, have the fairest and plumpest buds (a plain indication from whence they immediately proceed, the buds of the Scotch being larger and more turgid than those of the English), but these gentlemen do not regard the quality of the plants they sell, so they are paid for them, or are ignorant that by repeating this practice the English elm may be brought so far to degenerate, as in many graftings this way, to differ very little from the Scots; therefore, whatever kind the stocks are on which you graft the English, let the grafts be taken from trees of the true kind, raised by layers of their own mother. This, however little attended to, nature plainly dictates." Further, he goes on to say: "It may also be proper to notice here that all elms planted in gardens and by the sides of walks, lawns, or avenues, ought to be on Scots stocks, as these produce no suckers, which the English, French, or Dutch do in such quantities as to make it very troublesome and expensive keeping such places clear of them and in good order."

The whole of Boutcher's article on the elm is so valuable that it should be studied by anyone wishing to plant elms.

¹ *Treatise on Forest Trees*, 12-13 (1784).

Many persons at the present time are anxious when planting to obtain quick results; yet the planting of an avenue is an operation which cannot be hurried, or let by contract to persons who have no future interest in it. No doubt the nature of the soil has much influence on the growth and habit of the tree, but even in poor, dry calcareous soils the difference between the old trees grown from suckers in hedges and the trees bought from nurseries is so great that no one can mistake them.

It also frequently happens that elms are budded on stocks raised from seedlings of foreign origin, and these vary so much in their habit and origin, and are usually so much inferior to the true English elm that the results are what we usually see in modern plantings. There is no better proof of this than the young trees planted to fill the gaps in the Long Walk at Windsor, which are a lamentable illustration of carelessness in the propagation of elms.

No tree possesses the power of suckering¹ to a greater extent than the English elm, the roots often extending 50 yards or more; and in order to procure a quantity of young plants, it is only necessary to shut up a small field surrounded by elms of good type, and transplant the most vigorous suckers into a nursery, where they can be pruned and cultivated until 6 to 10 ft. high; or if desired to have them larger they may be transplanted every two or three years and safely moved when as much as 15 or 20 ft. high.

Mr. Knight published² in 1840 a method of propagating elms by using, as cuttings, slender shoots which were pulled out from the trunk near the ground, and then reduced to about an inch in length, with a single leaf at the apex.

If, however, it is desired to produce new varieties, the raising of elms from seed is a very simple matter, provided that the seeds are sown as soon as they are ripe, when they germinate in a few days, and make strong plants in the first year. The variation of most elms that I have sown, except the wych elm, is very great, and natural cross-fertilisation no doubt accounts for this.

The leaves do not show their true character at first, and it would be difficult to judge of their fitness for planting until they have attained a considerable size. If good timber trees are wanted, no variety surpasses the true English elm on its own roots in its own district. For the maritime climate of south-western England, Scotland, and Ireland I would recommend the true Cornish elm on its own roots. For Scotland, and the North of England, Boutcher was probably right in preferring trees of a good local variety budded on the stock of seedling wych elms, but never on that of imported seedlings.

The bark of dead or sickly elms will usually be found to contain the elm-bark beetle (*Scolytus destructor*) in one stage or another. Whether this insect attacks healthy trees has never yet been satisfactorily determined; and the remarks on this point of Dr. T. A. Chapman, an entomologist whose actual experience of Scolytidæ

¹ In *Gard. Chron.* 1872, p. 603, fig. 504, an article by the late W. Ingram, gardener at Belvoir Castle, has a figure showing the extraordinary root-development of an elm growing on the edge of a quarry.

² Loudon, *Gard. Mag.* xvi. 474 (1840).

is probably greater than that of all other English writers on the subject, seem worth quoting. He says:¹ "I do not remember having seen a *felled* elm trunk that *S. destructor* had not attacked, frequently whilst still trying to throw out shoots; yet I have never seen a trace of it in healthy growing trees; these are supposed to resent and repel the attacks of the *Hylesinidae* by pouring out sap into their burrows; and, in the case of *S. pruni*, I have observed burrows less than an inch long, some of which, containing a few eggs already laid, had been abandoned uncompleted by the beetles, apparently on account of the presence of a fluid which must have been sap, as no rain had fallen to account for it; these burrows had been formed in bark that was still nearly healthy, though near some dying bark which had doubtless attracted the beetles." The following is an account of Mr. J. Edwards' experience. Some years ago a large and apparently sound limb of a big elm at Colesborne was broken off, and it was allowed to remain where it fell. This fallen limb in due course showed traces of attack by *Scolytus*, of which, judging from the number of holes in the bark, there must have been some thousands. Up to the present no signs of *Scolytus* can be seen on the tree, which could not have been the case if any of the beetles bred in the bark of the fallen limb had established themselves either in the trunk or the main branches. As a preventive measure it has been recommended² that the bark be smeared with a fermenting mixture of cow-dung, slaked lime, bullock's blood, and tobacco; but I am inclined to think that steps calculated to maintain or increase the vigour of the tree would be more likely to succeed than any bark-dressing whatever. With the view of lessening the numbers of this pest, sickly trees and felled timber, as well as fallen limbs, should be got rid of without delay.

The branches of old elm trees are liable to fall³ without warning in calm weather, especially after heavy rains. Though in some cases the branches have been weakened by fungoid attacks, there is no doubt that in other cases the tree was quite sound when the branches fell. Many fatal accidents have been reported from this cause, as at Powis Castle⁴ in 1899, and in Kensington Gardens a few years ago. The English elm seems to be more liable to drop its branches than any of the other kinds.

ELM AS A WOODLAND TREE

The elm has seldom been considered by writers on forestry as a woodland tree in this country, and is rarely found in plantations⁵ except scattered among other trees. I have seen, however, at several places in the Midlands small areas of

¹ *Entomologist's Monthly Magazine*, vi. 127 (1869-1870). An interesting account of the ravages of this beetle was given by W. S. Macleay, in an article entitled "Abstract of a Report on the State of the Elm Trees in St. James's and Hyde Parks," which appeared in *Edin. Phil. Journ.* xi. 123 (1824).

² W. R. Fisher, Schlich's *Manual of Forestry*, iv. 278 (1907).

³ Cf. correspondence in *Gard. Chron.* xxxviii. 119, 134, 252, 268, 331 (1905), and xxxix. 11 (1906).

⁴ *Gard. Chron.* xxv. 340 (1899).

⁵ In the Forest of Dean, a mixed larch and oak plantation, aged 39 years, in which there were a few English elms, showed the following average measurements taken by Mr. A. P. Long in 1911: larch, 59 ft. high, 41 in. girth; English elm, 54 ft. high, 37 in. girth; oak, 40 ft. high, 26 in. girth.

almost pure elm, probably grown from suckers, which convince me that on suitable soil and near a good market it might prove to be one of the most profitable forms of woodland.

At Brampton, near Huntingdon, I saw on the roadside a belt of elms of moderate quality which stood thick on the ground, and am indebted to M. D. Barkley, Esq., of Huntingdon, for the following particulars:—"The elm belt at Brampton contained 1 acre and 30 poles; there were 330 trees containing 8750 feet of timber. These were left much too thick on the ground to develop properly." I should expect on land worth 20s. to 25s. per acre, in the vale of Gloucester, or on the Oxford clay, about 6000 to 8000 cubic feet per acre from elms grown from suckers that had been properly trimmed, and this should be produced in from 70 to 100 years, according to the quality of the land. Assuming only 9d. per foot to be the price, such a crop would realise £250 to £300 per acre at 100 years, and no other tree except black Italian poplar would be likely to approach this result.

A good system on those properties which are managed systematically in elm-growing districts is to leave in every chain of hedgerow two or three of the best suckers to grow into timber; and these are carefully trimmed every few years to prevent their branches from spreading, and are felled when they contain 50 to 100 feet of timber. Such hedgerow trees are not detrimental to grass land, and produce a sum equal in some cases to 15 or 20 per cent of the rent of the land adjoining.

With regard to the elm as a forest tree on the Continent, Huberty is of opinion that it can only be cultivated profitably on fresh fertile soils, and in situations where it can extend both its branches and its roots without hindrance. *U. montana* is less exacting in its demands on the soil than the other species, and is extremely hardy, having been unaffected by the severe spring frost (-4° Cent.) which severely injured, in the Ardennes on May 26-27, oak, ash, chestnut, Robinia, and larch. *U. montana* keeps pace in youth with the beech, though eventually it is suppressed by the latter in the Forêt de Soignes. The elm is liable to be split by severe frost, when the trunk is exposed by a fall of timber. It requires light and room when it passes the youthful stage. Mouillefert says¹ that the elm, which he calls *U. campestris* (but which is *U. nitens*), forms nearly pure groves in the woods attached to the Agricultural School at Grignon; while Fliche states² that it forms a considerable proportion of the forests in the valleys of the Saône and Adour.

REMARKABLE TREES

Loudon says that the oldest trees on record are perhaps those at Mongewell Park in Oxfordshire, once the property of the Bishop of Durham, but the figure of these in Strutt's work (*Sylva Britannica*, plate xvi.) shows that they were neither

¹ *Essences Forestières*, 160 (1903).

² In Mathieu, *Flore Forestière*, 300 (1897). Cf. p. 1897.

very large nor very old. Of other very old trees mentioned by Loudon the Crawley elm, also figured by Strutt (plate xxii.) is perhaps the finest remaining. It stands in the Brighton road at one end of the town, and was in 1838, 70 ft. high and 61 ft. in girth at the ground. It was then hollow, and measured 31 ft. round the inside, which was closed by a door, and it is said that a poor woman once gave birth to a child in the hollow tree. Now it is a venerable wreck with some living branches; but the great swelling at the base which formed its immense girth is much decayed, and owing to the suckers which have sprung from the ground round it, it is difficult to measure. Miss Smith, who lives opposite the tree, told me that in her youth she had seen twelve people seated at tea in the hollow trunk. The other English elm figured by Strutt, which grew at Chipstead in Kent, was not a very large tree, and died soon after he drew it. None of the other elms mentioned by Loudon seem to have been as large as several which I have measured, as will be seen in the following list drawn up in the alphabetical order of the counties:—

In Bedfordshire there are fine trees at Woburn Abbey and Wrest Park, but most of the big elms in this county are *U. nitens*.

In Berks the best that I have seen are in Windsor Park, where the "Long Walk," leading from the Castle gates to the statue, is still one of the finest and most imposing avenues in the world. I am indebted to Mr. W. C. Squires, who has charge of the trees in Windsor Park, for reading and correcting when necessary, the following account:—The planting of the Long Walk is ascribed by Menzies¹ to the example of Evelyn, who states that in 1664 he planted some land at Says Court with elms, "being the same year that the elms were planted by His Majesty in Greenwich Park." In 1670 Evelyn visited Windsor. "King Charles II.," he says, "passed most of his time in hunting the stag and in walking in the Park, which he was now planting with rows of trees." In 1678, 1679, and 1680, Evelyn was at Windsor again. In 1680 a survey of the land between the Castle and the Great Park was made, and the intervening fields were purchased at a cost of £1242:4:9. We may safely presume that the planting of the Long Walk was at once commenced. The distance from the Castle to the statue is $2\frac{3}{4}$ miles. There were originally 1652 trees. The distance between the two inner rows is 50 yards. The trees are 30 feet apart from each other in two lines also 30 ft. apart, perhaps rather too close for the health of the trees. At the end nearest the Castle the soil is loam from 10 to 15 feet deep overlying chalk, and here the trees have done well and are mostly still sound. Where they have room enough, as in the adjoining part of the Park, there are many really fine trees up to 120 ft. in height and 15 ft. or 16 ft. in girth; but farther on where the soil is clay overlying gravel, and beyond the double gates where it is heavy clay, the trees are much smaller, and many have died at various periods and been replaced with elms of varied character, many of which now are, and never will be anything but an eyesore. Previous to 1861 the condition of this part of the avenue had attracted attention, and a good deal of correspondence on the subject had taken

¹ *History of Windsor Great Park and Forest*, 17 (1864).

place, which will be found in the Report of the Commissioners of Woods to Parliament in March 1861.

Along the Thames valley throughout Berks there are abundance of splendid elms of the best type, but as far as I know none so large as exist farther west.

In Bucks, the same remarks apply to all the alluvial soil; and those in the playing fields at Eton must recall happy days to numbers of our readers, though like some of the older elms in the country they are decaying and being replaced by inferior grafted trees. The two best trees in 1907 were, 113 ft. by 17 ft. 8 in. and 115 ft. by 17 ft. 3 in., as measured by Henry.

In Cambridgeshire we are out of the region of native English elms, but there are some of good size in the College Backs at Cambridge. Two of the largest, which grew in the grounds of St. John's College, and were known as the Sisters, were blown down in the great gale of 14th October 1881. These were recorded at the time by Mr. J. W. Clark,¹ as 10 ft. in girth, and about 130 ft. in height to the topmost branches. Prof. Hughes² counted 218 rings on the base of one of the fallen trunks, showing that these elms were planted a few years after the College grounds were laid out, as is generally supposed, in 1630. Perhaps the finest English elm now at Cambridge is in the grounds of King's College, which measured 130 ft. by 13 ft. in 1906.

In Cheshire the only fair elms that I have seen are in the park at Eaton Hall; but I must confess that I have unduly neglected this county, where, perhaps on account of the soil, trees do not generally attain a large size.

In Cornwall true English elms are rare, if not entirely absent, all those which I have seen being of other species.³

In Cumberland, and in Derbyshire we are too far north to see this tree at home, but there are some fine trees in Kedleston Park.

In Devonshire there are many splendid elms, among which I have seen none finer than those at Powderham. Plate 404 shows a tree which, in 1902, when it was photographed for this work, measured 125 ft. by 22 ft., but when I revisited Powderham in 1906, it had lost a large limb.

In Dorsetshire the finest elms I know of are at Melbury, where a row of seven, known as the Seven Sisters, stand in front of the house, on what was described by the gardener as a thin, but evidently a very fertile soil. The centre tree in this row measured 130 ft. by 17 ft. 10 in. in 1906.

In Essex⁴ there are great numbers of this elm, which may be called the prevalent tree of the county, and it is difficult to select the finest. Mr. J. C. Shenstone

¹ In *Cambridge Review*, 26th October 1881.

² In *Comm. Antiq. Soc. Cambridge*, xxiv. page xxxix (1884).

³ Cf. pp. 1884, 1889.

⁴ Holinshed, *Chronicles*, ii. cap. 22 (1586), says:—"Of elme we have great store in everie high waie and elsewhere, yet have I not seene there of anie together in woods or forrests, but where they have bene first planted and then suffered to spread at their own willes. Of all the elms that ever I saw, those in the south side of Dover Court, in Essex, near Harwich, are the most notable, for they grow in such a crooked maner, that they are almost apt for nothing else but navie timber, great ordinance and beetels: and such thereto is their naturall qualitie, that being used in the said behalfe, they continue longer, and more long than anie the like trees in whatsoever parcell else of this land, without cuphar, shaking, or cleaving as I find."

tells me that in the avenue at Earls Colne he measured a hollow tree 124 ft. by 24 ft. 4 in., but I cannot be sure that this is a true English elm. At Boreham House there is a fine avenue leading to the main road from London to Chelmsford, in which Mr. Shenstone in 1890 measured a tree 132 ft. by 20 ft. which he considered to be the tallest in Essex; but when I was there in 1907 I could find none taller than a double-stemmed tree of which the one half was 125 ft. by 17 ft. and the other broken off at about 25 feet was 23 feet in girth. Nearer the coast elms grow to a great size on the fertile brick earth, but usually are either *U. major* or *U. nitens*.

Gloucestershire holds the record for the tallest elms that I know of, which are at Forthampton Court, near Tewkesbury, the seat of the late J. Reginald Yorke, Esq. A tree, of which I saw the stump, was blown down in March 1895, and was reported by Mr. French, the gardener, in the *Gardener's Magazine* for 6th April of that year, to have been 150 ft. by 20 ft., as measured on the ground with a tape. Mr. Yorke confirmed this statement, assuring me that it was considerably taller than one which I measured in 1906 at the same place, and found to be about 140 ft. by 20 ft. A butt covered with ivy, about 23 ft. in girth over bark, is broken off about 30 ft. high; and its top is said to have been 40 yards long as it lay.

At Badminton there are two immense elms close to the kennels, the largest of which measures 30 ft. in girth or 26 ft. if taken below a large burr. An immense limb has broken off low down; and the top of this tree as well as that of its neighbour, which is 24 ft. in girth, were blown off many years ago. There are many other fine elms and oaks in the park here, but I saw none of equal girth to the one above mentioned.

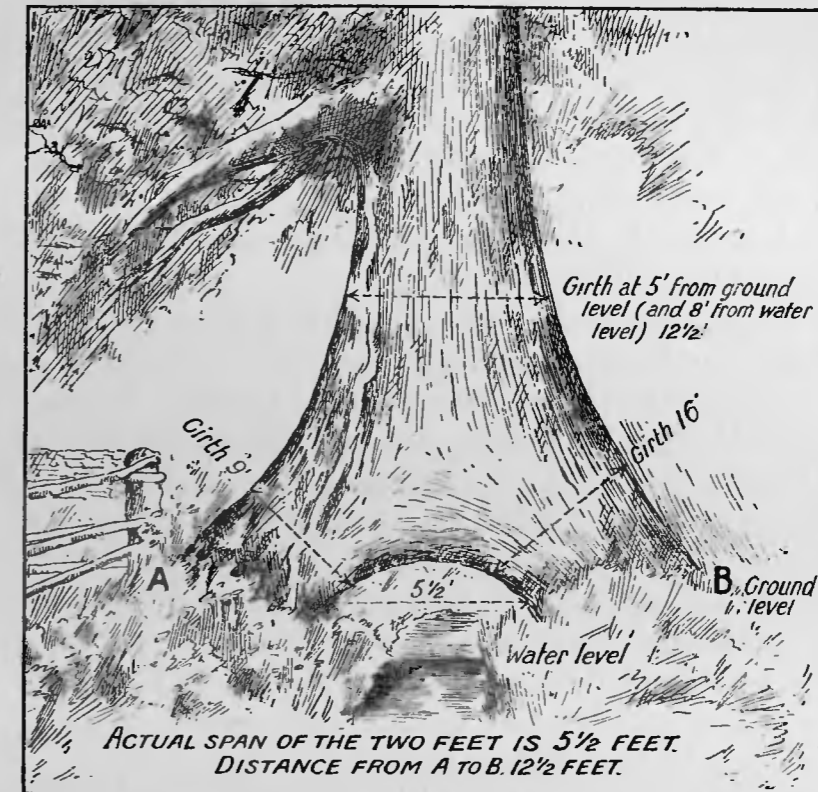
A splendid old elm, of which Col. Thynne has sent me a photograph, grows near Thornbury Castle, and measures 93 ft. by 27½ ft. Elms containing from 600 to 1000 cubic feet of timber are mentioned by timber merchants as having been felled on several occasions in the vale of Gloucester. The tree mentioned by Loudon under the name of Piffe's Elm, which he says was in 1783 the largest tree in Gloucestershire, was quite small in comparison with many now living. I saw two blown down at Sandywell Park, the seat of C. W. Lawrence, Esq., which each contained over 600 feet.

In the valley of the Coln, close to an old Manor House called Compton Casey, belonging to the Earl of Eldon, there are eleven (formerly twelve) fine elms growing in a row only 90 yards long, which average 13½ ft. in girth and about 115 ft. high. The largest is 16 ft. 9 in. in girth.

At Cirencester, at Ampney, at Williamstrip, at Barnsley, and other places, there are many large trees, which have, as they grow old, a tendency to become very burry at the base, but on the more brashy soil of the Cotswolds they rarely exceed about 110 ft. by 15 ft.

At Huntly Manor, Gloucestershire, the seat of B. St. John Ackers, Esq., there is a remarkable tree of which the text-plate gives a better idea than any description. The watercourse when I saw it in September 1910 was nearly dry, but runs freely

most of the year. Mr. Ackers tells me that if you put a ferret into the root on one side, it can pass through and come out on the other, which shows that the butt is partly hollow, though the tree looks sound and is about 100 ft. high. It is difficult to explain the origin of this curious freak.



In Hampshire the fertile valleys are full of big trees; but on the chalk they are of a more stunted character, and are often *U. major*. The largest true English elm in this county was recorded in 1887 at Broadlands, near Romsey, and, according to Mr. J. Smith of that town, was 110 ft. by 24½ ft.

Herefordshire, though not so remarkable for the size of its elms as for its oaks, is full of fine trees, some of which were recorded by Dr. Bull in the volume of the *Woolhope Transactions* for 1868; and in later volumes other elms are mentioned at Croft Castle and Longworth. The largest I have measured is in the deer park at Hampton Court, a tree with two trunks from the same root, girthing 20 ft. and 16 ft. respectively, and 125 ft. in height in 1908.

The elms of Hertfordshire are mostly of the glabrous-leaved species, and are described under *U. nitens*; but the finest English elm I have seen is in Hatfield Park, and measured in 1905 120 ft. by 20½ ft. The girth in 1911 was found by Mr. Barton to be 21½ ft. At Bayford Church there is a fine tree, apparently quite sound, which was measured by Mr. H. Clinton-Baker in 1911 as 110 ft. by 18 ft. 9 in. Near Bayford Lodge another is 93 ft. by 21 ft. 9 in.; and a record exists that this tree had a girth of 17 ft. 1 in. in 1813.

Kent has a great variety of elms, which appear to be mostly of a different type to those of the Thames and Severn valleys, and as a rule are planted in parks and

pleasure grounds, and not natural in the hedgerows. The best that I have measured is one at Eastwell Park, which in 1907 was 115 ft. by about 20 ft. in girth.

In Lancashire, Leicestershire, and Lincolnshire I have not seen any English elms remarkable for size or beauty. The majority of the trees in these counties look more like hybrid seedlings of foreign origin than true English elms.

On November 23, 1910, I saw at Well Vale, Lincolnshire, the seat of Mr. W. H. Rawnsley, some English elms (Plate 405) which had preserved their leaves quite green after several nights of frost, when the thermometer sank to 17° Fahr. These elms, one of which measured 108 ft. by 8 ft. 2 in., seem to have been grown from suckers; and though they retain their leaves abnormally late in the season—in 1911 till the first week in December—they are English elms, and differ entirely from the Kidbrook elm referred to, p. 1896.

In Middlesex, and all round London, the majority of the elms appear, like those of the London parks, to be foreign seedlings or hybrids; and Loudon did not record a single one of any great size which seems to exist at present, though he gave many details of trees at Hampstead, Fulham, and elsewhere. Though there are many large English elms at Hampton Court, Richmond, Syon, and in Kew Gardens, they seem to be suffering more or less like those in Hyde Park from smoke and old age, and none of the younger trees which have been supplied from nurseries to fill their place appear likely to develop into first-class elms. The tallest that I have measured is at Chiswick House, and this in 1904 was a healthy sound tree 137 ft. by 12½ ft. Another in the grounds of Fulham Palace is 120 ft. by 18 ft. Henry saw one at Hampton Court, with a broken top, girthing 27 ft. 9 in. in 1910; and another at Osterley Park, 108 ft. by 16 ft. 4 in. in 1907.

In Monmouthshire and in South Wales generally, though elms are common enough they are no longer a characteristic hedgerow tree.

In Norfolk I cannot remember to have seen a single really first-class English elm, most of the hedgerow trees being either *U. nitens* or the small-leaved elm (*U. minor*), which, so far as I have seen, is usually a comparatively small and ill-shaped though picturesque tree. Marshall¹ was, I think, not far wrong when he said that there was not, generally speaking, a good elm in the county of Norfolk; and the only elm mentioned by Grigor of great size was what he calls an English elm over 20 ft. in girth.

In Northamptonshire, where oak and ash grow so well, I have seen few very striking elms; and the same may be said of Nottinghamshire, where in the beautiful parks of Thoresby, Rufford, Welbeck, and Clumber they are not so conspicuous a feature as the oaks. At Althorp there are many splendid trees, three of which were measured in 1893 by Mr. F. Mitchell² as follows:—(No. 1) In the pleasure grounds, 117 ft. by 20 ft., with two stems, containing 924 ft. (No. 5) By the carriage drive, 105 ft. by 19 ft. 8 in., also divided, and containing 841 ft. (No. 17) West of Harleston House, 110 ft. by 18½ ft., containing 715 ft. I verified these measurements in 1904, and found that in eleven years they had made but little increase.

¹ *Planting*, ii. 431 (1796). Cf. Loudon, p. 1383.

² *Trans. Roy. Scott. Arb. Soc.* xiii. 90 (1893).

Oxfordshire may be called *par excellence* the county of the elm, and it would be hard to find a place in it, except in the barest parts of the Cotswolds, where they do not form a conspicuous feature of the landscape. Among the parks where they grow best the following may be mentioned:—Barrington, Blenheim, Cornbury, Fawley Court, Heythrop, Thame. At Brightwell Park, among a number of large old elms, I measured in 1905 two trees, 119 ft. by 17½ ft. and 110 ft. by 19 ft. respectively; and probably larger ones can be found. One of the oldest in this county is the "Tubney Tree" at a roadside meet of the Old Berkshire hounds, eight miles from Oxford. This has larger leaves than usual, but no suberose branches. Its trunk is 27 ft. in girth, and still fairly sound, and at about 20 ft. from the ground divides into five ascending limbs, which were topped about twenty-five years ago, and have thrown out many healthy branches. The Rev. H. J. Bidder of St. John's College has a water-colour drawing of this tree, made before it was topped. In Magdalen College Park at Oxford there are some very tall English elms, one being, in 1905, 134 ft. by 13 ft. 5 in.

In Shropshire, notwithstanding the splendid soil, the elms are not so large as the oaks; and in Somersetshire¹ I have neither seen nor heard of any elms of larger size than one in the park at Dunster Castle, which in 1904 measured 120 ft. by 22 ft. The same remarks apply to Staffordshire and Suffolk.

Surrey and Sussex are more remarkable for conifers than for elms, and my local knowledge is not enough to enable me to indicate where the finest elms are to be found. Among the innumerable residences with which these counties are so thickly studded, no part of England would better repay the researches of any one interested in trees; and we have probably missed some of great rarity, though we have visited a great number of places in these counties. Henry measured in 1905 in Betchworth Park, near Dorking, an English elm 122 ft. in height and 23 ft. in girth.

Warwickshire and Worcestershire are, like Oxford and Gloucester, renowned for large and fine elms. Loudon recorded at Coombe Abbey a tree, 150 ft. high and 28½ ft. in girth, which I fear no longer exists, as I could find none nearly as large now standing at that place.

In Mr. Berkeley's park at Spetchley, near Worcester, there are great numbers of large trees, about 200 years of age. I measured one 108 ft. by 21½ ft.; another 127 ft. by 14 ft.; and in front of the house, one with very large spreading branches, 125 ft. by 20 ft. The largest in girth was 22 ft. 8 in., broken off at about 20 ft. up. At Ombersley Court, 6 miles north of Worcester, Lord Sandys showed me the remains of a huge tree, only the ivy-covered stump of which is left, and measures about 23 ft. in girth. From it about 1700 ft. of timber was sold; and I was assured by Mr. Groom of Hereford that this tree contained 2000 ft. of timber. A little way off I measured a tree, which is perhaps the largest sound English elm now standing, and which I found to be 130 ft. high by 23½ ft. in girth; another in the park was 125 ft. by 21½ ft.

¹ Babbage, in Loudon, *Gard. Mag.* xvii. 356 (1841), and xviii. 488 (1842) gave particulars of English elms at Nettlecombe Court—one, only eighty years old, having a clean trunk 32 ft. long, with a middle girth of 12 ft., containing 200 cubic ft. of timber; and another, sixty-nine years old, containing 360 ft. in the trunk, and 120 ft. in the top and branches.

Wiltshire, like the adjoining counties, is full of elms, which attain a large size where the soil is deep. The best that I have measured is at Corsham Court, close to the house, and was 123 ft. by 20 ft. in 1905.

In Yorkshire I have seen no remarkable English elms, even at Castle Howard or Studley, where the wych elm grows to perfection; but in the finer soils of this great county there are no doubt many good trees which we have not heard of.

In Wales the best place for English elms that I know is at Maeslwyd, near the borders of Herefordshire, in the rich valley of the Wye, where there is an avenue containing many fine trees, which attain 110 to 120 ft. in height. In south Wales, where the demand for elm timber is probably greater than anywhere in England, I have seen none worthy of special notice; and in central and north Wales the wych elm is the prevalent species.

In Scotland we know few English elms¹ of importance; but Mr. Renwick measured two trees at Loudon Castle, Ayrshire, 107 ft. by 15 ft. 4 in., and 105 ft. by 16 ft. 4 in., in 1908; and at Milton Lockhart, Lanarkshire, a tree 90 ft. by 15 ft. 1 in. in 1911. Most of the elms in Scotland are *U. montana*.

In Ireland I find no records in my journals of true English elms, except at Adare, the seat of the Earl of Dunraven, where, on the river bank, the finest English elm I have seen in Ireland, was about 120 ft. by 13½ ft. in 1909. There is a beautiful tree at Riverview, Ferrybank, Waterford, of which Mr. T. A. Penrose sent us a photograph. It is growing in deep loamy soil, and measured 91 ft. in height and 14 ft. in girth in 1912. Mr. R. A. Phillips records an English elm at Loughrea, 100 ft. by 12 ft. Most of the hedgerow elms in the east are scrubby and corky twigged. In the south of Ireland the glabrous and Cornish varieties are more generally grown, but only in the demesnes of large landowners, and the timber is here so little valued that when required for large works it is sometimes imported from England.

TIMBER

After the oak and ash, elm is the most important of the non-coniferous timbers grown in England, but its value per foot is inferior to either of them. It varies immensely in different districts, and according to the distance from a sawmill; but it may be put at about 1s. per foot for the best quality of trees, containing from 50 to 200 cubic feet, and 8d. to 10d. for old, faulty, and ill-shaped trees.

Large old elms are often defective in some part of their trunk on account of their liability to lose large limbs from wind; and where limbs have been blown off, or cut off, the stump generally decays, and its decay extends into the body of the tree, unless the wound has been dressed with tar, creosote, or some preservative, and covered with lead or cement.

The removal of elm trees, often weighing many tons, is expensive and difficult; and though engines are now used for the purpose, it is often found economical, where a number are to be felled, to erect a sawmill close by, and cut them up

¹ Walker, *Essays Nat. Hist.* 70 (1812), says: "We have no English elms in Scotland of an old date or of a large size."

into such sizes as they are fit for on the spot; and sometimes large trees are sawn on the ground lengthways into halves so as to make them more portable.

Laslett¹ says that if used where it is constantly under water, or in situations where it is always kept dry, elm is one of the most durable of timbers, but it decays rapidly under any other circumstances. I have seen, however, many old barns and sheds in Hants, Wilts, and Essex covered with elm weather-boards, which, when tarred, have remained sound for a very long period, perhaps over a century.

Elm timber should not be left lying long after it is cut; and when converted into boards must be carefully stacked to dry under cover, as, though it does not crack so much as oak or ash, it twists and warps much more.

Until iron water-pipes were introduced, elm was the favourite wood for this purpose, and old water-pipes are often dug up in London and elsewhere which have remained sound for 200 years or more. I saw one of these at Chirk Castle, which was found at Clerkenwell in 1898, by the new River Water Company, of which Sir Hugh Myddleton, ancestor of the present owner, R. Myddleton, Esq., was the founder. This is said to have been laid down in 1613, and measures 8 ft. long by 14 in. in diameter at the big end. The bore, which is much encrusted by a limy deposit, is 9 in. in diameter at one end and 6 in. at the other. Similar water-pipes are preserved in the museum at Kew and in the Surveyors' Institution in London.

Elm was also formerly much used for the blocks and keels of ships; and most of the large elms cut in Essex are used, I believe, for piles, groynes, wharves, and for the timbering of the sluices, which carry off the flood-water of the Essex marshes, as well as for weather and coffin boards.

In all the counties nearest to south Wales the greater part of the elms which are blown down or felled, are used for making boxes for tin-plates, as it has been found that this wood does not discolour the plates, and there is less waste in converting for this purpose than for any other, the boards being small and thin. The price in these counties therefore depends very much on the prosperity of the tin-plate trade.

A very large quantity of elm is also used for coffin-boards though, according to "Acorn," whose account of this timber is well worth consulting, this branch of trade has lately suffered like all our home industries from foreign competition. The sizes required for this purpose, he says, are 6½ to 7 ft. long by 11 to 14 in. wide, and ¾ to 1 in. thick, and cost about half as much as oak, though the figure is in some cases very handsome when polished.

For the seats of Windsor chairs, elm is also largely used. The greater part of the tip-waggons used by railway and harbour contractors were formerly made of elm, though now in many cases iron and imported timber are preferred. Barge-builders, box-makers, and wheelwrights also consume a large quantity of elm, the latter preferring it to oak for the stocks or hubs of wheels, as well as for felloes of large size; and here again Canadian rock elm (*Ulmus racemosa*) is now a formidable competitor, which tends to keep down the price of home-grown timber.

With regard to the best quality of elm for wheelwrights I have made many inquiries among country tradesmen, whose opinions differ according to the locality.

¹ *Timber and Timber Trees*, 218 (1875).

Wych elm is generally considered, even in the south, the toughest and best for wheel stocks, trees of small size being cut into lengths and bored through the heart to keep them from splitting as they dry. Most country wheelwrights who have a reputation for the durability and soundness of their waggons prefer to select the trees when growing in their own district; but I have not been able to find any agreement as to what they consider the best timber.¹

As one goes north, however, the comparative value of wych elm as compared with English and smooth-leaved elm, increases; and it may be said generally that whilst in the southern and midland counties, English elm is worth a third more than wych elm; in the north, where the former is falling off in size and quality, they are equally valued, and in Scotland wych elm, the native tree of the country, is preferred; and when speaking of elm in Scotland, wych is generally implied. Many wheelwrights speak of "bastard elm," a term which they apply to any trees which do not show in their timber the colour and character which is associated with English elm.

In France the same uncertainty and difference of opinion seems to exist; and I was told by an experienced waggon-builder in Savoy that he preferred the elm stocks imported from Angoulême, to any that were grown in the east of France.

For ornamental purposes or furniture, elm is little used in England, probably because it is liable to the attacks of wood-boring larvæ. Large tables were sometimes made of a solid elm plank, but few examples remain of ancient furniture made from this wood. One of the secondary staircases at Hatfield House is made of elm, which has not warped and shows handsome figure, but it does not seem to be of great antiquity. The best ornamental use, however, to which elm wood can be put is as veneer, cut from the mottled, waved, and curiously veined burrs, which are found not uncommonly on the trunks of old trees, especially of the wych elm. These when cut into board, crack, shrink, and warp so badly that they can hardly be used in cabinetmaking, but in the form of veneer they are sometimes of very great beauty. In rare cases, the outside slab of an elm tree is found full of markings like that of bird's-eye maple, which are due to undeveloped buds. Mr. E. Gimson, of Daneway, near Cirencester, whose reputation as an artistic worker in fine woods is great, showed an elm cabinet with a very rare mottled figure, made from a tree grown in the neighbourhood, which I have never seen equalled.

In Scotland I procured very fine examples of wych elm burr which, when polished, show a deep rich reddish-brown colour, and from which all the lower part of a most handsome bookcase was made for me.

When visiting the palace of Fontainebleau, I was shown the cradle presented by the city of Paris to Napoleon I. for his son and heir. I was assured by the guardian that this was made from a rare and costly foreign wood, but though overloaded with gilt metal-work, I recognised an elm burr, no better than many which are allowed to rot in our English parks, from one of which it probably came. Very handsome solid table-tops are also made from similar burrs, but more often they are too full of holes and rindgalls to be of any value. (H. J. E.)

¹ Cf. p. 1886 for the wood of the Dutch elm, p. 1889 for that of the Cornish elm, and p. 1902, note 3, for that of the small-leaved elm.

ULMUS JAPONICA

Ulmus japonica, Sargent, *Trees and Shrubs*, ii. 1, t. 101 (1907).

Ulmus campestris, var. *japonica*, Sargent ex Rehder, in Bailey, *Cycl. Amer. Hort.* iv. 1882 (1902).

Ulmus campestris, var. *levis*, Fr. Schmidt, in *Mém. Acad. Sci. St. Pétersb.* xii. 174 (1868) (in part).

Ulmus campestris, var. *vulgaris*, Shirasawa, *Icon. Ess. Forest. Japon.* ii. t. 15, figs. 10-21 (1908).

Ulmus campestris, Komarov, *Flora Manchuriae*, ii. 82 (1903) (not Linnæus).

A tree, attaining in Japan about 100 feet in height, and 12 feet in girth. Young branchlets pale brown, often roughened with minute tubercles or ridges, and covered with dense soft pubescence, more or less retained on the branchlets of the second year, which are fissured and roughened with slight corky ridges; in some specimens,¹ prominent corky ridges are developed in the second and third years. Leaves (Plate 411, Fig. 4) obovate or elliptic, about 3 to 4 in. long, and 1½ to 2½ in. wide, oblique at the base, acuminate at the apex; upper surface scabrous with numerous tubercles and scattered bristle-like hairs; lower surface pale green, pubescent throughout with white short hairs, conspicuous on the midrib and nerves, and forming slight axil-tufts at their junctions; lateral nerves twelve to sixteen pairs, prominent beneath, occasionally forking before reaching the margin, which is coarsely biserrate; petiole ½ to ¾ in. long, densely pubescent.

Flowers nearly sessile, regularly tetramerous, with four sepals and four stamens. Fruit narrowly obovate-oblong gradually tapering to the base, glabrous, non-ciliate, about ¾ in. long, and ⅜ in. wide near the apex; notch open, triangular, with the stigmas slightly incurved; seed touching at its apex the base of the notch.

This species is readily distinguished by the peculiar fawn colour of the branchlets in their first season.

This species, which is closely related to the European *U. nitens*, is a native of Japan, Manchuria, and Amurland. Komarov states that it is common throughout Manchuria, growing along rivers and on hill-sides, usually solitary, but occasionally forming small woods. (A. H.)

In Japan, this elm is said by Sargent,² to occur in the mountain ranges of Hondo at 3000 to 5000 feet, where it is a small tree with the branchlets often conspicuously winged. In Hokkaido this tree is much more abundant, growing on the plains almost at sea-level, and on the lower slopes of the mountains. In the streets and environs of Sapporo it is the most conspicuous tree, and attains 80 to 90 ft. in height by 10 to 12 ft. in girth. I measured a tree close to the station at Iwamigawa 110 ft. by 11 ft., with a clean stem 40 to 50 ft. high; but as a rule it has a more branching and pendulous habit, which reminded me, as it did Sargent, of the American elm, but which is as variable as the habit of *U. nitens*. I found a tree of this species growing close to one of *U. montana* in the virgin forest near

¹ Collected by Elwes, in virgin forests at Asahigawa in central Yezo. Cf. also Shirasawa's figure, *Icon. Ess. Forest. Japon.* ii. t. 15 (1908).

² In *Garden and Forest*, vi. 323, fig. 50 (1893), and *Forest Flora of Japan*, 57, t. 18 (1894), where a tree growing near Sapporo is figured.

Asahigawa, and noted that though the bark of the two was indistinguishable, the leaves were very distinct. I did not, however, notice that it produced suckers.

U. japonica was introduced into the Arnold Arboretum by seeds sent in 1895 from Sapporo by Professor Miyabe, and has grown there rapidly. Professor Sargent informs us that in October 1911, the trees which were raised vary from 17 to 30 ft. in height, and 1 ft. 2 in. to 2 ft. 4 in. in girth. Some of them produced flowers in the spring of 1907. This elm is perfectly hardy in eastern Massachusetts, where it promises to become an ornamental tree of great value. It was subsequently introduced into Europe by Späth¹ in 1900.

There are two trees at Kew, one obtained from the Arnold Arboretum in 1897, which is now about 12 feet high; and another obtained from Späth in 1900. There is also a good specimen in the Edinburgh Botanic Garden, about 15 feet high. (H. J. E.)

ULMUS ALATA, WAHOO, WINGED ELM

Ulmus alata, Michaux, *Fl. Bor. Am.* i. 173 (1803); Loudon, *Arb. et Frut. Brit.* iii. 1408 (1838); Sargent, *Silva N. Amer.* vii. 51, t. 313 (1895), and *Trees N. Amer.* 291 (1905).
Ulmus pumila, Walter, *Fl. Carol.* 111 (1788) (not Linnæus).

A tree, attaining in America 50 ft. in height and 5 ft. in girth, with thin scaly bark. Young branchlets minutely pubescent, furnished in the second or third season with two peculiar thin and wide corky wings which persist for many years. Buds ovoid, glabrous, sharp-pointed. Leaves (Plate 411, Fig. 12) deciduous in autumn, thin in texture, $1\frac{1}{2}$ to $2\frac{1}{4}$ in. long, averaging $\frac{3}{4}$ in. broad, oblong-lanceolate or narrowly elliptic, slightly unequal or subcordate at the base, acute or acuminate at the apex; smooth above; lower surface without axil-tufts and glabrescent, except for hairs on the midrib; lateral nerves eight to ten pairs, rarely forking before reaching the margin, which is biserrate and fringed with minute cilia, only visible with a good lens.

Flowers, appearing in spring before the leaves, few in a fascicle, on long pedicels; calyx five-lobed; ovary tomentose, stalked. Samara narrowly elliptic, $\frac{1}{3}$ in. long, contracted at the base into a long slender stalk, tipped at the apex with long incurved stigmas, covered on the surface with long white hairs, which are most numerous on the thickened margin.

This species is readily distinguishable by the corky wings on the branchlets, which differ from those on the other corky elms (except *U. crassifolia*) in being regularly two in number, very thin, and of considerable width (Plate 411, Fig. 12).

U. alata, which is sometimes known by the native Indian name *wahoo*, is indigenous in the warmer parts of the eastern United States, occurring from southern Virginia southward to Florida, and westward to southern Indiana, southern Illinois, Missouri, Arkansas, Indian Territory, and the valley of the Trinity river, Texas. It is usually too small in size to be of any value for timber.

¹ Späth, *Cat.* No. 106, p. 124 (1900-1901).

It is said by Loudon to have been introduced into England in 1820; but it has apparently not thriven in our climate, as we have never found any old trees. It appears to be very rare, if it exists at all, in collections on the Continent. It has lately been reintroduced by Späth of Berlin; and young trees which were obtained from him in 1909, are now to be seen at Kew, where they are already beginning to show the corky branchlets that are characteristic of the species. (A. H.)

ULMUS CRASSIFOLIA

Ulmus crassifolia, Nuttall, in *Trans. Amer. Phil. Soc.* v. 169 (1837); Sargent, *Silva N. Amer.* vii. 57, t. 315 (1895), and *Trees N. Amer.* 294 (1905).
Ulmus opaca, Nuttall, *Sylva*, i. 35, t. 11 (1842).

A tree, attaining in America 80 ft. in height and 9 ft. in girth. Bark deeply divided by interrupted fissures into broad flat scaly ridges. Buds ovoid, acute, $\frac{1}{8}$ in. long, with minutely pubescent scales. Young branchlets slender, covered with a short erect pubescence; glabrous and striated in the second year, when they often begin to develop two shining brown corky wings. Leaves (Plate 411, Fig. 2) oval, about 1 to 2 in. long, and $\frac{1}{2}$ to 1 in. broad; acute or rounded and never acuminate at the apex; slightly oblique with both sides rounded and usually subcordate at the base; upper surface light green, scabrous, with scattered minute hairs; lower surface paler green, with a scattered minute pubescence, conspicuous on the midrib, and not forming axil-tufts; margin serrate or occasionally biserrate, with triangular spreading and not incurved teeth, minutely ciliate; lateral nerves, eight to eleven pairs, usually forked, not regularly parallel; petiole $\frac{1}{8}$ in. long, covered with a minute pubescence. Stipules triangular-lanceolate, $\frac{1}{4}$ in. long, pubescent, clasping the stem by their broad bases, persistent till the leaves are fully developed in May.

Flowers opening in autumn, on slender pedicels ($\frac{1}{3}$ to $\frac{1}{2}$ in. long), three to five in a fascicle; calyx deeply divided below the middle into five to eight narrow pointed lobes; ovary pubescent. Samara, $\frac{1}{3}$ in. long, ovate, deeply notched at the pointed apex, with the stigmas incurved and nearly touching at their tips, pubescent on both surfaces, densely ciliate in margin; seed occupying more than two-thirds of the samara.

U. crassifolia, which is known in North America as the cedar elm, is distributed from the valley of the Sunflower river, Mississippi, through southern Arkansas and Texas to Nuevo Leon in Mexico. In Arkansas, it grows usually on river cliffs and low hill-sides; but is most common in Texas, where it ranges in the west from the valley of the Pecos river to the coast, growing both in deep alluvial soil and on dry limestone hills, and attaining its largest size in the alluvial flats of the Guadalupe and Trinity rivers.

This species is very rare in Europe, the only specimen which I have seen being a tree at Kew, about 15 ft. high, which was obtained from Sargent in 1870. The twigs die off annually; and evidently this species is unsuitable to our climate, and can only be grown as a botanical curiosity in favoured districts in the south of England. (A. H.)

ULMUS PUMILA

Ulmus pumila, Linnæus,¹ *Sp. Pl.* 226 (1753); Trautvetter, in Maximowicz, *Prim. Fl. Amur.* 248 (1859); Planchon, in De Candolle, *Prod.* xvii. 159 (1873); Franchet, *Pl. David.* i. 268 (1884).

Ulmus pumila, var. *transbaicalensis*, Pallas, *Fl. Ross.* i. 77, t. 48, A, B, C, and e (1784).

Ulmus humilis, Gmelin, *Fl. Sibir.* iii. 105 (1768).

Ulmus microphylla, Persoon, *Syn.* i. 291 (1805).

Ulmus campestris, var. *parvifolia*, Loudon, *Arb. et Frut. Brit.* iii. 1377 (1838) (not *U. parvifolia*, Jacquin).

Ulmus campestris, var. *pumila*, Ledebour, *Fl. Ross.* iii. 647 (1851); Maximowicz, in *Mél. Biol.* ix. 23 (1872).

A tree attaining 50 ft. in height in Eastern Asia, but often shrubby. Bark furrowed and scaly, as in *U. nitens*. Young branchlets slender, clothed with a dense short white pubescence, persistent more or less on the second year's branchlets, which are fissured and finely striate. Buds minute, ovoid, pubescent. Leaves (Plate 411, Fig. 1) membranous and thin in texture, ovate to ovate-lanceolate, about 1 to 1½ in. long, and ½ to ¾ in. broad; acute or shortly acuminate at the apex; nearly equal, occasionally subcordate, at the base; upper surface dark green, glabrous or scabrous and minutely pubescent; lower surface lighter green, with a scattered minute pubescence, often conspicuous on the midrib, and with minute often obsolete axil-tufts at the junctions of the midrib and nerves; nerves about ten pairs, often forked; margin simply and regularly serrate; petiole ⅙ to ⅛ in. long, pubescent.

Flowers five to six in a fascicle, appearing in spring, on very short pedicels; tetramerous or pentamerous. Samara orbicular, about ⅞ in. in diameter, glabrous, non-ciliate, with a deep notch at the apex, usually closed by the overlapping incurved stigmas; seed in the centre of the samara, with its apex close to the base of the notch.

VARIETIES

1. Var. *pinnato-ramosa*, Henry.

Ulmus pinnato-ramosa, Dieck, ex Späth, *Cat.* No. 95, p. 113 (1895), and Dieck, *Verk. Verzeich. Zöschen*, 1897, p. 20; Koehne, in Fedde, *Rep.* viii. 74 (1910) and in *Mitt. Deut. Dend. Ges.* 1910, p. 92.

Ulmus turkestanica, Regel, in Dieck, *Hauptkat. Baumeschul. Zöschen*, 1883, p. 36, and in *Gartenflora*, xxxiii. 28 (1884).

A tree of straggling habit, giving off remarkably long shoots, 2 to 3 ft. in length; leaves (Plate 411, Fig. 6) ovate-lanceolate, acuminate.

This elm, which is said to have been introduced by Dieck from western Siberia,

¹ Linnæus founded his species on *U. humilis*, Gmelin, in Ammanus, *Stirp. Ruth.* 180 (1739), and on *U. pumila*, Plukenet, *Alm.* 393 (1696), the latter being described as an elm in Siberia with small leaves. Litwinow, in *Schede Herb. Fl. Ross.* vi. 166 (1908), states that the specimen of *U. humilis*, Gmelin, in the St. Petersburg Herbarium, is *U. pumila*. He has also verified at St. Petersburg the type specimens of *U. pumila*, var. *transbaicalensis*, Pallas, and of *U. microphylla*, Persoon.

appears to differ little from *U. pumila*, and is identical with specimens¹ collected lately in Turkestan by Mr. M. P. Price. It was raised both by Späth and by Von Sivers from seed sent from Turkestan; and produces flowers at Berlin in the middle of April, ripening its fruit in the end of May. Three trees at Kew, labelled *U. pinnato-ramosa*, which were obtained from Späth in 1900, are now about 25 ft. high, and are very vigorous in growth. A small tree named *U. turkestanica*, obtained from the Arnold Arboretum in 1907, is identical with those labelled *U. pinnato-ramosa*.

2. *Ulmus arbuscula*, Wolf, in *Mitt. Deut. Dend. Ges.* 1910, p. 286, was raised in 1902 from seeds gathered from a large tree of *U. montana* in the St. Petersburg Botanic Garden. It bears leaves 1 to 3 in. long, and is supposed to be a hybrid between *U. montana* and *U. pumila*. I have seen no specimens of this tree.

3. *Ulmus Koopmannii*, Lauche, ex Späth, *Cat.* No. 62, pp. 6 and 101 (1885-1886). This is a form of *U. pumila* with small ovate leaves, 1 to 1¼ in. in length. It is represented at Kew by a poor tree, about 15 ft. high, which was obtained from Transon in 1896. Lauche, *Deutsche Dendrologie*, 349 (1883), states that Koopmann sent seeds of the small-leaved elm from Margilan in Turkestan to the Berlin Botanic Garden, where this variety is represented by a tree with a dense oval crown of foliage like *U. nitens*, var. *umbraculifera* in habit; and the same form is now sold by Späth. Koopmann informed Ascherson and Graebner² that this elm is frequently planted in cemeteries in Turkestan, where it is often of great size.

DISTRIBUTION

U. pumila, which was described by Pallas from shrubby specimens gathered in Dahuria, appears to be widely distributed in eastern Siberia, Manchuria, and northern Korea, where, according to Komarov,³ it attains 50 ft. in height, and usually grows solitary in river valleys on stony or sandy ground. Bretschneider⁴ states that it is the common elm in the Peking plain, where it grows very rapidly, forming a stately tall tree. It is much valued by the Chinese for its timber, which is used in making carts. A nourishing white meal, containing mucilage, is obtained from the thick inner bark, and is used as food by the people in the mountains. The use of this meal is ancient in China. *U. pumila* also occurs in Turkestan and in western Tibet, where Thomson collected specimens⁵ at Nubra at 10,000 feet elevation.

U. pumila, though mentioned by Loudon, does not seem to have been introduced in his time; and the only specimens which I have seen are at Kew. One of these, labelled *U. pekinensis*, was obtained from the Arnold Arboretum in 1908. Purdom also sent this species from north China to Messrs. Veitch in 1910.

(A. H.)

I received from Peking in 1908 a section of a branch of this tree about 2 in. in diameter, as that of a poplar, but on potting it leaves were produced; and I have

¹ It also agrees with specimens in the Kew Herbarium, labelled *U. campestris*, var. *pumila*, Ledebour, which were collected by Regel in Turkestan in 1878.

² *Syn. Mitteleurop. Flora*, iv. 557 (1191).

³ *Flora Manchuria*, ii. 88 (1903).

⁴ *Bot. Sinic.* ii. 128 (1892).

⁵ Identified with *U. parvifolia*, Jacquin, by Hooker, *Flora British India*, v. 481 (1888).

now two healthy trees about 5 ft. high, which are quite hardy, and seem to grow well at Colesborne. I have rarely heard of an elm being struck from cuttings.¹

(H. J. E.)

ULMUS PARVIFOLIA

Ulmus parvifolia, Jacquin, *Hort. Schoenbr.* iii. 6, t. 262 (1798); Maximowicz, in *Mél. Biol.* ix. 25 (1872); Franchet et Savatier, *Enum. Pl. Jap.* i. 431 (1875); Forbes and Hemsley, in *Journ. Linn. Soc. (Bot.)* xxvi. 448 (1894); Shirasawa, *Icon. Ess. Forest. Japon.* i. text 68, t. 37, figs. 1-9 (1900).

Ulmus chinensis, Persoon, *Syn.* i. 291 (1805).

Ulmus virgata, Roxburgh, *Fl. Ind.* ii. 67 (1832).

Ulmus campestris, var. *chinensis*, Loudon, *Arb. et Frut. Brit.* iii. 1377 (1838).

Planera parvifolia, Sweet, *Hort. Brit.* 464 (1830).

Microptelea parvifolia, Spach, in *Ann. Sci. Nat.* xv. 359 (1841).

A tree, attaining in China and Japan about 40 ft. in height and 4 ft. in girth. Bark scaling off in small plates, showing the reddish brown cortex beneath. Young branchlets slender, sparingly covered with a short wavy white pubescence, retained more or less on the branchlets of the second year, which are fissured, but not finely striate; on older branchlets corky ridges are not produced. Buds minute, ovoid, pubescent. Leaves (Plate 411, Fig. 5) sub-evergreen, persisting till December or January, ovate- or obovate-lanceolate, thick in texture, 1 to 1½ in. long, ½ to ¾ in. broad, acute at the apex, nearly equal at the base; upper surface dark green, shining, glabrous, smooth to the touch; lower surface lighter green, glabrous except for axil-tufts at the junctions of the midrib with the basal nerves; nerves ten to twelve pairs, usually forked; margin crenately and simply serrate, non-ciliate; petiole, ⅓ to ½ in. pubescent.

Flowers appearing in autumn, in clusters of two to five in the axils of the leaves, on very short pedicels, tetramerous; calyx deeply cleft into four segments; ovary minutely pubescent; stigmas white. Fruit ovate to almost orbicular, about ⅓ in. long, shortly cleft at the apex with convergent densely pubescent stigmas; surface minutely pubescent; seed in the centre of the samara.

U. parvifolia is a native² of China, Tongking,³ Formosa,⁴ and Japan. In Japan, it is confined to the southern parts of Hondo, Skikoku, and Kiusiu, where it is usually a small tree, often only 15 to 20 ft. in height.

In China, it is known as *lang-yii*, and is widely spread throughout the provinces of the Yangtze valley, and southwards, extending to Tongking. The wood is hard, heavy, and tough, but difficult to cleave, and seldom large enough for planking.

U. parvifolia is said to have been introduced into France in the reign of Louis

¹ In *Gard. Chron.* xxxix. 35, fig. 20 (1906), a case is illustrated of elm posts, put in the ground for a pergola, which took root and produced abundant foliage at Redworth, Totnes.

² The western Tibetan specimens referred to this species by Hooker, *Flora British India*, v. 481 (1888), are all barren branches, and appear to be *U. pumila*. Mayr, *Fremdländ. Wald- u. Parkbäume*, 524 (1906), confuses *U. parvifolia* and *U. pumila*, stating erroneously that the former is a native of the cold regions of Manchuria and North China.

³ A specimen in the Kew Herbarium was collected by Balansa in the mountains of Tongking at 2700 feet altitude.

⁴ Collected by me at Bankinsing.

XV. by Abbé Gallois, who supposed it to be the tea-plant, and for a long time it was known as "thé de l'Abbé Gallois."

It appears to have been introduced into England by Mr. James Main¹ in 1794, who brought home some plants from China, which were cultivated in a garden at Hackney. It is, however, very rare in cultivation, though it seems to be perfectly hardy, and is very ornamental, retaining its foliage in England usually till late in December or early in January. A tree² at Kew, about 35 ft. high and 3 ft. in girth, died in 1912; it used to produce flowers occasionally in November, but never set fruit. Another at Beauport, Sussex, grafted on the common elm, was 40 ft. by 3 ft. 8 in. in 1911. There is also a tree at Enys, in Cornwall, about 20 ft. high.

At Verrières,³ near Paris, its growth is rapid, a specimen only twelve years old being 25 ft. in height in 1906. This produces flowers and fruit, but the latter is usually destroyed by frost. There are also good specimens at Segrez and Grignon. A fine tree in the Jardin des Plantes at Paris, about 45 ft. high and 3½ ft. in girth, was just about to open its flowers on 5th September 1902. This tree is remarkable for its large leaves, up to 3 in. long and 1¼ in. wide; and possibly constitutes a distinct variety, which I have not been able to match exactly with any native specimens in herbaria. The finest specimen in Italy is probably one on Isola Bella in Lake Maggiore, which produces good fruit, and measured in 1909 about 40 ft. by 2½ ft.

The largest and finest specimen in the United States is growing in Central Park, New York, near the 72nd Street entrance from Fifth Avenue. It was introduced in 1865 by Thomas Hogg.⁴ (A. H.)

¹ Main was sent as a collector to China in 1791-1794 by Mr. Gilbert Slater of Low Layton, Essex, noted for its extensive gardens and rare plants. Bretschneider, *Hist. Europ. Bot. Disc. China*, 214 (1898), refers to Slater's introductions; but omits all mention of Main. The latter gives an interesting account of his voyage in *The Horticultural Register*, v. 62 (1836).

² The tree at Kew was figured under the erroneous name of *U. pumila* in *The Garden*, February 20, 1904, p. 133. This tree suffered from the disease known as "slime-flux," the trunk exuding a sweet sap, which attracted a large number of wasps during the summer and autumn of 1911. Mr. Bean in *Nature*, vol. lxxxvii. p. 516 (1911), states that this affection is probably due to a yeast, which finds its way to the cambium layer, by means of a wound, and there sets up decomposition of the cells, forming sugary products, which exude from the trunk in solution, and partly ferment into alcohol. Cf. also *Gard. Chron.* l. 323 (1911). Fraser, in *Gard. Chron.* xlix. 59 (1911), also alludes to exudation of sap from elm trees, which may continue for many years, causing the bark to become perfectly white, owing to the death of the green alga, which usually lives upon it.

³ *Hort. Vilmorin.* 52 (1906).

⁴ *Garden and Forest*, i. 231, 312 (1888).

KOELREUTERIA

Koelreuteria, Laxmann, in *Nov. Comm. Acad. Petrop.* xvi. 561, t. 18 (1772); Bentham et Hooker, *Gen. Pl.* i. 396 (1862).

DECIDUOUS trees and shrubs belonging to the order Sapindaceæ. Branchlets, with numerous lenticels, showing in winter elevated leaf-scars, marked in the centre with numerous dots, and girt with a projecting rim-like margin. Buds all axillary, no true terminal bud being developed, each covered externally by two opposite scales, which are united at first by their apices, but ultimately gape apart, exposing the villous interior of the bud. Leaves alternate, without stipules, either unequally and simply pinnate or equally bipinnate; leaflets opposite, sub-opposite, or alternate, with lobed, toothed, or serrate margins.

Flowers polygamous, irregular, in large terminal panicles. Calyx deeply divided into five unequal lobes. Petals five, yellow, unequal, each with a bifid gland on the base of the lamina, above the woolly claw. Disc oblique, with three to five lobes alternating with the petals. Stamens five to eight, inserted within the disc, exerted, declinate; filaments woolly. Ovary three-angled, pubescent, with an elongated style and a trifid stigma, three-celled, each cell containing two ovules. Fruit, an inflated capsule, membranous, three-winged, splitting loculicidally into three valves. Seeds, two or three in each capsule, usually only one developing on the centre of the septum in the middle of each valve, subglobose, blackish, without an aril; embryo spirally convolute.

Four species are known, natives of China and Formosa, distinguishable as follows:—

I. *Leaves simply pinnate with an odd number of leaflets.*

1. *Koelreuteria minor*, Hemsley, in Hooker, *Icon. Plant.* t. 2642 (1900).

Leaflets, fifteen to twenty-five, small, not exceeding $1\frac{1}{2}$ in. long and $\frac{1}{2}$ in. broad, crenate. Capsule, with orbicular valves, $\frac{3}{4}$ in. in breadth; seed $\frac{1}{8}$ in. in diameter.

This is a rare shrub, which was discovered on the Lienchow river in Kwangtung, China, by Ford in 1887. It has not been introduced, and probably would not be hardy in England.

2. *Koelreuteria paniculata*, Laxmann. See p. 1932.

Leaflets, nine to thirteen, $1\frac{1}{2}$ to 3 in. long, toothed or lobed in margin; occasionally some of the leaflets are so deeply cut that the lobes are distinct, making the leaf incompletely bipinnate. Capsule, with ovate acuminate valves, $1\frac{1}{2}$ in. long, and $\frac{3}{4}$ in. wide; seed $\frac{1}{4}$ in. in diameter.

II. *Leaves bipinnate, with an even number of pinnae, which bear an even or odd number of leaflets.*

3. *Koelreuteria Henryi*, Dümmer, in *Gard. Chron.* lii. 148 (1912).

Leaflets alternate, five to eleven, 3 in. long, glabrous except for axil-tufts beneath, serrate. Branchlets glabrous. Capsule with broadly oval or orbicular valves, about $1\frac{1}{4}$ in. across; seed $\frac{1}{5}$ in. in diameter.

This is a tree, attaining about 50 ft. in height, which was discovered by me in 1894, near Bankinsing in the mountains of central Formosa. It has not yet been introduced, but might possibly be hardy in the milder parts of England and Ireland.

4. *Koelreuteria bipinnata*, Franchet, in *Bull. Soc. Bot. France*, xxxiii. 463 (1886), in *Rev. Hort.* lx. 393, fig. 93 (1888), and *Pl. Delav.* 143, pl. 29, 30 (1889).

Leaflets opposite, sub-opposite, or alternate, nine to thirteen, 3 in. long, pubescent on the midrib and veins, serrate. Branchlets pubescent. Capsule with oval or elliptic valves, rounded at the apex, about $2\frac{1}{2}$ in. long and $1\frac{1}{2}$ to 2 in. broad; seed $\frac{1}{4}$ in. in diameter.

This is a tree, attaining 90 ft. in height in mountain woods in central and south-western China. It was discovered in 1887 by Delavay near Tapintze, north-east of Tali in Yunnan, at 6000 ft. elevation. It was subsequently found by me near Mengtse in the same province, and in the hills north of Ichang in Hupeh. Faber collected it in the mountains near Ningpo in Chekiang.

In 1887 Delavay sent home seed, which germinated freely in the Jardin des Plantes at Paris. One of the seedlings, which has been in the Temperate House at Kew since 1889, is now about 40 ft. high, but has not as yet borne flowers. This species has not apparently been tried in the open air in this country, but is likely to prove hardy in mild districts like Cornwall. It is rare¹ on the Continent, but is reported to be growing at Les Barres² and at the Villa Thuret, Antibes.³ (A. H.)

¹ Simon-Louis, *Cat.* 1908, p. 44, mentions it as very tender to frost at Metz.

² *Frut. Vilmorin.* 42 (1904).

³ Pardé, in *Bull. Soc. Dend. France*, 1911, p. 259.

KOELREUTERIA PANICULATA

Koelreuteria paniculata, Laxmann, in *Nov. Comm. Acad. Petrop.* xvi. 561, t. 18 (1772); Loudon, *Arb. et Frut. Brit.* i. 475 (1838); Hemsley, in *Journ. Linn. Soc. (Bot.)* xxiii. 138 (1886); Masters, in *Gard. Chron.* ii. 563, fig. 111 (1887); Mottet, in *Rev. Hort.* lxxviii. 466, fig. 181 (1906).

Koelreuteria paullinoides, L'Héritier, *Sert. Angl.* 18, t. 19 (1788).

Koelreuteria chinensis, Hoffmannsegg, *Verz. Pfl.* 70 (1824).

Sapindus chinensis, Linnæus, *Syst. Veg.* 315 (1774).

Sapindus sinensis, Gmelin, *Syst. Veg.* 642 (1796).

A tree attaining about 60 ft. in height and 6 ft. in girth. Bark¹ smooth at first, becoming scaly on old trunks. Branchlets glabrous. Buds ovoid, about $\frac{3}{8}$ in. long; outer scales two, glabrous without, villous within, gaping apart in winter; leaf-scars triangular to semi-orbicular, elevated on projecting pulvini. Leaves unequally pinnate, 6 to 12 in. long; rachis pubescent on the upper side; leaflets nine to thirteen, opposite or sub-opposite, ovate, $1\frac{1}{2}$ to 3 in. long, sub-sessile; variously toothed or lobed, the basal lobes occasionally separated by sinuses extending to the midrib; both surfaces slightly pubescent on the midrib and veins.

Panicles terminal, large, 6 to 9 in. long, with pubescence slight on the principal and secondary axes, and dense on the pedicels and calyx; flowers numerous, yellow, clustered in threes, about $\frac{1}{4}$ in. wide. Fruiting capsules, ripe in autumn, with ovate valves, which are acuminate at the apex, and about 2 to $2\frac{1}{2}$ in. long and $1\frac{1}{4}$ in. wide. Seeds globose or slightly pyriform, about $\frac{1}{4}$ in. in diameter, blackish, shining, only two or three maturing in each capsule. Seedling² with two strap-shaped cotyledons raised above ground, followed on the stem by alternate primary leaves, which have three irregularly toothed or lobed leaflets.

VARIETIES

The large deeply cut leaflets,³ borne by some trees, are probably associated with vigorous growth due to soil and similar conditions, and scarcely indicate a distinct variety.

A specimen branch with variegated leaves, which does not seem to have been propagated, was sent to Kew in 1885 by Major Alcock Beck from Eastwaite Lodge, Hawkside, Ambleside.

DISTRIBUTION

K. paniculata is a native of northern China, where it is common in the hills around Peking; and has also been found in the mountains of Shensi, Kansu, and

¹ Schneider, *Dend. Winterstud.* 40, fig. 47 (1903), depicts the scaly bark on an old stem.

² Cf. Kerner, *Nat. Hist. Plants*, Eng. trans. i. 9, fig. 1 (1898).

³ Wyman, in Bailey, *Cycl. Amer. Hort.* ii. 861 (1900), mentions under the name *K. japonica*, Siebold, a form with deeply cut leaflets. Beissner, in *Mitt. Deut. Dend. Ges.* 1898, p. 424, refers to *K. japonica*, a shrub with a "bipinnate leaf, pubescent beneath," growing in the nursery at Plantières, near Metz, but this is not recognised as a distinct variety in the catalogue of Simon-Louis. Cf. also *Hortus Vilmorin.* 338 (1906).

western Szechwan. It was known by the Chinese as the *luan* tree in classical times, when it was planted around the graves of Ministers of State; but is now called *mu-lan-tze* at Peking, where the leaves are used as a black dye and the seeds as beads.¹ It is not recognised by Japanese botanists as a native of Japan,² where it was introduced at an early period by the Buddhist monks, but it is frequently cultivated and occasionally naturalised³ in Hondo.

It was cultivated under glass at St. Petersburg in 1752, and was probably raised from seed sent to Paris about 1747-1751 from Peking by D'Incarville, who introduced about this time other trees from North China, like *Sophora japonica* and *Ailanthus glandulosa*.⁴ *K. paniculata* is said⁵ to have been introduced into England by the Earl of Coventry in 1763. It is perfectly hardy, forming a small ornamental tree, which produces abundant panicles of yellow flowers about midsummer. The leaves, which are elegant in form, often turn a beautiful crimson colour in autumn. It is easily propagated by seeds, by layers in autumn, by cuttings of young branches in spring, or by root-cuttings.

The finest specimen in England is probably one in Waterer's nursery at Knaphill, Woking, which was 40 ft. high by 6 ft. in girth in 1911. Elwes saw a fine tree⁶ at the east corner of the upper north terrace of Windsor Castle in July 1912, when it was covered with a rich crop of flowers. This measured about 40 ft. by $5\frac{1}{2}$ ft. It ripens seeds at Bitton, near Bath, which come up naturally.

In France⁷ it reproduces itself naturally by seed in the neighbourhood of Montpellier; and there is a fine specimen at Verrières, which is considered by Mottet⁸ to be one of the original seedlings, dating perhaps from 1751. In 1906, it measured 62 ft. high and 6 ft. 11 in. in girth, with a spread of branches about 60 ft. in diameter. It produces fruit freely every year. M. Hickel tells me that there is a large tree at Heidelberg; but it does not seem to be hardy⁹ in other parts of Germany where the winter is very severe, as in Silesia. In the United States¹⁰ it is perfectly hardy as far north as Massachusetts, but is liable after a hard winter to have single limbs die back to the trunk. The seeds readily germinate where they fall to the ground, so that in some places in North America it is becoming naturalised. (A. H.)

¹ Bretschneider, *Bot. Sinic.* ii. 381 (1892), and iii. 491 (1895), and *Hist. Europ. Bot. Disc. China*, i. 159, ii. 850 (1898).

² *K. japonica*, Hasskarl, *Cat. Pl. Hort. Bog. Alt.* 226 (1844), was a name given to a shrub of *K. paniculata* that was introduced from Japan into Java.

³ Franchet and Savatier, *En. Pl. Jap.* i. 85 (1875), record a specimen as wild in a wood in Hondo, which was undoubtedly naturalised.

⁴ Cf. vol. i. p. 32. A tree of *Ailanthus glandulosa* in the garden of the Master of Trinity College, Cambridge, is said to have come as a seedling from London in 1758, and is undoubtedly one of the original trees raised from seed sent by D'Incarville in 1751. The old *Sophora japonica* tree (vol. i. p. 42) at Cambridge in all probability dates from the same year.

⁵ Aiton, *Hort. Kew.* ii. 7 (1789).

⁶ A branch with fruit of a tree at Windsor is figured in *Gard. Chron.* ii. 563, fig. 111 (1887).

⁷ Pardé, in *Bull. Soc. Dend. France*, 1909, pp. 103, 114.

⁸ *Rev. Hort.* lxxviii. 466, fig. 181 (1906).

⁹ *Mitt. Deut. Dend. Ges.* 1903, p. 8. A fine specimen, growing in the Royal Garden at Friedrichshafen on the Lake of Constance, is figured in *Mitt. Deut. Dend. Ges.*, 1912, p. 310.

¹⁰ *Garden and Forest*, vii. 305 (1894), and x. 49 (1897).

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SMALL-LEAVED LIME AT SPROWSTON, NORWICH

PLATE 372.



WHITE LIME AT ALBURY



WEeping WHITE LIME AT HATHEROP CASTLE



CHUSAN PALM AT LAMORRAN

PLATE 375.



ACACIA DEALBATA AT DERREEN

PLATE 376.



HOLLY AT GORDON CASTLE

PLATE 377.



WHITETHORN AT HETHEL

PLATE 378.



WEeping WILLOW AT CHELTENHAM



WHITE WILLOW AT HAVERHOLME



CRICKET-BAT WILLOW AT HERTFORD

PLATE 381.



GREY POPLAR AT COLESBORNE

PLATE 382.



FEMALE LOMBARDY POPLAR IN BRUNSWICK

PLATE 383.



CAROLINA POPLAR AT DANNY PARK

PLATE 384.



FASTIGIATE BLACK POPLARS IN BELGIUM



BLACK ITALIAN POPLAR AT BELTON

PLATE 386.



BALSAM POPLAR AT BUTE HOUSE, PETERSHAM

PLATE 387.



WESTERN BALSAM POPLAR IN VANCOUVER ISLAND



EUROPEAN WHITE ELM AT SYON

PLATE 389.



EUROPEAN WHITE ELM AT UGBROOKE

PLATE 390.



AMERICAN WHITE ELM IN MASSACHUSETTS

PLATE 391.



AMERICAN WHITE ELM AT HARGHAM

PLATE 392.



WEeping WYCH FLM AT GLASNEVIN



WYCH ELM AT STUDLEY ROYAL

PLATE 394.



HUNTINGDON ELM AT MAGDALEN COLLEGE, OXFORD

PLATE 395.



ELMS IN KENSINGTON GARDENS



CORNISH ELMS AT COLDRENICK

PLATE 397.



WHEATLEY ELM AT RICHMOND

PLATE 398.



SMOOTH-LEAVED ELM AT SHARPHAM

PLATE 399.



WYCH ELM AT CASSIOBURY

PLATE 400.



SMOOTH-LEAVED ELM AT BRIGGINS

PLATE 401.



SMOOTH-LEAVED ELM AT SALING

PLATE 402.



GOODYER'S ELM AT WESTON BIRT

PLATE 403.



ENGLISH ELM AT POWDERHAM

PLATE 404.



ENGLISH ELMS AT WELL VALE

PLATE 405.

FASTIGIATE BEECH

WE are indebted to Mr. F. R. S. Balfour for the picture of a very remarkable beech which he showed me in 1908, growing close to Dawyck House, Peeblesshire. So far as we know, the habit of this tree is unique; though, according to Koch,¹ a fastigiata beech formerly existed in the nursery of Simon-Louis at Metz. The tree at Dawyck was 48 ft. by 4 ft. 2 in. in 1912; and is supposed by Mr. Balfour to be about forty years old, but to my eye it is much older. It has lately been described and illustrated by H. A. Hesse² of Weener, Hanover, under the name *Fagus silvatica Dawycki*. Young plants have been propagated by layering and by grafting, and two of these are growing well at Colesborne.

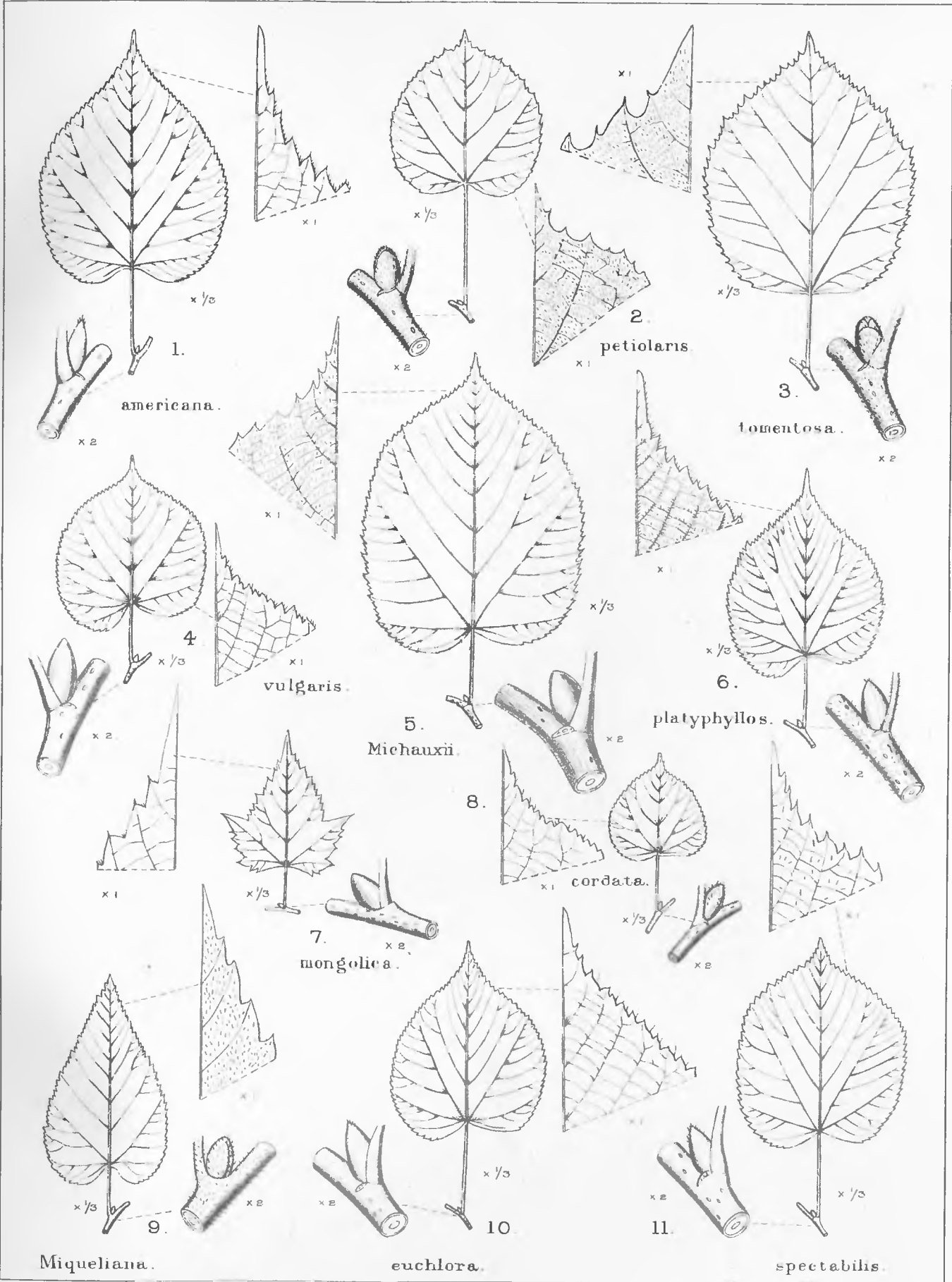
¹ *Dendrologie*, ii. pt. ii. 17 (1873). Simon-Louis, who called this form var. *fastigiata*, do not advertise it now in their catalogues. Var. *pyramidalis*, Petzold and Kirchner, *Arb. Mus.* 662 (1864), described as being pyramidal in habit, is unknown to us.

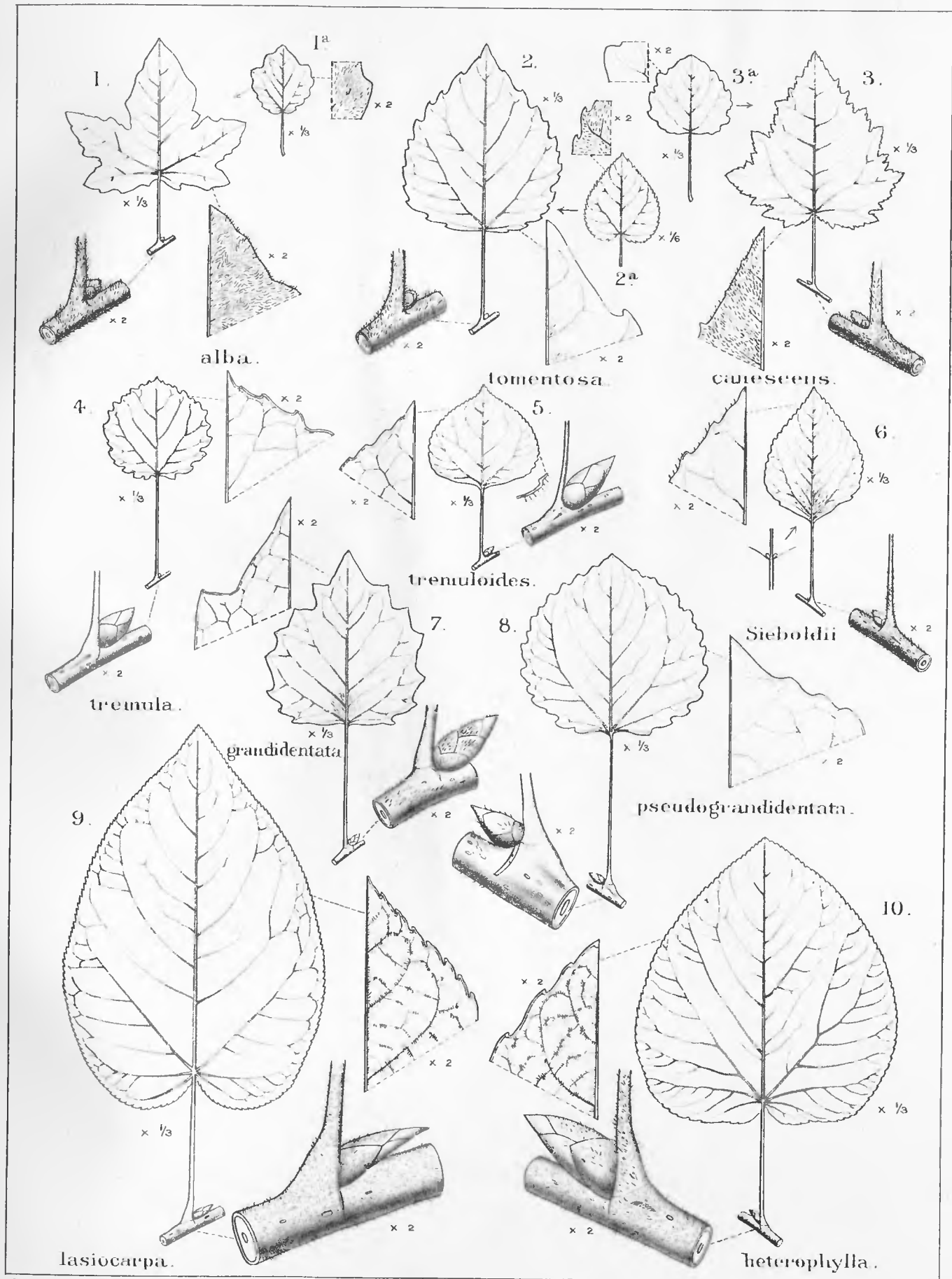
² In *Mitt. Deut. Dend. Ges.* 1912, p. 366.



FASTIGIATE BEECH AT DAWYCK

PLATE 406.

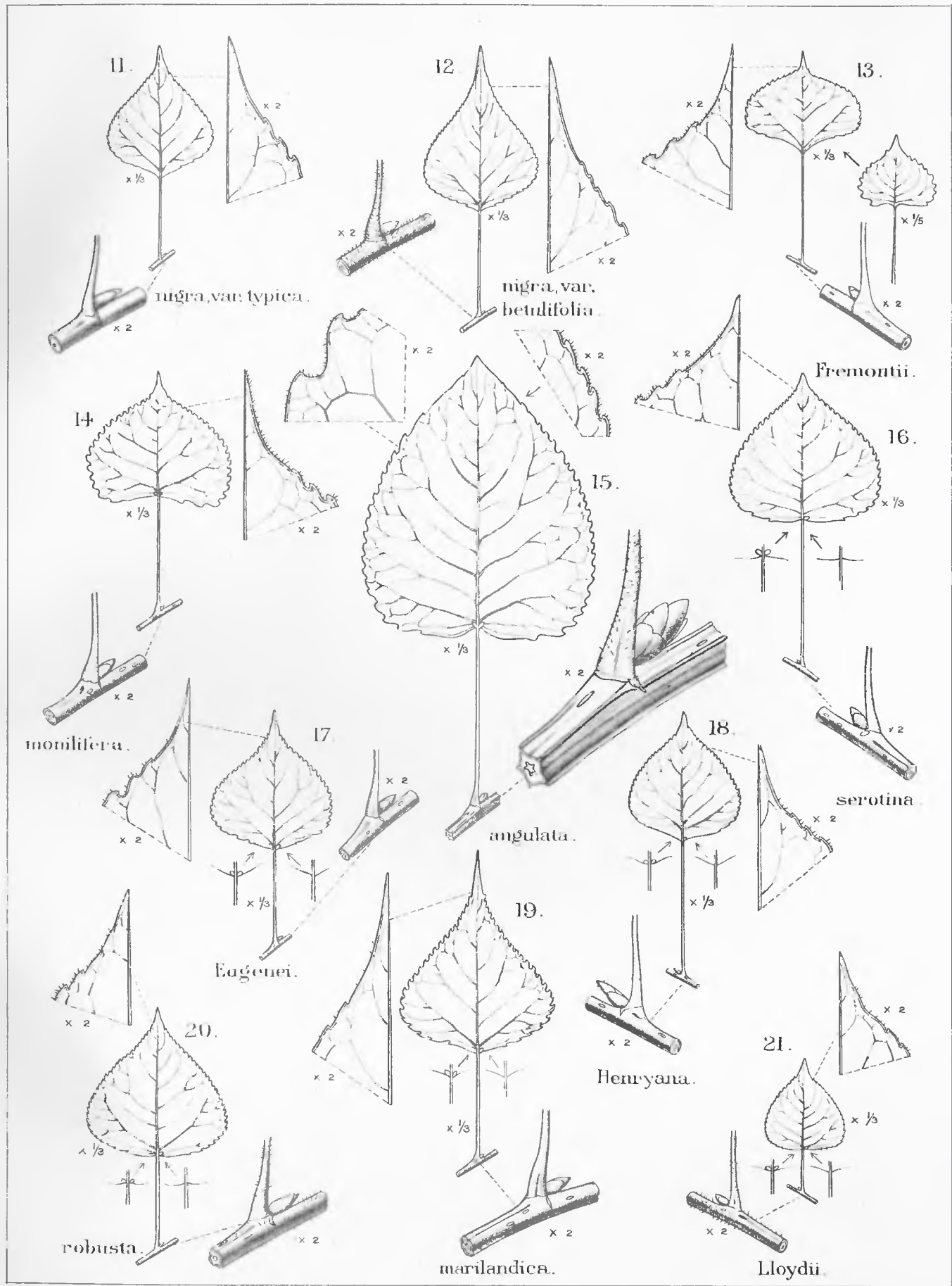




Hutt., del. Huth., lith.

PLATE 408.

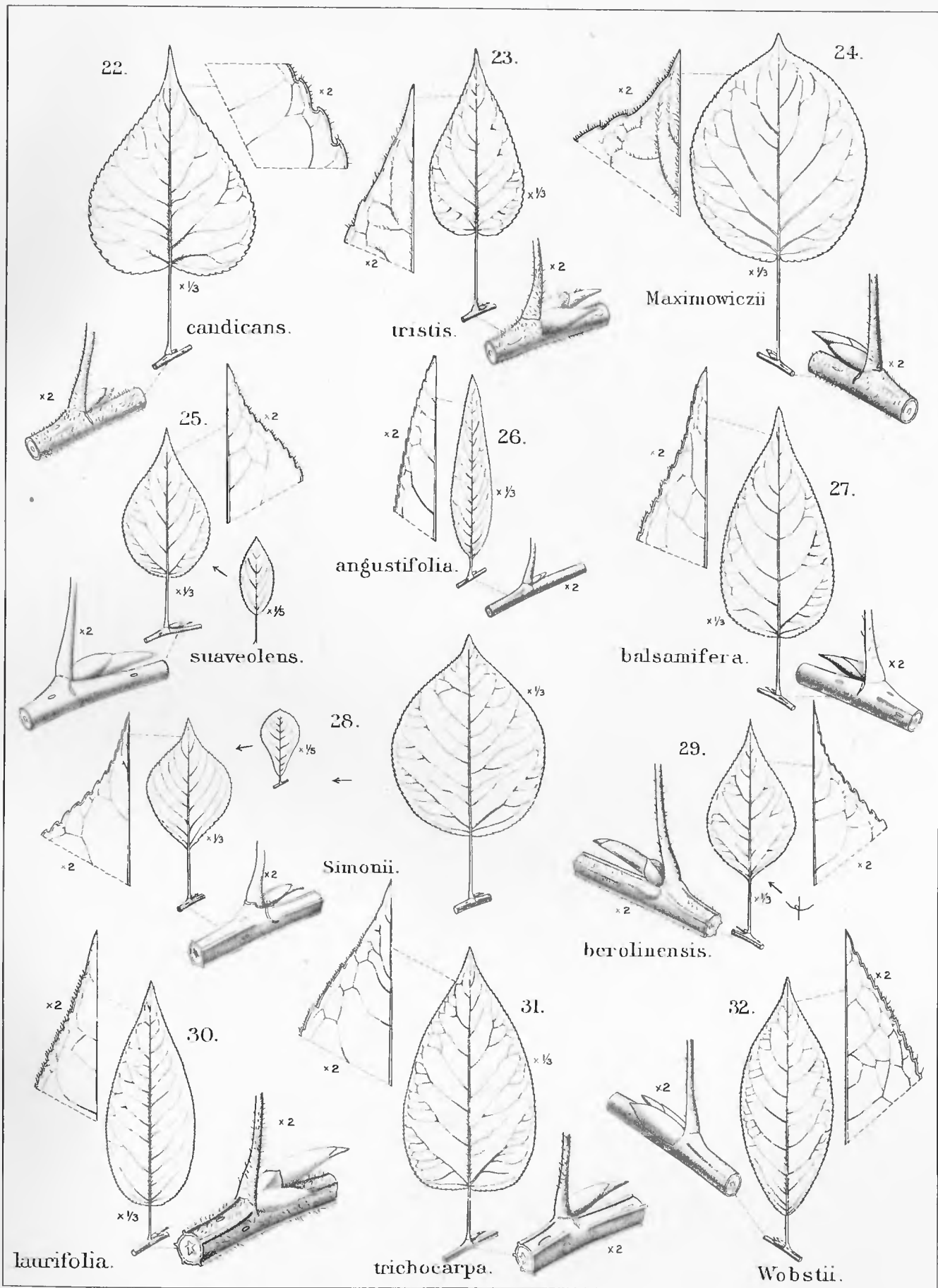
POPULUS.



Hunt, del. Euth. lith.

PLATE 409.

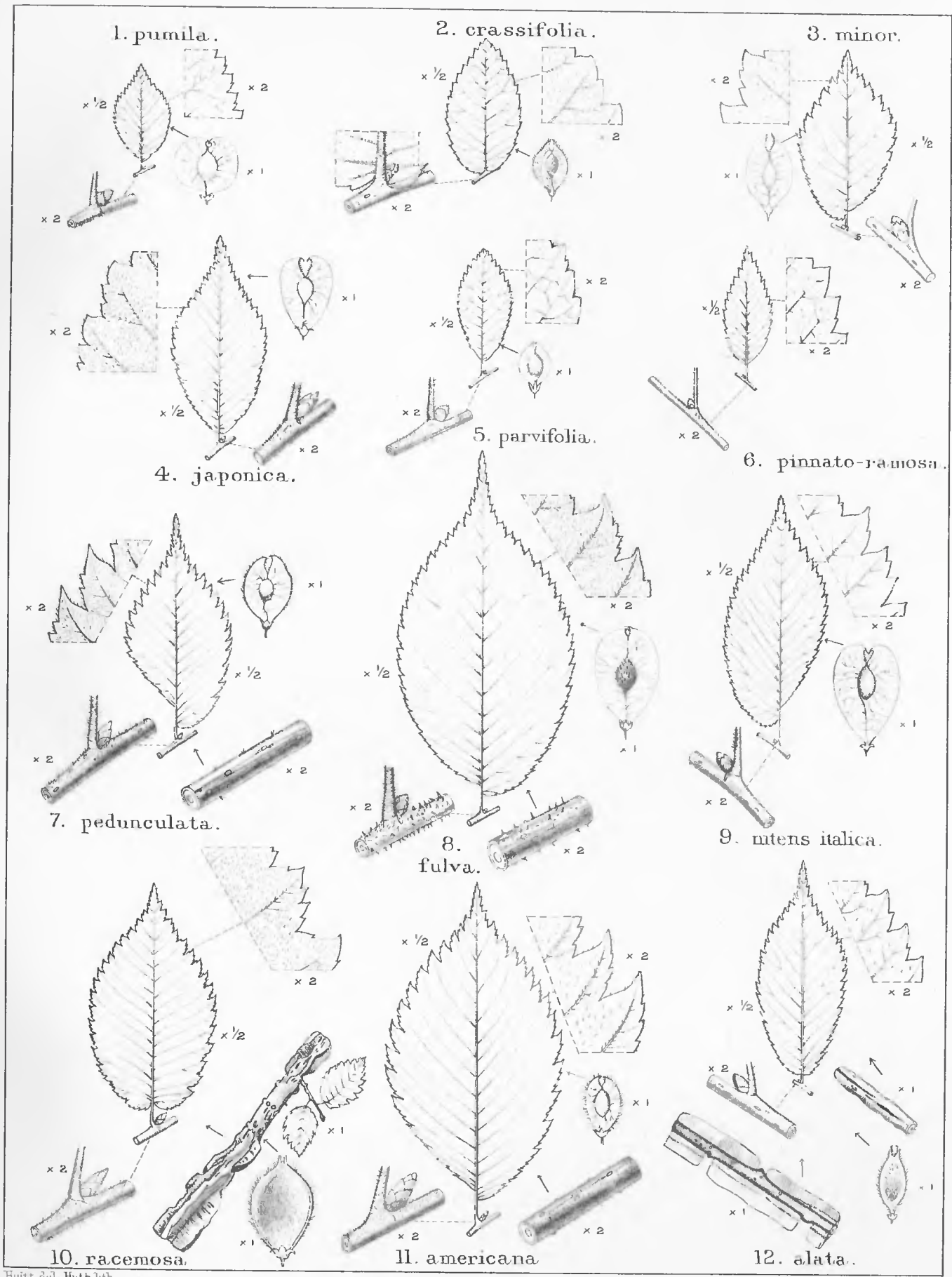
POPULUS.



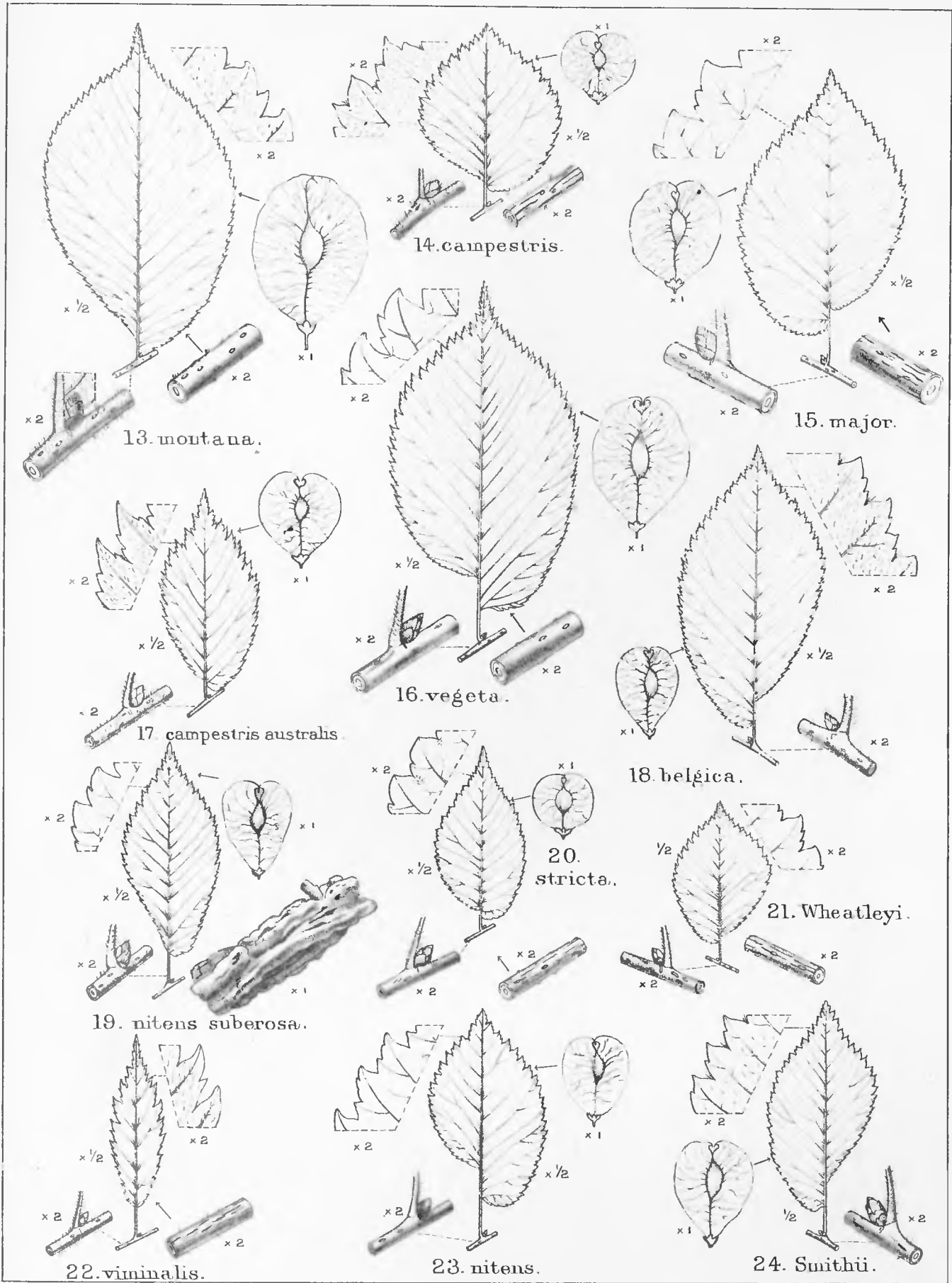
A.E. Huit, del. Huth, lith.

PLATE 410.

POPULUS.



Hort. del. Huth lith.



Q. 700
E4
v. 7
pt. 3



The Trees
of
Great Britain
& Ireland

BY
 Henry John Elwes, F.R.S.
 AND
 Augustine Henry, M.A.

Edinburgh: Privately Printed

THE TREES OF GREAT BRITAIN AND IRELAND



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OF
GREAT BRITAIN
AND IRELAND

BY
HENRY JOHN ELWES, F.R.S.

AND
AUGUSTINE HENRY, M.A.

INDEX, ETC.

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THE JERSEY
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POSTSCRIPT

BY

HENRY JOHN ELWES, F.R.S.

AND

AUGUSTINE HENRY, M.A.

In the Introduction to the first volume of this work, published in 1906, we stated the objects which we had in view, and which, during the seven years which have now elapsed, we have endeavoured to carry out to the best of our power. If the patience of our Subscribers has been unduly taxed, we can only say that the magnitude of the task which we set before us was even then hardly realised; and that the difficulty of discovering, identifying, describing, and figuring the rare and remarkable trees in Great Britain is one which grew with our knowledge, and with each succeeding volume. The want of order in this work, on which some of our reviewers have remarked, has been really of the greatest service; for by leaving the more difficult and little-known genera to the last, we have been able to make the work more complete and accurate than it would have been if every genus had been taken in its accepted botanical sequence; and though a few additions may be made to the earlier volumes, we know of no really important omissions in them.

Though some local botanists and arboriculturists have studied the native trees of their own counties with more or less care, British botanists, until recently, have taken little notice of the trees which form so conspicuous a feature in the vegetation and scenery of England; and in many counties, whose flora, birds, and insects have been most carefully and accurately studied by local naturalists, we have found no one who, apparently, knew or cared for the trees, and have had to depend largely on our own observations.

An immense quantity of foreign as well as British literature has been referred to, as evidenced by almost every page of the work; but a general bibliography seems unnecessary, as the references are fully given; as well as the authority for nearly every fact, opinion, or observation not made by ourselves.

As it is possible that in the future, questions may arise as to the correct nomenclature of some of the numerous trees that we have described and figured, it is well to say that the herbarium accumulated by us in the course of our work is preserved at Cambridge and at Kew, so that the actual specimens from which

the descriptions and identifications were made can be referred to in case of doubt.

It is impossible to acknowledge in full detail the help that we have received from landowners and their agents, foresters, gardeners, and friends in all parts of Great Britain which we have visited during the course of the work; but we have felt on many occasions that without this help the work would have been impossible.

Amongst those to whom we are most indebted for help, I must especially mention the following:—

Sir William T. Thiselton-Dyer, F.R.S., who has carefully read the proofs of all the volumes except the first, and whose suggestions and advice we have followed in many difficult questions; Mr. Charles Palmer of Stewkley Grange and Manchester, who has also read the proofs with extraordinary care; the Director and staff of the Royal Gardens at Kew, who from first to last have shown a personal interest in our work which has been of the greatest support and assistance. We must here call attention to the fact that the collection of living trees at Kew is, and we hope always will be, so far as its soil and climate will allow, the most complete, correctly named, and well-cared-for in Europe; while its unrivalled library and herbarium, where much of our work has been prepared, and the references checked, have been indispensable in connection with the living specimens.

The staff of the Botanical Department of the British Museum of Natural History, as well as the Directors of the Botanical Gardens at Edinburgh, Glasnevin, Oxford, and Cambridge have afforded us every facility for studying both the trees and herbaria in their charge, and we gratefully acknowledge their assistance.

In the United States we have received much help from the officials of the National Bureau of Forestry, and from many private individuals, amongst whom I must mention Prof. Elrod of the Montana University, Mr. Gifford Pinchot, the late Chief Forester of the United States, and especially Mr. Charles S. Sargent of the Arnold Arboretum, who has given us much valuable information and help on many occasions.

In Canada Messrs. J. M. and W. T. Macoun of Ottawa have been on many occasions most helpful and obliging.

In France we have to thank numerous friends for shewing us many of the finest trees and forests in all parts of the country; amongst them we are especially grateful to MM. Maurice and Philippe de Vilmorin of Paris, Prof. Flahault of Montpellier, M. Leon Pardé, Inspecteur des Eaux et Forêts of Beauvais, M. Hickel of Versailles, M. Guinier of Nancy, M. Jouin of Plantières near Metz, and Mr. Cecil Hanbury of La Mortola in Italy.

In Holland Mr. L. A. Springer of Haarlem, in Belgium Prof. Bommer of Brussels, M. Huberty, Inspector of Forests, Verviers, and the late Baron de Selys-Longchamps, in Germany the late Herr Späth of Berlin and the late Prof. Blasius of Brunswick, and the Directors of the Botanic Gardens we have visited in Germany, Russia, Italy, Sweden, Norway, Spain and Portugal, Bulgaria, and Servia, have all given us most valuable notes and assistance.

In Denmark we have also received much help and information from Forest Inspectors Mundt and Bramsen, who personally conducted us through many interesting forests and private arboreta.

In Japan I have on two occasions received unusual attention and assistance in visiting the most interesting forests, and in procuring good photographs of the trees, for which I shall be ever grateful both to the past and present Ministers of Agriculture, and especially to Dr. H. Shirasawa of Tokyo, and numerous other officials and friends.

Amongst the English landowners, who have afforded us the greatest assistance and kindness on all occasions, I must specially mention His late Majesty King Edward, to whom our work is dedicated, and whose fine trees at Windsor, Sandringham, Balmoral, and Osborne have been frequently mentioned in our pages. The Earl of Ducie, who during a long life has had the pleasure of seeing many rare trees planted by himself come to maturity, and who, perhaps better than any English landowner, has realised the importance of attending to his trees after they were planted. The late Sir Charles Strickland, who often told me that the pleasure of watching the growth of trees which he had himself raised and planted, was the one interest in life which remains undiminished in extreme old age. Sir Hugh Beevor, who has inherited a taste for arboriculture and forestry, and on many occasions has contributed most valuable notes and measurements of remarkable trees in many places. The Dukes of Argyll, Bedford, Northumberland, Portland, Richmond, and Wellington. The Marquesses of Bath, Lansdowne, Ripon, and Waterford. The Earls of Annesley, Bathurst, Bradford, Brownlow, Cawdor, Coventry, Darnley, Fortescue, Ilchester, Leicester, Manvers, Pembroke, Portsmouth, Powis, Radnor, Selborne, Spencer, and Yarborough. The Viscounts Falmouth and Powerscourt. The Lords Bagot, Barrymore, Clinton, Dynevor, Kesteven, Llangattock, Lovat, Methuen, Northbourne, Peckover of Wisbech, Penrhyn, Rayleigh, Redesdale, Sackville, Scarsdale, Sherborne, and Walsingham. Sir C. T. D. Acland, Sir E. Stafford Howard, Sir George Holford, Sir E. Loder, Sir John Stirling Maxwell, Sir Herbert Maxwell, Sir Frederick Moore, Sir John Ross-of-Bladensburg. The Hon. Vicary Gibbs, Mr. H. Clinton Baker, Mr. R. Birkbeck, Mr. F. R. S. Balfour, Brodie of Brodie, Mrs. Baldwyn Childe, Capt. D. Cameron of Lochiel, Major Dent, Mr. W. Steuart Fotheringham, Major Lloyd, Col. Malcolm of Poltalloch, Mr. E. R. M. Pratt, Mr. C. Coltman Rogers, Dr. Herbert Watney, and Mr. R. Woodward, Jr.

For special information respecting the trees of Scotland we are indebted to Mr. John Renwick of Glasgow, and for notes on Irish trees to Mr. R. A. Phillips of Cork and Sir F. W. Moore.

The conditions which determine the successful cultivation of exotic trees in different parts of Great Britain are so complicated by local variations of soil, climate, and elevation that after many attempts I have failed to construct a map which would divide the country into arboricultural regions. The best guide to the possibility of growing any particular species in any given locality is to know

whether it has succeeded reasonably well in any place of similar soil and climate; and as we have recorded the accumulated experience of our predecessors, it may usually be presumed that if no degree of success has been attained it is only a waste of time and money to plant species which have died out or remained in a stunted condition. Generally speaking it may be said that there are four principal types of climate in Great Britain.

The first is characterised by a high summer and a low winter temperature, combined with a low average rainfall; and this includes all those districts in which wheat is the most important agricultural crop, namely the eastern counties as far north as the Humber, and the southern counties as far west as Dorset and the Severn Valley. In many parts of this region where, owing to the influence of sea air or elevation, late spring and early autumn frosts rarely occur, the best climatic conditions for the growth of most exotic trees are found.

Secondly, the south-western counties and the maritime districts of Wales, the greater part of Ireland and western Scotland, where the summer temperature is lower and the winters shorter and milder, and where the rainfall and the humidity of the air is much greater. In this region alone a great many of the rarer trees and shrubs thrive wherever suitable soil and shelter from wind are found; but the trees which require a high summer temperature and abundant sunshine to ripen their wood, such as walnuts, hickories, Catalpas, and many North American species, are not often successful, and do not attain large dimensions or ripen their seeds in normal seasons.

Thirdly, the north-eastern and midland counties and those districts of southern England where the summers are shorter, where late and early frosts are prevalent, or where the soil is too heavy or too wet to suit a great many exotic trees; but many exceptions will be found in this region, especially near the sea, and in this district may be included parts of Scotland bordering on the Moray Firth, where the climate is distinctly more suitable to arboriculture than in the northern and midland counties of England generally.

Fourthly, the mountains of central and northern England, Wales, Scotland, and Ireland, at elevations over 1000 feet, where only a few of the hardier conifers can be grown with much hope of success.

Next to climate, the geological formation and depth of the soil is the most important factor in the successful growth of trees; and this again is variable even in the districts where climate is favourable; so that we find the best instances of arboriculture are scattered in all parts of the country. Generally speaking, the soils which produce the finest hardwoods are on the old red sandstone and lower greensand formations; and though some species attain a large size on other soils, yet wherever heavy clay or thin rocky soils prevail, especially on limestone, many exotic trees will not grow at all, or become stunted and unhealthy as soon as their roots get into the subsoil. As a result of careful soil preparation trees may appear to thrive for a number of years, yet they eventually become sickly or die if nature has not provided a suitable subsoil. Want of knowledge or of attention to these two factors, has led in the past to immense waste of time and money in planting trees which are quite

unsuited to their surroundings, and we have seen numerous instances in all parts of Great Britain which prove how little man can do where nature does not favour his efforts.

Another point which has been insufficiently realised by most planters, but which my own experience has repeatedly proved, is the remarkable variation in the individual constitution of trees of the same species, even when raised from seeds of the same tree under precisely similar conditions. In a state of nature there is a continual struggle for existence among individuals under which only a few of the strongest survive, and these are the seed-bearers from which future generations arise; but when we sow a number of seeds under the most favourable conditions which we can devise, and protect them artificially in their youth against their natural enemies, or when we propagate trees by other means, which are often adopted not because they are the fittest but because they are the quickest and cheapest means of reproducing them, we obtain a variable percentage of weaklings which thrive only under the best conditions, and which when transplanted to less favourable environment are sure sooner or later to succumb. For this reason I have always advocated the raising of forest trees when possible from seed of known healthy parents growing in the same or a similar locality to that where they are to be planted, and rejecting in the nursery all but the most vigorous. This may prove a slower and more costly method than that of buying the trees from a nursery, but I believe it to be the most economical in the end wherever conditions are not very favourable for their growth. With regard to exotic trees which only ripen their seed in this climate in very favourable seasons, I have often found that the seedlings raised from imported seed are more vigorous than those raised from home-grown seed, but my observations, though they have been carried on since 1900, are insufficient to enable me to express a decided opinion on this subject.

When we consider how remarkably variable our climate is, it is clear that a great deal of the success of planting any trees which are more exacting as regards heat, sunshine, or moisture¹ than indigenous species, must depend on a good series of seasons in their youth; for if trees are severely checked by drought, or by late spring or early autumn frosts when young, they suffer much more than when older and better established. Therefore in planting exotic trees it is wise not to depend on one or two individuals, but to plant several of the same species in a group, with the object of selecting the most vigorous and well-shaped when they begin to crowd each other.

Another point which is often forgotten by planters of ornamental trees is the fact that in nature these grow gregariously or mixed with other trees, in more or less thick or shady woods, and not isolated in grass. To use a gardener's expression, "a well-furnished tree" such as a cedar, a Sequoia, or a beech with spreading branches resting on the ground, may be a very beautiful object on a lawn or in a park; but it is not the usual natural shape of these trees; and if the trunk is always

¹ As an instance I may say that at Colesborne the rainfall of June, July, and August, during which months most of the growth of the majority of trees is made, was, in 1911, 3.39 inches, with only 21 days on which rain fell, and in 1912, 22.30 inches, with only 21 days without rain.

sacrificed to the branches, we rarely get such magnificent boles as these trees are capable of producing when planted under more natural conditions.

Another point too often neglected by English arboriculturists is early and regular pruning, which, unless they are planted in close order, is necessary in the case of most broad-leaved and some coniferous trees, until they have attained a considerable size and age. Though the lower branches should not be cut off close to the trunk before it is thick enough to support a well-shaped crown, yet the earlier it is done after the tree has become established, the quicker and better is the wound healed; and the careful planter must continually watch that no branches are allowed to attain undue proportions at the expense of the trunk. With some trees pruning and shortening of large branches is best done in early spring before the sap rises; with others, in July or August, when the tree is in vigorous growth; but though art may do a great deal to form a well-shaped tree, yet unless the soil is deep enough and fertile enough to keep it in health, stunted and stag-headed trees will be the result.

The influence of grass on the roots of trees is a subject upon which a great deal of light has been thrown by the experiments carried on by the Duke of Bedford and Mr. Spencer Pickering.¹ Though opinions differ on the extent to which their conclusions apply to trees universally, and how far they are due to particular soils, yet there can be no doubt that as a general rule the soil should be kept free from grass for a distance of about three feet all round the trunk for some years at least. On the peculiar soil of Colesborne I have found that some trees, among which Scots and Corsican Pine are conspicuous, do not suffer when planted in a thick sward, and actually seem to grow faster and to be more healthy. I am inclined to believe that wherever the soil is deficient in fertility, grass over the roots of trees, though it may check their growth in dry seasons, is better in most cases than a bare soil which has been impoverished by cultivation. Good soil will overcome almost all other obstacles to the growth of trees, and this fact leads me to speak of another question which planters and foresters often insufficiently consider.

Is it more economical and profitable to plant land, which, like many of the natural woods and plantations in Great Britain, has been allowed to remain as woodland only because it was not thought good enough to cultivate; or to plant land which is producing more or less profitable crops? We rarely see the dimensions that trees are capable of attaining in Great Britain, except on the estates of families which for centuries have been rich enough to plant good land, and to leave trees standing after they have attained maturity; and though the largest trees are not always the most valuable, yet the highest quality of timber, which usually fetches a higher price per foot, is rarely produced on inferior land, whilst the quantity per acre that can be grown in a short time is the most important factor in the profit or loss of planting.

In forestry as in agriculture the best land is the most profitable and therefore the cheapest. But when I speak of good land I do not mean that the best land for farming is the best for trees, because trees root so much more deeply than agricultural plants that they can penetrate and feed where the roots of plants cannot reach; and on steep hill-sides especially, trees seem to thrive wherever the rock is suffi-

¹ *Thirteenth Report of the Woburn Experimental Fruit Farm*, London, 1911. See also *Ninth Report*, 1908.

ciently broken up, provided that it contains the chemical elements of fertility; so that the agricultural or grazing value of any particular spot often affords no indication of its value for tree-planting.

Though the world has now been nearly everywhere explored, and the number of trees capable of growing in Great Britain has been more than doubled by fresh introductions since Loudon wrote in 1838, it is very surprising how few, if any, of the newer introductions seem likely to supersede or even to equal our long-trying native and introduced trees. Though no one can be a stronger advocate than I am, both in principle and in practice, of the planting of a great variety of exotic trees, and though in localities where somewhat unusual conditions are found, some of these species—such as Japanese larch, Sitka spruce, Lawson and Nootka cypress, and Douglas fir—do seem likely to be more profitable than older introductions like the European larch, Silver and Spruce firs, yet I can hardly think of any broad-leaved tree, except some poplars which are not yet fully proved, and possibly the grey alder, which seems likely to have much economic value or to supersede our native oak, beech, ash, elm, and sycamore, which to timber merchants are at present the only trees really worth looking at, and which will grow to a large size in almost all parts of our islands. Whether time will prove this to be a fact or not, we have done our best to describe every tree as yet introduced, with the exception of some of the latest introductions from China.

When trees have passed the age of maturity and are beginning to decline in health they usually show it by the death of the upper branches, which is particularly noticeable on very heavy or very dry soils after a long hot summer. If there is no serious decay in the trunk, this decline may often be checked, for a considerable time at any rate, by a top-dressing of leaf-mould mixed with old rotten manure and fertile soil, spread about three inches deep over the area covered by the branches; but such dressing must not be too thick or too strong, especially in the case of conifers, for which pure leaf-mould is perhaps the best manure. When wounds caused by broken branches, fungi, or other injuries appear on the trunk, it is important to fill them as soon as possible. The same principles adopted in filling decayed teeth are perfectly applicable to trees, namely, to clear out all decayed wood as far as possible, to apply an antiseptic to the exposed surface, to fill up the cavity with cement, and to cover with lead any cracks or holes by which water can get into the trunk. When branches become dangerous or inclined to split off, they are often supported by iron rods, bands, and chains; and I believe that when this is done in such a way that the band can be loosened as the branch thickens, it is a safer and more permanent method than passing a rod through a hole in the branch and putting a nut on it to keep it in place.

There are many other special points in the cultivation of trees which only experience can teach, though the general principles are given in works on forestry and arboriculture; and in many cases these special points are dealt with in the pages of our work. Opinions vary and always will vary as to the best systems of planting, and the best mixture to adopt, which depend on the peculiar conditions we have to deal with; but in tree-planting, whether for economic or other objects, it cannot be

too strongly emphasised that a study of local conditions is always essential. The more a man knows of the risks and difficulties which planters have to contend with in most parts of the country, the less willing will he be to offer advice, or to form estimates of cost and expected profits based on experience which is not local. For this reason I look with suspicion on hastily considered working plans and estimates of costs and results which are not supported by local knowledge. Even in old-established forests abroad, where the expenses and profits are based on the experience of centuries, and where nothing is done without the approval of Government foresters, changes are constantly being made in practice to meet the changing conditions of the times; and when we remember that our long-established systems of woodcraft in England have been completely revolutionised in the last fifty years by changes in economic conditions, the duration of which cannot be foreseen, it seems evident that what we think right to-day may turn out to be wrong long before the trees we plant are mature.

Before concluding I should again like to offer a warning word on the question of planting and management for profit, as contrasted with planting for ornament, sport, and shelter. English landowners are sometimes reproached with ignorance and neglect of the principles of pure forestry; but it must always be remembered that the economic, social, and in many districts the climatic conditions of Great Britain, make planting for profit a very uncertain and often a very risky investment. In our work we have endeavoured to show the possibility of cultivating a great number of exotic trees which have not, and probably never will have, any economic value from the forester's point of view, because we believe that when planted in small quantities with sufficient knowledge of their cultural requirements, they will add greatly to the interest, beauty, and residential value of British country homes; and we have illustrated the finest examples of most of the trees which exist in Britain. We ought to aim as far as possible at planting those species which local experience has tested, in situations which are most suitable to them. This warning must apply not only to the rarer species, but to some which have been very extensively planted of late years by enthusiasts in arboriculture, who look only at the successes of others and refuse to look at the failures. I have myself learnt more from my failures than from my successes; and have never been able to understand why in so many cases people are unwilling to show or to write of their failures, when these are due—as they often are—to natural obstacles rather than to want of care or knowledge.

The future of arboriculture in Great Britain is a brilliant one, if landowners are not deterred from planting by ill-considered or hostile legislation; but the future of pure forestry—in England at least—is very problematical. For though there are districts where the land may—under State foresters working on a larger scale than private owners—produce a more profitable return under timber than when used for other purposes, yet I believe that these districts are so few and far between that the establishment of a State industry, financed by taxation, to compete with the long-established private industry of timber-growing would not be justified by any advantage that would result to the country.

(H. J. E.)

In concluding our work there are a few points about which I think it advisable to add some explanatory remarks. First, with regard to its scope, it was intended at the outset to include only those trees which attain timber size in the British Isles. It was found, however, impossible in practice to draw a rigid line between the timber trees and the smaller trees, which like shrubs are cultivated for ornament or curiosity. In the case of genera, which comprise both large and small trees as well as shrubs, our treatment has not been logically uniform. All the species of oak in cultivation have been described in detail, because in this genus shrubs are of exceptional occurrence. On the other hand, only the larger maples have been the subject of separate articles, as it was evident that a brief notice would suffice for the shrubby species. In the case of genera of exceptional interest, as *Pinus*, *Juniperus*, *Cephalotaxus*, all the introduced species, even those of small size, have been treated in full.

The keys for the identification of species are based upon the characters of the twigs, leaves, and buds, and not upon those of the flowers and fruits, as has been usual in botanical works. The latter characters are often not available in the case of trees, the determination of which may be required when they are in the young state, or at some period of the year when flowers and fruit are not present.

When the preparation of the seventh volume was drawing near a close, we saw that it would be impracticable, without unduly deferring the completion of the work, to include many of the new species that of late years have been introduced from China and Japan. On this account, *Eucommia*, *Tetracentron*, *Cercidiphyllum*, *Pistacia*, *Phellodendron*, *Idesia*, *Poliothyrsis*, *Davidia*, etc., have been necessarily omitted. For obvious reasons, I was unable to take up the complete study of such genera as *Cratægus*, which is almost exclusively composed either of shrubs or small trees that are merely ornamental in character; and I have limited my account in this case to a full description of the two indigenous species. Generally speaking, the Conifers have been described exhaustively in our book; but certain rare kinds of which there are only a few specimens of small size in Cornwall and in the mild districts of Ireland, have been left untouched, as *Podocarpus*, *Callitris*, *Tetraclinis*, *Widdringtonia*, *Dacrydium*, and *Phyllocladus*.

Though, as just explained, all the species of trees in cultivation in England, Scotland, Wales, and Ireland, are not included, yet a vast number have been described, as is evidenced by the Index, which extends over 80 pages. The Index has been compiled with great care, and should prove of service to our readers, as it embraces, in addition to the common names and the usually accepted scientific names, nearly all the appellations which have been applied to the various species and their varieties and sports in countless lists, catalogues, and books. The compilation of this synonymy has been a heavy labour and a thankless task. The choice of the correct name of each species has not been always easy.

As some of the reviews of the published volumes criticise certain names which I have adopted, it will be well for me to explain my views on the vexed question of nomenclature. That, in a work of this magnitude, I have refrained from the

invention of new names, except in one case for a species¹ and in two or three cases for hybrids,² gives me a claim to be heard on the subject. In the earlier volumes, I followed the Kew practice of the time, that of selecting as the correct name the oldest one, which had been used under the genus to which the species is now referred. In the latter volumes, I have followed, except in a few instances, the Vienna Rule, that of adopting the oldest specific name, no matter to what genus it had been attached. Most German and American botanists follow this rule "blindly," as one of them remarked to me.

As a result names which have been current for a century, not only in scientific books but in popular literature, have now to give way to supposed earlier names, which have been resuscitated from the works of writers whose descriptions are often so ambiguous as to render it impossible to say what species was actually meant. The strict application of the Vienna Rule is sometimes so difficult that the best authorities disagree thereon. As an example, we are bidden to change the name *Alnus glutinosa*, Gaertner, which has been used for the common alder for over a century in every botanical text-book and Flora. Certain botanists substitute for it the name *Alnus rotundifolia*, Miller, whilst one authority puts forth a strong claim for *Alnus vulgaris*, Hill.³ This displacement of a well-known scientific name by an obscure one is a pedantic and harmful practice. Its absurdity is shown by the fact that some recent writers, who adopt under all circumstances the Vienna Rule, are obliged, in order to specify clearly the species which they mean, to use two names, the second of which is the old-established name in brackets. The common oak is called by these writers⁴ "*Quercus Robur*, Linn. (*Q. pedunculata*)"; while the wych elm is cumbered⁵ with the appellation "*Ulmus glabra*, Huds. = *U. montana*." The confusion of the new practice is doubled, when the Vienna name for a species happens to be (as in the last case) the same as the old-established name for another species of the same genus. Thus, no one now knows without some explanation which species of elm is meant by the term *Ulmus glabra*.

In order to avoid such confusion, I have preserved in certain cases the old-established name, if its use involves no ambiguity. I have thus kept up *Larix europæa*, *Larix americana*, *Larix leptolepis*, *Abies pectinata*, *Quercus pedunculata*, *Betula pubescens*, *Betula verrucosa*, a series of names which have been consecrated by long usage in books on botany, arboriculture, and forestry. If I am wrong in using these names, I err in company with nearly all the writers who have mentioned these trees during the last century.

The postponement to the last volume of the more difficult genera has enabled me to devote time, labour, and travel to their study; and has resulted in a clearer knowledge of the numerous cultivated kinds of elms and poplars, the systematic position of which has been the despair of botanists. The results of the experimental sowings of the seeds of various elms, which I made in 1909, together with a study

¹ Cf. *Populus Maximoviczii*, vol. vii. 1838.

² Cf. *Populus Lloydii*, vol. vii. 1830, *Ulmus Mossii*, vol. vii. 1865, note 2.

³ Cf. Schneider, *Laubholzkunde*, ii. 890 (1912).

⁴ Cf. Schneider, *Laubholzkunde*, i. 197 (1904).

⁵ Cf. Tansley, *British Vegetation*, 148 (1911).

of the history of the Lucombe Oak and its descendants, have thrown much light on a class of trees, which though common in cultivation on account of their vigour of growth, are unknown in the wild state.

These trees undoubtedly originated as chance seedlings, due to accidental cross-fertilisation of two distinct species, and were immediately selected by observant nurserymen as desirable varieties to propagate. Trees like the Black Italian Poplar and the London Plane, which in botanical characters appear to be first crosses in each case, between an American and a European species, can be traced back to 1700, about which date the introduced species was long enough in the country to produce flowers and to fertilise the native species growing beside it.

Other trees, which I consider to be also first crosses, on account not only of their botanical characters but because they are unknown in the wild state, are:— the Common Lime, Huntingdon Elm, and Cricket-Bat Willow, the parents in their case being closely allied European species. All the preceding hybrids were produced accidentally; and similar cases occur periodically in certain nurseries, as at Plantières, near Metz, where two splendid hybrid poplars (*Populus Eugenei* and *P. robusta*) have been picked out of the seed-bed. The first to produce artificial crosses between forest trees was Klotzsch in 1845; and his experiments, though on a small scale, were successful in indicating that extra vigour of growth was obtainable with certainty.

Practically nothing, however, has been done, since his time, to improve the breeds of forest trees; and foresters have never even thought of the possibilities in this direction, though gardeners and farmers have shown the way for centuries. I suggested in a paper read on 7th April 1910 before the Linnean Society that artificial crossing should be tried in the Ash and Walnut, as the quality of the wood of these two valuable trees would be improved by more rapid growth.

During the past three years I have carried on cross-pollination of trees of certain kinds at Cambridge, in Kew Gardens, and near Exeter and Gloucester. These experiments have shown that there are obstacles in the way of obtaining successful results, owing to the difficulty of manipulation on trees swaying in the wind, and to the spring frosts which often injure the pollinated flowers. Moreover, suitable exotic trees, especially of the broad-leaved sorts, are hard to find, as those that exist rarely produce good flowers. I am convinced that such experiments could be carried on much more successfully in stations like Montpellier in France, or Washington in the United States, where suitable trees and a warm climate can be readily found. Nevertheless, I have raised a considerable number of hybrid seedlings, which are now under observation. First-crosses once obtained can readily be reproduced by cuttings or by layers; and the cost of propagation would be very moderate. That this is feasible, is shown by the splendid hybrid elms in Belgium and Holland, all of which are raised by layering in nurseries.

Many interesting problems, which had to be laid aside for the time, arose in the course of the researches which were undertaken in the work of preparation of the seven volumes. To some of these problems, especially those connected with the origin of sports and varieties, I hope to return. The belief is rapidly gaining

ground that all species of trees are comparable, in a greater or less degree, as regards their variation, to the remarkable instance of the Douglas Fir, the Rocky Mountain variety of which differs so much from that growing on the Pacific Coast, while between these two extremes lie a series of intermediate forms. Similar variation is well known in the case of *Pinus Laricio*, the geographical forms of which behave very differently in cultivation. Such differences probably exist in all species with a wide distribution; and in the future, care in the selection of seed may be the most important point in silviculture.

All the bibliographical references in the work have been checked independently, and no effort has been spared to indicate with accuracy the source of our information, where it is not the result of our own observations. Though in the course of our labours, we have had the benefit of mutual criticism, it should be clearly understood that each of us is only responsible for the parts which are signed by his initials. It would be inaccurate to quote both our names, when only one of us has verified the fact or studied the question at issue. As an example,—“Elwes, in Elwes and Henry, *Trees of Great Britain*, v. 1179,” is the correct citation for the account of *Cupressus lusitanica* in Portugal; whereas, “Henry, in Elwes and Henry, *Trees of Great Britain*, v. 1183,” is responsible for the article on *Cupressus arizonica*. It will readily be seen, that while the purely botanical part (including the identification of specimens) has been done by me, that the other part, dealing with distribution, history, and cultivation, has been divided in varying proportions between the two authors.

(A. H.)

ERRATA AND ADDENDA

- Vol. i. p. vii, line 15. The English Elm was not introduced from Italy. Cf. vol. vii. p. 1907.
- i. p. 2, line 32. For Dryander, in Ait. read Aiton.
The leaves of the North American beech are figured in vol. iii. Pl. 202, Fig. 6.
Rehder, in *Rhodora*, ix. 113 (1907), and in *Mitt. Deut. Dend. Ges.* 1907, p. 70, states that the correct name of the American beech is *Fagus grandifolia*, Ehrhart, *Beit.* iii. 22 (1788), and describes three varieties: (1) var. *typica*, Rehder; (2) var. *pubescens*, Fernald and Rehder; and (3) var. *caroliniana*, Fernald and Rehder, the latter having a sub-variety *mollis*.
- i. p. 2, line 39. For north read the north.
- i. p. 4, line 1. Add *Fagus Hohenackeriana*, Palibin, in *Bull. Herb. Boiss.* viii. 378 (1908), is probably a form with large leaves of *F. orientalis*, Lipski.
- i. p. 6, note 2, line 2. Omit the hazel, the cotyledons of which are not aerial. Cf. vol. iii. p. 521.
- i. p. 8, line 40. This is var. *Rohanii*, Masek, in *Mitt. Deut. Dend. Ges.* 1905, p. 196 and 1908, p. 140, described as a purple beech with deeply cut leaves like those of var. *quercoides*, from a tree of which it is said to have arisen through pollination by a purple beech that stood near.
- i. p. 10, line 21. The Weeping Beech at Endsleigh is figured in vol. ii. Pl. 58A.
- i. p. 13, line 31. For Lyons-le-Forêt read Lyons-la-Forêt.
- i. p. 17, line 42. For Buckholt read Buckhold.
- i. p. 29, line 13. For *Vilmoriana* read *Vilmoriniana*.
- i. p. 30, note 1. For 14 read 15.
- i. p. 31, note 1. Add vol. ii. Pl. 126, Fig. 3.
- i. p. 32, line 2. For *Japan* read *Japon*.
- i. p. 38. Concerning *Sophora japonica*, var. *pendula*—
Bretschneider, in *Journ. N. China Br. R. Asiat. Soc.* xv. 15 (1880), states: “The Chinese produce this tree artificially by causing two young trees of *Sophora japonica*, growing close together, to join by grafting, and then turning upwards the roots of one of them.” De Vries, *Mutation Theory*, 101 (1911), says, however, that the Weeping Sophora originated in Joly’s nursery at Paris in 1800.
- i. p. 38, note 1. This note is to be deleted, as the plate mentioned has not been published.

- Vol. i. p. 44. *Araucaria araucana*, Koch, is the correct name of the Chilean Araucaria, according to the Vienna Rules.
- i. p. 44, line 2. For iv. 2432 (1844) read iv. 2432 (1838).
- i. p. 44, line 4. For Rich. read Richard.
- i. p. 44, line 5. For Mirb. read Mirbel.
- i. p. 57, line 31. For develops read develop.
- i. p. 64, line 4. For var. ? *chinensis* read var. ? *chinense*.
- i. p. 65, line 2. For *tulipifera* read *Tulipifera*.
- i. p. 65, line 8. After leaves insert (Vol. iii. Pl. 204, Fig. 7).
- i. p. 66, line 30. After buds insert (Vol. ii. Pl. 126, Fig. 1).
- i. p. 76, line 33. Omit opening red.
- i. p. 76, line 37. Omit the buds open green, and
- i. p. 77, line 1. *Picea morindoides* is fully described under the correct name, *Picea spinulosa*, Henry, in vol. vi. p. 1392. Its native country is Sikkim and Bhutan.
- i. p. 80, line 37. For Serajevo read Sarajevo.
- i. pp. 85, 89. If, as is probable, both the Ajan spruce (*Picea ajanensis*) and the Hondo spruce (*Picea hondoensis*) constitute only one species, its correct name is *Picea jezoensis*, Carrière.
- i. p. 85, line 16, and i. p. 89, line 13. It is doubtful if the distinctions here noted, as regards the colour of the opening buds, are valid. In the specimens of *P. hondoensis* which I have examined, the buds open with a slightly reddish tinge.
- i. p. 88, line 10. For *tremula* read *Sieboldii*.
- i. p. 92, line 26. The specimens in the Kew Herbarium with pubescent branchlets, from the Columbia river, which are mentioned as a variety of *Picea sitchensis*, must be referred to *Picea Engelmanni*.
- i. p. 93, line 3. After 1892 insert xiv. 184.
- i. p. 99, line 6. For *Pruminopitys* read *Prumnopitys*.
- i. p. 100, line 32. *Taxus canadensis*, Marshall, is undoubtedly a distinct species, and is peculiar not only in its shrubby habit but in having monœcious flowers.
- i. p. 107, line 21. For 53 read 31.
- i. p. 107, line 22. For the Hokkaido read Hokkaido.
- i. p. 110, line 32. For 58 read 34.
- i. p. 111, lines 13, 14. For *Cesthuntsensis* read *Cheshuntsensis*.
- i. p. 114, line 18. After mentioned above add (p. 107).
- i. p. 117, line 24. For Low read Lowe.
- i. p. 117, line 32. R. J. Moss, in *Scient. Proc. R. Dublin Soc.* xii. 92 (1909), found 0.6 per cent of taxine in the leaves of the Irish yew (var. *fastigiata*) as compared with 0.12 per cent in the leaves of the female common yew and 0.18 per cent in those of the male common yew, recorded by Thorpe and Stubbs in *Journ. Chem. Soc. Trans.* 1902, p. 874. Moss refers to a case, in which pheasants, which are believed to eat common yew with impunity, were poisoned by the leaves of the Irish yew.
- i. p. 120, line 35. For 54, 55 read 32, 33.

- Vol. i. p. 122, line 22. For Low read Lowe.
- i. p. 123, line 9. For Whittinghame read Whittingehame.
- i. p. 132, line 34. The article on Distribution in China should be signed (A. H.).
- i. p. 139, line 1. For Hempsted read Hemsted.
- i. p. 139, line 28. For Worcestershire read Herefordshire.
- i. p. 142, line 17. The species of the sections *Aucuparia* are treated in detail in vol. vi. p. 1574.
- i. p. 142, line 25. For *Pyrus thianschanica*, Regel, read *Pyrus tianschanica*, Franchet.
- i. p. 142, line 30. For Torrey and Gray read De Candolle. See vol. vi. p. 1574.
- i. p. 142, line 32. *Pyrus sambucifolia*. Add the following note:—Cf. vol. vi. p. 1574, note 3.
- i. p. 144, line 32. For Linnæus read Ehrhart.
- i. p. 148, line 19. For Mountmorris read Mountnorris; for rector read late vicar.
- i. p. 148, line 23. For Lee's read Lees.
- i. p. 149, line 33. For Connaught read Albany.
- i. p. 149, line 34. For Snell read Smelt.
- i. p. 159, line 3. For 915 read 912.
- i. p. 175, line 26. For Seeman read Seemann.
- i. p. 177, last line. For *uniflora* read *aquatica* (cf. vol. iii. 513).
- i. p. 182, and note 1. *Thuja*, the spelling adopted by Linnæus, *Sp. Pl.* 1002 (1753), is to be preferred to that of *Thuya*.
- i. p. 184, line 8. For non A. Murray read not Balfour in A. Murray.
- i. p. 192, lines 6 and 15, and i. 198, line 16. For *Retinospora* read *Retinispora*. Regarding the correct spelling of the word, see vol. v. p. 1146, note 2.
- i. p. 195. The correct name, according to the Vienna Rules, of *Thuya japonica*, Maximowicz, is *Thuya Standishii*, Carrière.
- i. p. 196, line 1. For Komaror read Komarov.
- ii. p. vi, last line. Insert a comma between Ailanthus and Cladrastis.
- ii. p. 202, line 36. For *Cryptomera* read *Cryptomeria*.
- ii. p. 202, line 4. For *Thoujopsis* read *Thujopsis*.
- ii. p. 203, last line. Read *Thujopsis Hondai*, A. Henry.
- ii. p. 208, line 41. For A. read Æ.
- ii. p. 218, line 10. For A. read Æ.
- ii. p. 225, line 6. Add the note:—*Pavia rubra*, Poiret, in Lamarck, *Ency.* v. 94 (1804), is *Æsculus Pavia* (cf. p. 207).
- ii. p. 225, line 17. For A. read Æ.
- ii. p. 228, line 34. For Maximowicz read Masters.
- ii. p. 234. It will probably be better to adopt for this species the name *Tsuga heterophylla*, Sargent, as the correct one under the Vienna Rules.
- ii. p. 240, line 9. For *loc. cit.* read *Timber Trees and Forests of North Carolina*, 1898.
- ii. p. 244. The correct name for this species is *Tsuga dumosa*, Sargent.
- ii. p. 282. Moss, in *Journ. Bot.* 1910, p. 6, and Schneider, *Laubholzkunde*, i. 197 (1904), adopt the name, *Quercus Robur*, Linnæus, for the pedunculate or common oak.
- ii. p. 282, line 25. After Branchlets insert (Pl. 78, Fig. 1).

- Vol. ii. p. 283, line 3. After Leaves insert (Plate 79, Fig. 1).
- ii. p. 285, line 12. For (1844) read (1838).
- ii. p. 285, line 15. For *comptonæfolia* read *comptoniaefolia*.
- ii. p. 288, line 30. For Boenn. read Boenninghausen. A fuller account of the hybrid oak, *Quercus intermedia*, Boenninghausen, is given by Dr. C. E. Moss, in *Journ. Bot.* 1910, pp. 1, 34, plate 502.
- ii. p. 291, line 14. *Quercus sessilis*, Ehrhart, cannot be adopted as the correct name of the sessile oak, as it was unaccompanied by any description. Cf. Moss, in *Journ. Bot.* 1910, p. 2, and Schneider, *Laubholzkunde*, i. 196 (1904), and ii. 901 (1912).
- ii. p. 291, line 22. After Branchlets insert (Pl. 78, Fig. 2).
- ii. p. 291, line 25. After Leaves insert (Pl. 79, Fig. 8).
- ii. 294, line 2. Read *Quercus lanuginosa*, Lamarck, *Fl. Franc.* ii. 209 (1778); Thuillier. Insert the following reference as a new line:—*Quercus Robur*, var. *lanuginosa*, Lamarck, *Encyc.* i. 717 (1783).
- ii. p. 376, line 18. For unlikely read likely.
- ii. p. 379, title. Add Dahurian Larch.
- ii. p. 382, line 5. Insert A remarkable tree at Henham Hall, Suffolk, which according to the Earl of Stradbroke was planted between 1790 and 1803, is grafted on a common larch stock, forming a trunk about 6 ft. high and 7 ft. 4 in. in girth. It divides into numerous branches, which extend horizontally for a distance of about 100 ft., supported on larch poles. None of the branches rise more than two or three feet above this level; and when Elwes saw the tree in August 1909, they were covered with new and old cones.
- There are two good specimens of the Dahurian larch at Stanage Park, Herefordshire, which measured about 80 ft. by 5 ft. in 1910. They were planted as *Larix pendula* in 1836.
- ii. p. 383, title. Add Kurile Larch.
- ii. p. 384, title. Add Japanese Larch.
- ii. p. 393, note. Insert reference ¹.
- ii. p. 398, line 27. For *albertiana* read *Albertiana*.
- ii. p. 409, line 18, and ii. 410, line 18. The form of *Pinus Laricio*, which occurs in the mountains of the central, north-eastern and south-eastern provinces of Spain is identical with that of the Cevennes and Pyrenees, and is to be referred to var. *tenuifolia*. The best account of the *Pinus Laricio* of Spain is given by S. E. Cook, *Sketches in Spain*, ii. 228, 234, 237, 244 (1834); and the name *P. hispanica*, Cook, *op. cit.* 234, may be added to the synonymy of this tree. Laguna, *Flora Forestal Española*, i. 80 (1883), gives full details of its distribution.
- ii. p. 424, line 6. Omit rarely. For 6 read 8.
- ii. p. 428, line 23. For *Guilandina diocus* read *Guilandina dioica*.
- ii. p. 433, line 6. After regular insert full stop.
- ii. p. 435, line 11. Insert A tree standing close to Weston Birt House, measured by Elwes in October, 1912, was 47 ft. by 3½ ft.

- Vol. ii. p. 437, line 18. For DIPTERA (*sectio nova*) read DIPTERA, A. Henry (*sectio nova*).
- ii. p. 438, line 26. For *Juglans fraxinifolium* read *Juglans fraxinifolia*.
- iii. p. 452, line 23. Add Interesting details concerning the flowers, cones, and seedlings, as well as the rate of growth of the cedars, are given by Hutchison, in *Trans. Roy. Scott. Arbor. Soc.* xiii. 200 (1893).
- iii. p. 452, line 24. The seedling here described was that of *Pinus halepensis*; and this paragraph should be transferred to vol. v. p. 1100.
- iii. p. 471, line 12. For last January read in January 1907.
- iii. p. 475, line 25. After now add (1907).
- iii. p. 480, line 23. For *albertiana* read *Albertiana*.
- iii. p. 485, line 25. For Endlichler read Endlicher.
- iii. p. 489, line 10. For 1888 read 1870.
- iii. p. 489, line 27. For *Thuja Craigana*, Murray, read *Thuja Craigana*, Balfour, in Murray. The correct name of the Incense Cedar of North America is *Libocedrus Craigana*, Low, ex R. Brown, in *Trans. Bot. Soc. Edin.* ix. 373 (1868). Cf. A. Henry, in *Gard. Chron.* liii. 325 (1913).
- iii. p. 490, line 30. For Murray read Balfour, and for *Thuja* read *Thuja*.
- iii. p. 492, line 35. For Park read Place.
- iii. p. 494, note 2. The new species from Formosa has been named *Cunninghamia Konishii*, Hayata, in *Gard. Chron.* xliii. 194 (1908). Cf. Clinton-Baker, *Illust. Conif.* iii. 84 (1913), and Elwes, in *Quart. Journ. Forestry*, vi. 274 (1912). It has not yet been introduced.
- iii. p. 513, note 1. For 1904 read for 1903. Add Cf. vol. i. p. 177 and note 3.
- iii. p. 540, line 29. For *Ostrya Ostrya*, Sargent, read *Ostrya Ostrya*, Karsten, *Deutsch. Fl.* 20 (1895); Sargent.
- iii. p. 545, lines 1 and 23; 546, lines, 8, 11, 21, 24, and 37; 547, lines 9, 11, and 16; 548, line 13; 549, line 1; 550, line 18; 553, line 29. For Oerstedt read Oersted.
- iii. p. 553, line 21. After now add (October, 1907).
- iii. p. 553, line 33. For Foster read Forster.
- iii. p. 558, note 1. *Arbutus canariensis* is said, by W. Fitzherbert in *Gard. Chron.* lii. 44 (1912), to be 30 ft. high at Abbotsbury. It is perfectly hardy at Rostrevor, where I saw a shrub 10 ft. high in May 1913.
- iii. p. 563, line 33. For *Brit.* 1119 read *Brit.* ii. 1119.
- iii. p. 564, line 28. For Klotzch read Klotzsch.
- iii. p. 565, line 31. For *procera*, Lindley, read *procera*, Douglas, ex Lindley.
- iii. p. 573, line 27. After var. *scotica* add A. Henry.
- iii. p. 576, note 2. Add Cf. vol. v. p. 1130, note 2.
- iii. p. 586, line 5. For 162 read 131.
- iii. p. 595, line 23. For *Primer* read *Pruner*.
- iii. p. 599, line 5. For Schneider ex read Schneider, *Laubholzkunde*, i. 803 (1906);
- iii. p. 600, line 17. For *cordifolia*, Schneider, ex read *cordiformis*, Schneider, *Laubholzkunde*, i. 803 (1906), and ii. 1008 (1912);
- iii. p. 601, line 32. For Schneider ex read Schneider, *Laubholzkunde* i. 803 (1906);

- Vol. iii. p. 604, note. For Schneider by read Schneider, *Laubholzkunde*, i. 803 (1906) and ii. 872 (1912);
- iii. p. 605, line 29. For Schneider *ex* read Schneider, *Laubholzkunde*, i. 804 (1906);
- iii. p. 620, line 18. The evidence is now almost conclusive that *Platanus acerifolia*, Willdenow, the London Plane, is of hybrid origin, the parents being *P. occidentalis*, Linnæus, and *P. orientalis*, Linnæus.
- iii. p. 627, line 5. For *hybridus* read *hybrida*.
- iii. p. 640, note. For *mandschuricum* read *mandshuricum*.
- iii. p. 642, line 31. For *villosa* read *villosum*.
- iii. p. 652, line 22. For *austriaca* read *austriacum*.
- iii. p. 654, line 30. After paces add (Plate 185).
- iii. p. 657, line 38. For sugar maple read common sycamore.
- iii. p. 664, note 3. For 1889 read 1899.
- iii. p. 669, line 20. For M. E. Louis read M. Jouin.
- iii. p. 677, line 24. For *nigra* read *nigrum*.
- iii. p. 690, line 31. For trees, read trees (Plate 195).
- iii. p. 703, note. Add *Silva of California*, 143 (1910).
- iii. p. 706, line 7. For he wrote read this was written.
- iii. p. 706, line 35. After now add (1907).
- iii. p. 707, line 5. For 106 read 196.
- iii. p. 709, line 27. After now add (1907).
- iii. p. 709, line 28. After now add (1907).
- iv. p. 714, line 23. For all other conifers by read all other conifers except *Keteleeria* by. Cf. vol. vi. 1473.
- iv. p. 728, line 25. Insert The Marquess of Bath informed Elwes in 1910 that Col. Thynne had measured a silver fir near the house at Longleat which was 144 ft. by 17 ft. 4 in. in 1909.
- iv. p. 731, note 2. For 1896 read 1894.
- iv. p. 739, line 21. For *Panachaica* read *panachaica*.
- iv. p. 747, line 33. For a read at.
- iv. p. 756, line 15. For inch read inches.
- iv. p. 782, line 2. For 1840 read 1839.
- iv. p. 812, line 37. For *Pseudotsuga japonica*, Sargent, read *Pseudotsuga japonica*, Beissner, in *Mitt. Deut. Dend. Ges.* 1896, p. 62; Sargent.
- iv. p. 817, line 22. For in the Yellowstone Park in read from the Yellowstone Park in Wyoming to.
- iv. p. 818, line 11. For 3 read 1.
- iv. p. 824, line 10. For pine read fir.
- iv. p. 854, lines 9, 10. For *Icon. Forest. Japon.* read *Icon. Ess. Forest. Japon.*
- iv. p. 854, line 12. For Seeman read Seemann.
- iv. p. 860, line 20. For 898 read 900.
- iv. p. 862, line 1. For 907 read 905.
- iv. p. 862, line 5. For 904 read 912.
- iv. p. 862, line 19. For *longicuspis*, Blume, read *longicuspis*, Siebold and Zuccarini.

- Vol. iv. p. 862, line 36. For 906 read 907.
- iv. p. 862, note 1. For 21 read 25.
- iv. p. 863, line 15. For 905 read 906.
- iv. p. 876, line 2. For 124 feet read 97 feet.
- iv. p. 884, line 5. Schneider, *Laubholzkunde*, ii. 832 (1912) adopts the earlier name, *Fraxinus obliqua*, Tausch, in *Flora*, xvii. 521 (1834) for *F. Willdenowiana*, Koehne; and states that Lingelsheim identifies it with a wild specimen found by Bornmüller in Anatolia.
- iv. p. 904, line 13. For Hildenley at read Hildenley in.
- iv. p. 912, line 33. For 265 read 264.
- iv. p. 915, line 21. For *Pittcursii* read *Pitteursii*.
- iv. p. 918, line 8. For Hertfordshire read Herefordshire.
- iv. p. 918, line 38. For University Park read Christ Church Meadows.
- iv. p. 919, line 10. For 61 feet in girth read 61 feet in height.
- iv. p. 922, line 25. For Stukeley read Stewkley.
- iv. p. 940, line 17, and note 2. The variety in Japan has been described as a distinct species, *Alnus serrulatoides*, Callier, in Fedde, *Repert.* x. 229 (1911).
- iv. p. 946, line 24. For *montrosa* read *monstrosa*.
- iv. p. 952, line 16. For *multinervis*, Schneider, read *multinervis*, Callier, *ex* Schneider.
- iv. p. 953, line 24. Delete comma after *Flora*.
- iv. p. 963, note 2. For *Eriophes* read *Eriophyes*.
- iv. p. 971, line 21. For 225 read 255.
- iv. p. 989, line 6. For *dahurica* read *davurica*.
- iv. Plate 264, Fig. 16. For *lancelotata* read *lanceolata*.
- v. p. 1013, line 15. For Bewdley read Bromsgrove.
- v. p. 1029, note 1. For *Rusticanum* read *Rusticum*.
- v. p. 1031, line 24. For Burwood House, near Cobham, Surrey, read Bearwood, near Wokingham.
- v. p. 1080, note 7. For saved read sowed.
- v. p. 1100, line 24. For *Pithyusa* read *pithyusa*.
- v. p. 1100, line 31. For *Eldarica* read *eldarica*.
- v. p. 1102, line 38. After *P. halepensis* insert (Plate 287).
- v. p. 1103, note 3. For Strangways read Steven. Cf. p. 1100 and note.
- v. p. 1107, line 32. For Solander in Aiton read Aiton.
- v. p. 1113, line 12. For Solander in Aiton read Aiton.
- v. p. 1124, line 36. For Burwood House, Surrey, read Bearwood, Berks.
- v. p. 1130, note 2. For Klotsch read Klotzsch.
- v. p. 1134, line 26. For *Mackintoshiana* read *Macintoshiana*.
- v. p. 1139, line 23. For *Aboretum* read *Arboretum*.
- v. p. 1140, line 1. For Solander in Aiton read Aiton.
- v. p. 1142, line 5. For 5 ft. 3 in. read 5.23 in.
- v. p. 1142, line 6. For 6 ft. 4 in. read 6.4 in.; for 8 ft. 3 in. read 8.3 in.

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- Vol. v. p. 1150, line 9. *Cupressus Hodginsii*, Dunn, has been made the type of a new genus, and is now known as *Fokienia Hodginsii*, A. Henry and H. H. Thomas, in *Gard. Chron.* xlix. 66, 84, figs. (1911). Cf. Clinton-Baker, *Illust. Conif.* iii. 85 (1913), who gives particulars regarding its introduction into cultivation.
- v. p. 1179, note 1, line 4. For Parlatores read Antoine.
- v. p. 1188, line 18. For Maichi read Imaichi.
- v. p. 1200, line 28. Insert (H. J. E.).
- v. p. 1203, note 2. For *pygmea* read *pygmaea*.
- v. p. 1229, note 5. For *schochiana* read *Schochiana*.
- v. p. 1235, note 2. After Small, read in *Bull. Torrey Bot. Club*, 1901, p. 157.
- v. p. 1257, line 21. For 317 read 318.
- v. p. 1257, line 24. For 318 read 317.
- v. p. 1289, between lines 19 and 20. Add as a synonym, *Quercus austriaca sempervirens*, Hort., a name by which this oak is still occasionally known in some nurseries.
- v. p. 1315, line 17. For *cerquhino* read *cerquinho*.
- vi. p. 1372. Two varieties of the Hondo spruce, vars. *reflexa* and *acicularis*, have recently been described by Shirasawa and Koyama, in *Tokyo Bot. Mag.* xxvii. 129, pl. ii. figs. 1-17 (1913).
An allied species, *Picea Koyamai*, Shirasawa, was published in *Tokyo Bot. Mag.* xxvii. 128, pl. ii. figs. 28-35 (1913).
- vi. p. 1374, line 3. Add Shirasawa and Koyama describe and figure *Picea Maximowiczii* in *Tokyo Bot. Mag.* xxvii. 130, pl. ii. figs. 18 to 27 (1913).
- vi. p. 1380, line 25. For Solander in Aiton read Aiton.
- vi. p. 1411, line 3. For Timbal read Timbal-Lagrave.
- vi. p. 1481, line 3; 1483, line 6; 1485, line 11; 1487, line 22; 1489, lines 12 and 23; 1490, line 29. For *Bull. Soc. Dend. France*, i. read *Bull. Soc. Dend. France*, ii.
- vi. p. 1487, line 18 and note 2. It will be advisable to adopt for this species the oldest name, *Catalpa ovata*, Don, and to abandon that of *C. Kaempferi*. Rehder, in Sargent, *Plant. Wilson*, ii. 304 (1912) agrees with me that this species is truly wild in Central China, and that *C. Henryi*, Dode, cannot be maintained even as a variety.
- vi. p. 1489, line 24. *Catalpa Duclouxii*, Dode, and *C. sutchuenensis*, Dode, in *Bull. Soc. Dend. France*, ii. 204 (1907), are considered by Rehder, in Sargent, *Plant. Wilson*, ii. 304 (1912), to be identical, and constitute a glabrous variety of *C. Fargesii*, Bureau, which varies much in pubescence.
- vi. p. 1569, line 11. For Solander in Aiton read Aiton.
- vi. p. 1580, note. Add The rowan (*Pyrus Aucuparia*) is called quicken tree in Wicklow and other parts of Ireland.
- vi. p. 1585, line 1. Schneider, *Laubholzkunde*, i. 806 (1906), adopts for this species the name *Magnolia virginiana*, Linnæus, *Sp. Pl.* 535 (1753), instead of *Magnolia glauca*.
- vi. p. 1616, note 2. For *E. Gunnii* read *E. coccifera*.
- vii. p. 1736, note 3. For Chevallier read Blin. Cf. *Bull. Dend. Soc. France*, 1913, p. 122.

(A. H.)

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